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Boosting the Fertilizer Production in Kenya: a CGE analysis

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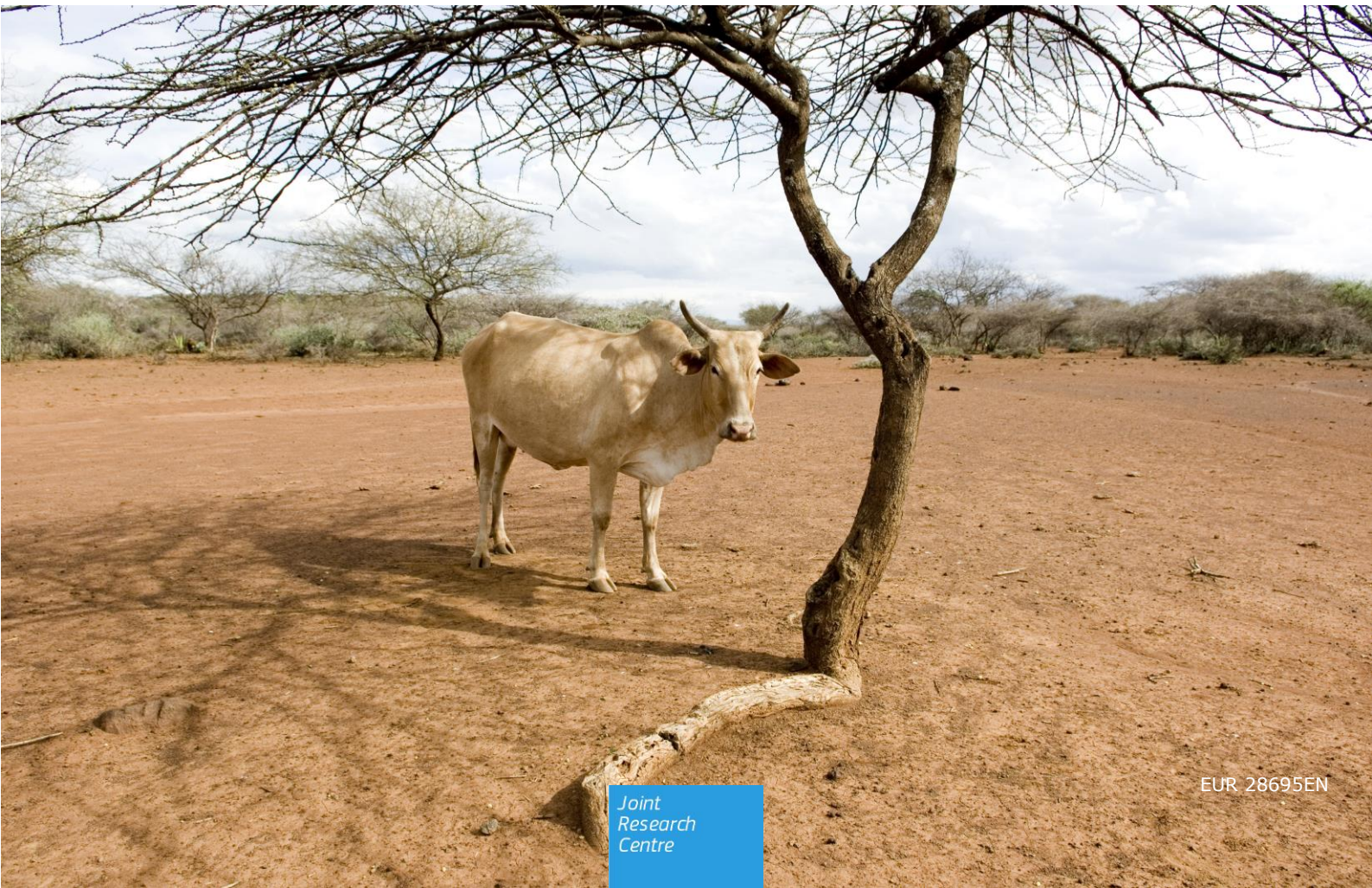

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Abstract

Food security remains a key challenge in many Sub-Saharan African countries and in Kenya in particular. Kenya addresses this concern with a noteworthy policy mix, aiming at giving to the agricultural sector a leading task in improving food security. In this paper, through a Computable General Equilibrium (CGE) model specifically modified for the context of developing country analyses, we address the impacts of the construction of a new fertilizer plant on the agricultural sector and the rest of the economy. For the purpose of the study, a desegregated version of a 2014 Social Accounting Matrix (SAM) has been developed. Results suggests that increasing domestic production of fertilizers do not fully achieve the objectives of reducing rural poverty and increasing agricultural production without complementary policies that help small-holder farmers to overcome the backward technology trap and give them better access to input and output markets.

1. Introduction

"Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996). Adopted at the World Food Summit, this definition remains the most widely cited, albeit different definitions of food security have been proposed over time.

The Joint Research Centre (JRC), the European Commission's in-house science service, is committed under the Administrative Arrangement JRC №33272-2013-10 DEVCO 325-863 between DG Development And Cooperation – Europeaid and DG Joint Research Centre (DG JRC) to provide support for: i) improvement of information systems on agriculture, nutrition and **food security**, ii) policy and economic analysis to support policy decision-making process and iii) scientific advice on selected topics concerning sustainable agriculture and **food and nutrition security**.

Tools for policy design in the agriculture and food and nutrition security will be made available to policy makers. This will allow impacts of policies to be better known, while good practices can be captured and made available for further policy decisions, which are based on thorough policy and economic analysis.

In the framework of this commitment, Economics of Agriculture Unit (JRC.D.4) of the Sustainable Development directorate is responsible to elaborate the methodology and tools to provide macroeconomic analysis of the national and regional economic systems related to: sustainability of policies in the sectors of agriculture, social transfer and fight against food and nutrition insecurity. The analyses should support the EU institutions, DG DEVCO and the partner countries for the formulation of policies and programmes in the sustainable agriculture and food and nutrition security areas through the provision of demand-driven technical and scientific advice. Among possible scientific tools, economic simulation models represent interrelationships between selected economic variables and provide a simplified representation of economic reality to be used to quantify impacts of policy changes (i.e., ex-ante policy analysis).

The scope to this report is to analyse the Kenyan case focusing on the current situation in terms of macroeconomic performances, food security and agricultural polices with the aim of understanding how selected agricultural and food security policies may impact on the country economic and sectorial performances and on its food security situation.

All the preparatory steps needed to write the following report have been agreed with colleague of the EU Delegation (EUD) to the republic of Kenya and colleagues form the DEVCO headquarters in Brussels. In particular, colleagues from the EUD have been key factors to individuate the key policies to be analysed, in the complicated search for the data and in offering valuable contacts with local researchers, relevant stakeholders and policy makers in Kenya and provide logistic support during our visits to the country.

The final version of the report has benefitted from the comments received during a workshop on "Modelling impacts of national policies on Kenyan economy" held in Nairobi on 28th of April 2016. All the participants gave important suggestions for the design of this study, on the data collection process and on preliminary results.

When dealing with food security, agriculture is certainly the key sector to analyse. Agriculture is the backbone of Kenya's economy, and the key sector in its development strategy. The agricultural sector contributes 30% of Gross Domestic Product (GDP) of the country, around 65% of exports and almost 80% of Kenyans are employed, at least part-time, in agriculture. Given the climatic differences among Kenyan regions, while some of them yield abundant surpluses, the whole productivity in the country is rather low. This is mainly due to semi-arid and arid land which covers most of the country where rainfall is less and less predictable. Irrigated land represents a marginal part of used land, i.e. in 2011 it represented only 0.38% of the agricultural area according to FAO-Agri-environmental indicator. In addition, innovative inputs are still lagging behind,

so that most farmers cannot reap the benefit of modern seeds, adequate fertilisers and other technologies. As a result, the country is prone to frequent food shortages.

While agricultural productivity is stagnating and the urban sector is not yet able to provide employment to people moving from rural to urban contexts, Kenya's population is growing. The demographic development is posing a major challenge to food security in the country, as in the whole African continent.

According to the growth projections provided by the Government of Kenya (GoK), economic growth should reach 10.1% in 2017. The higher growth should be premised on increased investment (targeted to reach 30.9% of GDP by 2017/18) while the current public sector investment will be sustained. To achieve the ambitious growth targets set by the GoK within their main policy document (Vision 2030), the government is pursuing macroeconomic policies which should benefit key economic sectors. In particular, agriculture is expected to grow by an annual average of about 6.4%. "Priority will be given to the implementation of the *fertilizer cost reduction strategy*, *expansion of land under irrigation* …, increase the *access* of Kenya's livestock products to regional and international markets, support to *extension services*, and establishment of greenhouses and agro processing plants in the counties. In addition, the national government will continue to actively promote value addition in farm products and to *increase exports* of agricultural and livestock products". (Government of Kenya, 2013, p. p.10).

To analyse some of the agricultural and rural policy priorities highlighted by the GoK to improve foods security, this report develops a modelling framework using a general equilibrium approach, taking into account the specificities of the Kenyan economy (e.g., high rates of subsistence and small-holder farming, multi-output structure of production, endogenous labour supply decision of households, segmented labour markets, migration etc…). The final achievement of this report should be to raise awareness among stakeholders (policy makers, international organisation, NGOs and other funders) and create the basis for an impact oriented policy approach.

A tailored version of a single-country Computable General Equilibrium (CGE) model is calibrated to an original 2014 Social Accounting Matrix (SAM) for Kenya. This latter comprises 54 activities producing 70 commodities using 3 types of labour (skilled, unskilled and semi-skilled) in 10 regions (30 labour accounts), 3 types of capital (agricultural, non-agricultural and livestock) and (irrigated and non-irrigated) land. It includes an enterprise account and 24 household accounts (rural and urban households in 7 regions and 10 urban households in 2 metropolitan areas which are further disaggregated according to expenditure quintiles).

The rest of the report is organised as follows. Section 2 introduces the Kenyan context, focusing on macroeconomic performances, the agricultural sector, food and nutrition security and relevant social indicators. Section 3 analysis some of the key policy issues related to food security and the development of the agricultural sector in Kenya; in particular fertilizer, seeds, water and land and infrastructure policies. Section 4 presents the methodology, i.e. main novelties of the CGE model employed and the database preparation. Section 5 describes the policy simulations and closure rules, while Section 6 analyses results and Section 7 concludes.

2. Context

This section presents the current economic, agricultural, food and nutrition and social context of Kenya nowadays.

A list of the most important economic and social indicators for Kenya, looking at the recent past and to outlook projections of some of the main indicators, can be found in the appendix of this report.

Kenya economic growth rates sustained at above 5%, for 8 consecutive years outperforming the regional average. Since 2014, its per capita GDP crossed the World Bank threshold of 1026 USD GDP per capita.

Agriculture is the backbone of Kenya's economy, and one of the main sectors in the national development strategy. Agriculture accounts for 30% of GDP, around 60% of Kenyan workers are involved in the agriculture sector and almost 75% of them are smallholders. Agriculture remains one of the primary drivers of growth of the country even if is still largely dependent on favourable weather conditions.

Agriculture in Kenya can be described as a bi-modal system made of highly competitive commercial agriculture with large farms and well integrated out-growers schemes and extensive smallholders agriculture, increasingly dividing their land because of demographic pressure, practicing mixed farming for subsistence and having limited access to market

Crops and livestock production has been increasing steadily since independence but, while some regions have yield-abundant surpluses, the overall agricultural productivity in the country is rather low and stagnating. Maize yields are projected to increase by only 17% over the next decade (ReNAPRI, 2015). Even accounting for some land expansion, Kenya will remain a net maize (and wheat) importer over the coming decade. Deficits are expected to increase substantially, even due the population increase, and imports needed to supply the market to increase substantially. This will exacerbate Kenyan trade position and expose the country to the fluctuations of the world market (ReNAPRI, 2015).The recurrent national grain deficit is due to two major factors: frequent drought episodes and a government regulations resulting in high production costs compared to neighbouring Uganda. As a consequence of the production deficit food prices are typically high for the marginalized population and the country suffers from a chronic dependence on Ugandan grain import. The current lack of competitiveness of the sector causes recurrent situation of food insecurity, in particular within ASAL region.

Agriculture production has experienced marginal growth in the last five years for the main food crops and a serious decrease in smallholder commercial crops such as sugar and coffee due to scarcity of land and conversion to food cropping. Low productivity is a key challenge of the Kenyan agriculture, in particular in arid and semi-arid land (ASAL) which covers 80% of the country. In these regions rainfall is less and less predictable and the overreliance on rain-fed agriculture makes them highly vulnerable and exposed to weather changes (exposition will even increase due to possible effects of climate change). Kenyan farmers face multiple key challenges which hinder their productivity: high post-harvest losses and diseases, increasing land constraints, chronic inadequacy of rural infrastructure (e.g., marketing, storage, water storage, roads, etc.), poor access to agricultural information and a limited budget allocation to agriculture and research by central and local governments. The use of innovative inputs is still lagging behind, so that most farmers cannot reap the benefit of modern seeds, adequate fertilisers and other technologies. In addition demographic pressure is impacting on access to land and natural resources results in youth migration to urban centre and the average smallholder farmers are aging.

Kenya mainly imports non-food products. Cereals and animal or vegetal fats and oils account for only nearly 10% of imports. The top agricultural imports are animal products or vegetable fats and oils, wheat, sugar, rice and tobacco.

On the other hand, more than one-half of Kenya's exports are composed of agri-food commodities. The key crops exports include horticulture products, tea, coffee, leguminous vegetables, animal or vegetable fats and oils and tropical fruits. Tea is the leading export commodity in Kenya and in 2013 contributed to € 917 million, generating 39% of the agricultural and fishery products export earnings.

Trade accounted for an average of 55.4% of GDP over the period 2000 to 2014. In 2013, Africa accounted for 44.9% of Kenyan exports. Europe was the second leading destination of exports with the bulk destined to European Union.

In terms of nutritional performances, both stunting and wasting rates have significantly declined in the past five years to reach 26% and 4% in 2014. But wasting rates above 10% are observed in many counties of the arid and semi-arid areas. The mortality rates for children under 5 also decreased in Kenya. However, the number of children affected by stunting will increase by 2025 as a result of future population growth if current efforts are not taken to scale. As a consequence these children will never reach their full physical and mental potential. The main factors are the lack of sanitation and clean water, bad infant and child feeding practices, high level of chronic food insecurity and gender disparities with the poorest female headed households facing the highest level of vulnerabilities.

Kenya public spending has not recorded significant fluctuations since 2000. Although increasing in absolute value, the share of the budget for the agriculture and rural development has declined considerably: from 5.1% in 2009/10 to 3.6% in 2012/13, figures which are way below the below the Maputo target of 10%.

With the devolution the allocation to the agriculture sector has been downgraded from 4% in 2014 to 2.7% in 2015.

3. Data

The simulations and the applications of CGE model developed in this study needs to be calibrated to a specific SAM that requires an ad hoc structured database. To this purpose, a virtually new SAM for Kenya (base year 2014) was estimated with an original structure. This new SAM incorporates specific accounts for the treatment of HPHC (Aragie (2015), McDonald (2010)) and a high level of regionalization based on agro-economic zoning and social characteristics. Accordingly, this new framework would make feasible to address specific issues such as semi-subsistence economic systems, agricultural production, mobility of factors, and other elements with a regional dimension.

3.1. Estimation of Social Accounting Matrix

To estimate a new SAM, data from different sources were employed. One of the main purposes is to generate SAM values which are as consistent as possible with the latest national statistics. Therefore, the 2014 Kenya SAM is a novel contribution as it is estimated from the new rebased National Accounts (including a short version of Supply and Use Tables) for Kenya (KNBS, 2015a, 2015b) including micro-data from the last Kenya Integrated Household Budget Survey (KIHBS) 2005/06 (Kenya National Bureau of Statistics, 2007). Other relevant databases related to agriculture (Government of Kenya, 2015a), and labour markets (Kenya National Bureau of Statistics, 2015a) and (Kenya National Bureau of Statistics, 2015b) revealed to be important to update the production structure of previous SAMs elaborated by IFPRI (Kiringai, et al., 2007), Thurlow et al. (Thurlow, Kiringai, & Gautam, 2007), Thurlow and Benin (Thurlow & Benin, 2008).

The new SAM, although based on the standard structure, deviates from other classical SAM in terms of structural assumptions. The structure and a short version of the SAM is summarised in Appendix while all technical details to estimate a SAM coherent with the SATGE-DEV model are available at Mainar et al., (2017).

HPHC concept is introduced in the SAM by assuming that each household has a corresponding "productive activity". Besides the classic Representative Household Groups (RHG) that collect household behaviour as consumers of goods and services and as providers of factors of production (and receptor-contributors of transfers), the Kenya 2014 SAM has accounts showing the behaviour of households as units of production. These accounts incorporate the economic behaviour of households as producers of food commodities (agricultural and livestock products for food) as well as cash crops. This requires also separate accounts for commodities produced by these households for their own consumption (HPHC as input or as a final product) and the same marketed commodities (produced both by households and by conventional productive activities). Rows of these commodity accounts reflect HPHCs use as intermediate inputs in the productive activities of households and their consumption in final demand of households (RHG). Their row sums must be equal to the sums of the columns that summarize the contributions of the activities of households to each of these goods. Similarly, columns of the households activities show how they use inputs (HPHC and marketed), while rows show the destination of their production as inputs, own-consumption goods or marketed commodities. Households considered as producers have been broken down regionally (according to the criteria that will be mentioned later), while commodities produced are homogenous at national level. The breakdown of commodities and activities is summarised in Appendix.

The agricultural regional breakdown in the 2014 Kenya SAM is based on agro-ecological characteristics. The country has been divided into seven AEZs, in addition to the two major metropolises, i.e., Nairobi and Mombasa. Based on previous studies (Mabiso et al. (2012), Thurlow and Benin (2008), Kiringai et al. (2006)) and own assumptions, AEZs distinguish the primary sector production in different regions of the country enabling specific analysis of the effects of different policies focusing on territories, products or specific activities. The nine regions considered are (i) Nairobi, (ii) Mombasa, (iii) High Rainfall, (iv) Semi-Arid North, (v) Semi-Arid South, (vi) Coast, (vii) Arid North, (viii) Arid South, and (ix) Turkana[1]. This regional breakdown has been applied to both households, as productive units or activities, and households, as institutional units.

In terms of agricultural production, the SAM accounts for three types of production agents. There are 9 agricultural household activities (one per each AEZ region) that produce 18 "subsistence commodities" not marketed and consumed at home and 17 marketed crops. Three regional households produce one or more of the 6 exported cash crops (cotton, sugar, coffee, tea, tobacco and other crops manly flowers). Then, the business enterprise sectors which at national level produces food and cash crops. These activities represent the market oriented larger holder producers.

The Representative Household Groups (RHG) have been further disaggregated into rural and urban, according to the area of residence. Moreover, the two metropolises Nairobi and Mombasa have been broken down by income quintiles. As a result, the 2014 Kenya SAM contains 24 RHG, a number allowing for a good analysis of redistributive aspects and specific impact of different policies.

According to the classification of work by education, there are three types of labour in the SAM: skilled, semi-skilled and unskilled labour. Each labour factor is also regionalized, giving the nine regions of reference plus a rest of the world account. Hence, the SAM takes into account 30 different types of labour.

In summary, the 2014 Kenya SAM consists of 193 accounts: 54 activities (12 of them accounts of households as producers) producing 52 marketed and 18 HPHC commodities using 3 types of labour (skilled, unskilled and semi-skilled) in 10 regions (30 labour accounts), 3 types of capital (agricultural, non-agricultural and livestock) and 2 types of

[1] The administrative county of Turkana is treated separately to be consistent with the regional scope of the study. Nevertheless data for Turkana are scarce (170 observations out of 13,212 for the whole country), jeopardising robustness of both results and analyse for this area.

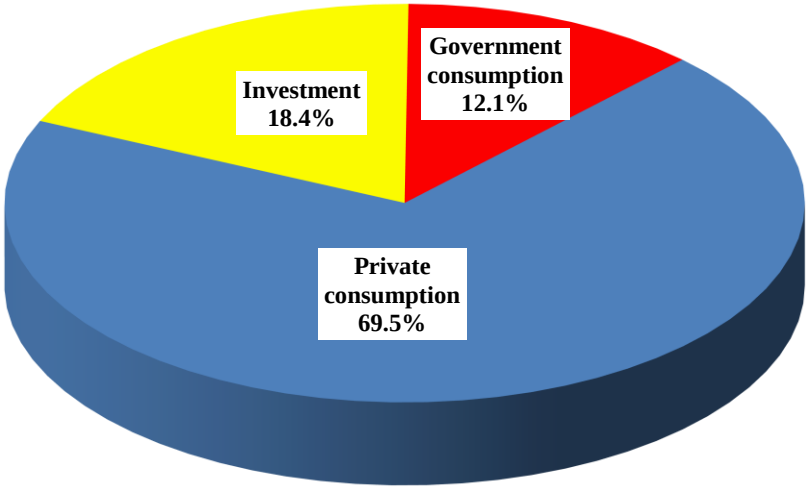
land (irrigated and non-irrigated). Regarding taxes and subsidies, 5 types of taxes has been disaggregated: direct, indirect, sales, factors and imports taxes. Also, 24 regionalized RHG has been obtained. Finally respective accounts for margins, saving-investment, enterprises, government and rest of the world are also included.

3.2. Structure of Kenyan Economy

The relationships among economic agents depicted by a SAM can be used to characterize the main features of an economy. In the case of the SAM of Kenya, the high level of disaggregation used allows to analyse a variety of aspects of the Kenyan economy.

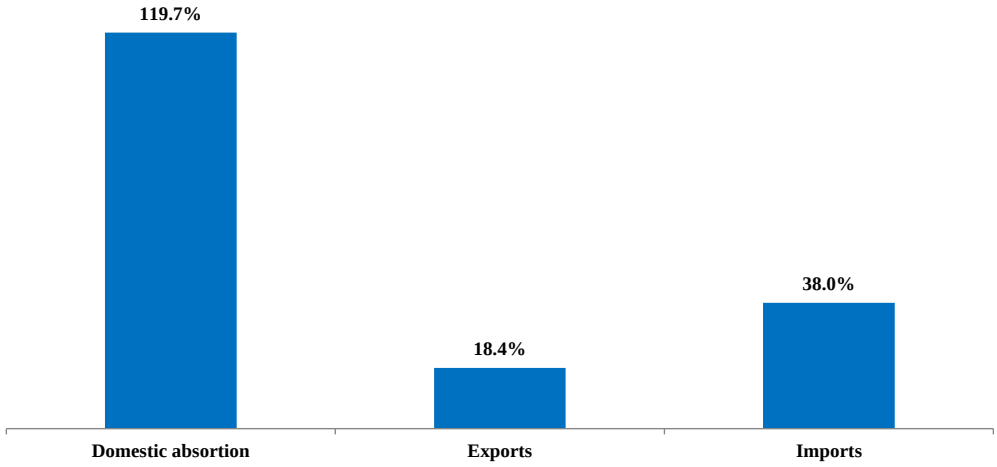
Kenya SAM shows how domestic absorption reaches almost 120% of the Kenyan GDP, being its basic composition private consumption (69.5% of this absorption, compared to just over 18% involving expenditure investment) (Figure 1). However, a clear external dependency is shown, with exports exceeding 18% of GDP compared with 38% of GDP value of imports (Figure 2).

Figure 1. Composition of domestic absorption. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

Figure 2. Domestic absorption, exports and imports as % of GDP. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

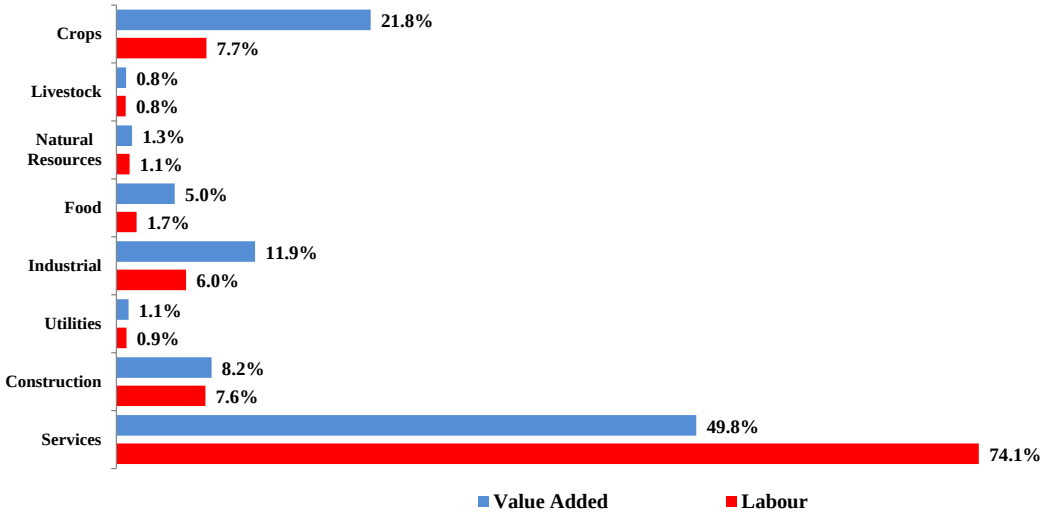
Despite the importance of agriculture in the Kenyan economy, the largest contribution to the value added comes from the services sector (49.8%), compared with 21.8% of crops or 5% of agrifood activities. The predominance of the services sector becomes more evident when considering factor income, since 74.1% of labour remuneration and 72% of the non-agricultural capital occur in service activities (Table 1).

Table 1. Distribution of Labour factor and non-agricultural Capital by aggregate activities. Kenya, 2014.

	Crops + Livestock	Natural Resources	Food	Industrial	Utilities	Construction	Services
Labour	8.6%	1.1%	1.7%	6.0%	0.9%	7.6%	74.1%
Capital (non-agricultural)	2.3%	1.0%	3.1%	13.3%	1.8%	6.9%	71.7%

Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

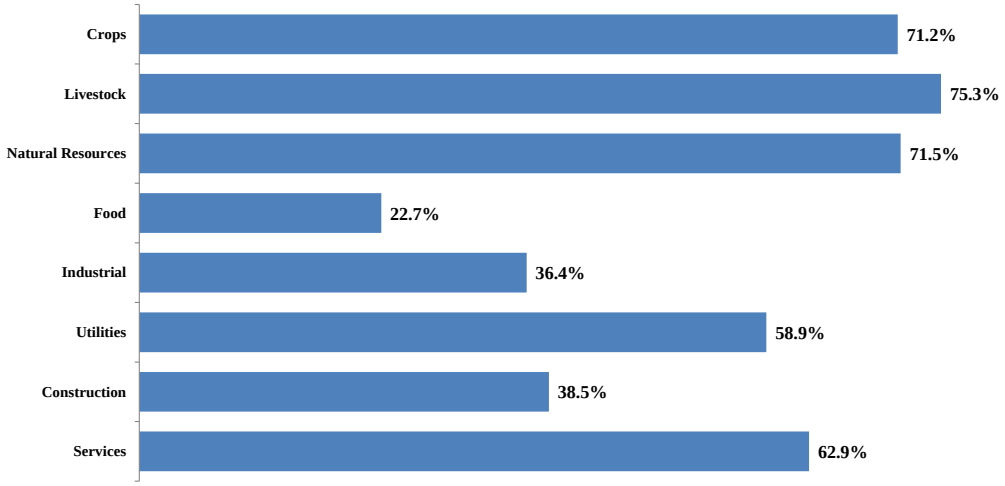
Figure 3. Distribution of Labour factor and Value Added by aggregate activities. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

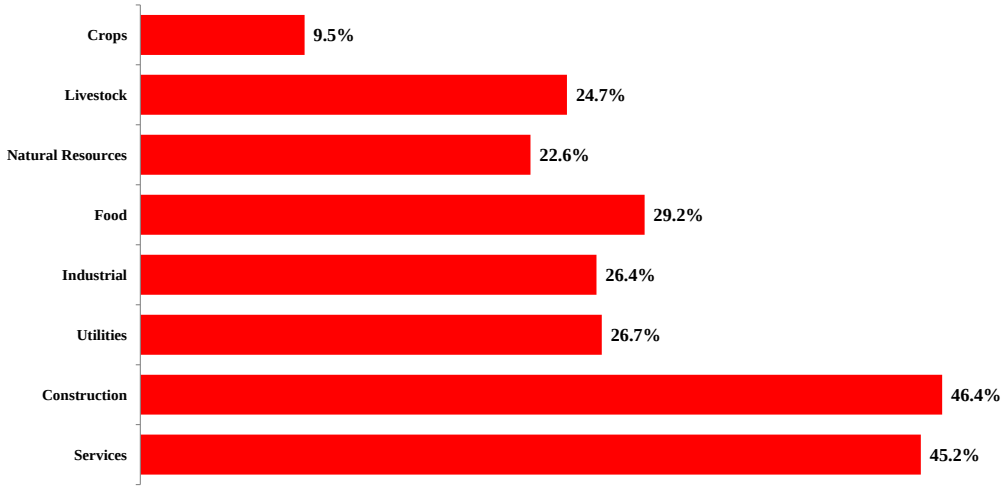
The primary activities show greater added value in relation to its gross output, exceeding 70%, above the ratio observed in Services (63%) (Figure 4). However, these relationships change if we consider the labour share in the value added. In the Construction and Services, this percentage is 46.4 and 45% of the value added generated by the sector, while it only reaches 9.5% in crops, although it reaches 29.2% in food activities (Figure 5).

Figure 4. Value Added/Gross Output ratio by aggregate activities. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

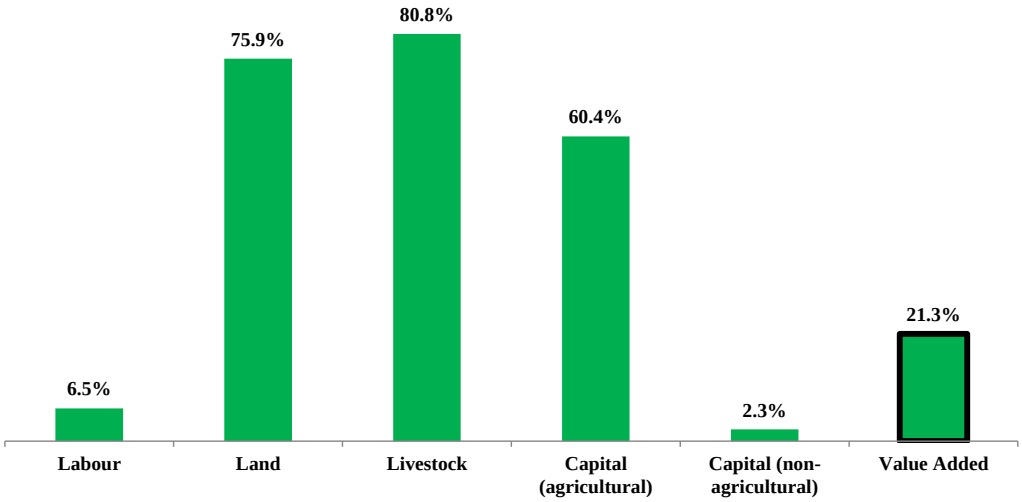
Figure 5. Labour factor/Value Added ratio by aggregate activities. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

Another important aspect related to the value added generated in the economy of Kenya is the weight of households as productive activities. Thus, livestock production factors, land and agricultural capital are concentrated in a majority in homes that act as activities (HPHC), with percentages of 75.9%, 80.8% and 60.4% respectively (Figure 6). However, only 6.5% of the remuneration to labour corresponds to these activities.

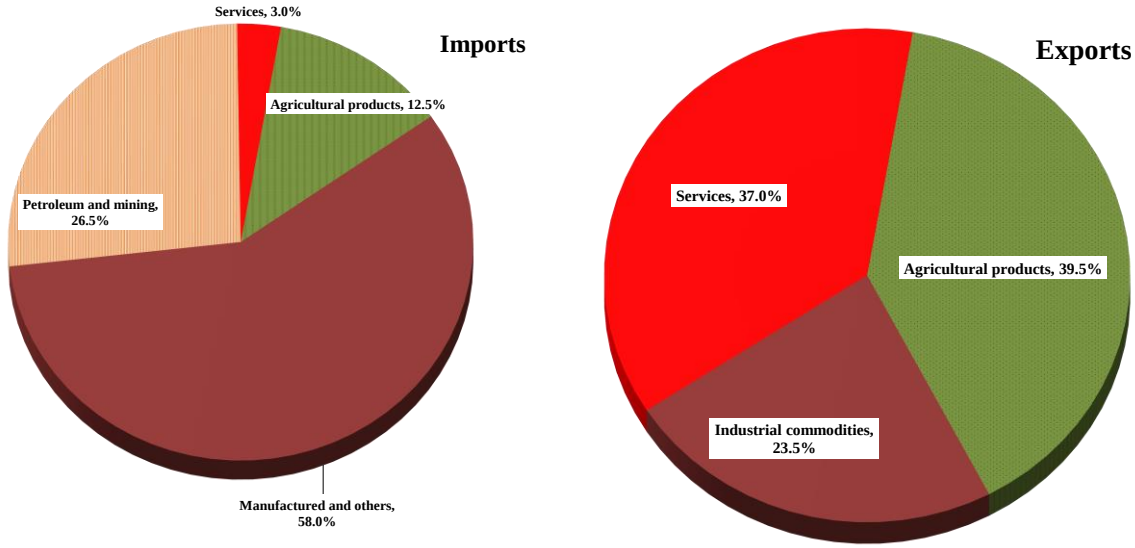
Figure 6. Share of HPHC activities in production factors. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

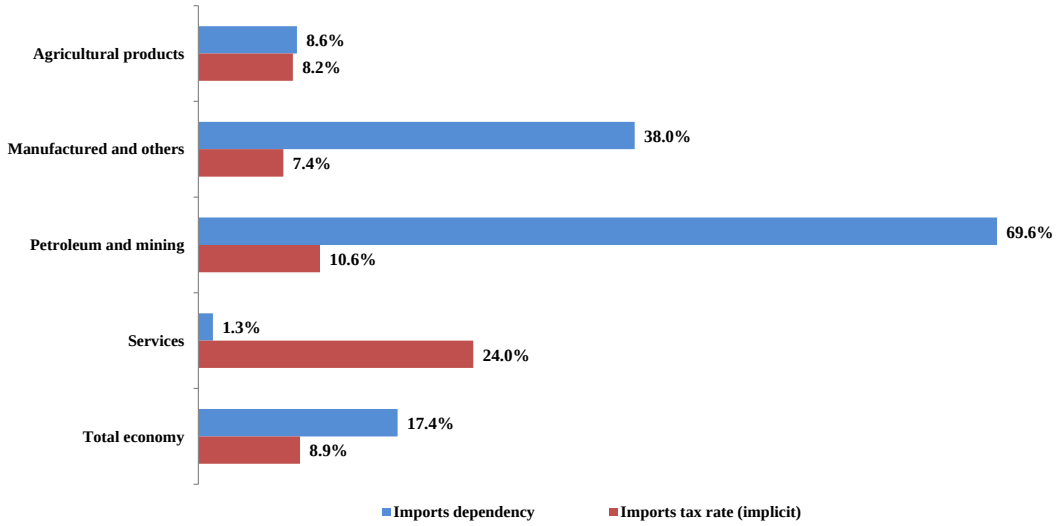
Almost 40% of sales of goods abroad correspond to agricultural products, while 37% are service charges. However, 58% of exports correspond to manufactured and industrial products, and 28.5% of purchases of oil and other energy products. The import dependence on the supply in the country is especially relevant in petroleum and mining (69.6%) as well as manufactured and industrial products (38%). Implicit tax rates on those sectors imports are 7.4 and 10% respectively, while in services (with a dependency ratio of only 1.3%) up to 24%. For agricultural products, dependence is 8.6%, with a rate of 8.2%. In the whole of the Kenyan economy, 17.4% of the supply of goods and services corresponding to imported products, with an average 8.9% implicit tax rate (Figure 33).

Figure 7. Imports and exports composition. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

Figure 8. Imports dependency and implicit imports tax rate. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

Table 2. Distribution of households' income. Kenya, 2014.

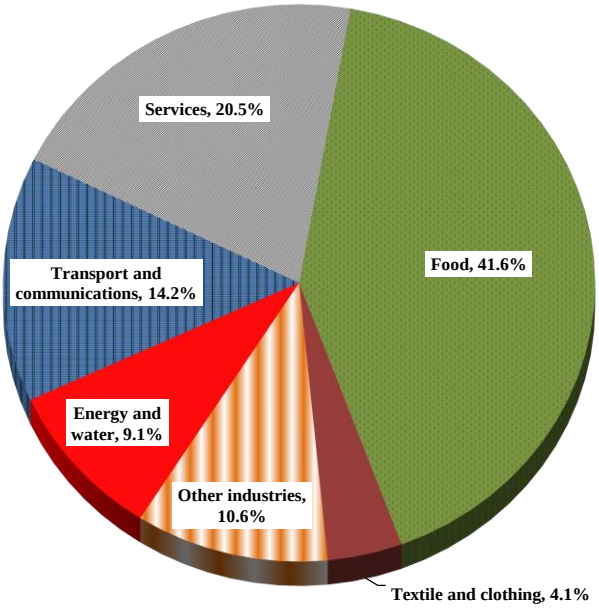
	Factors income					Transfers		
	Labour	Land	Livestock	Capital (agricultural)	Capital (non-agricultural)	Enterprises	Government	Rest of the World
Kenya	*34.1%*	*18.2%*	*3.7%*	*4.2%*	*9.7%*	*22.3%*	*0.9%*	*6.9%*
Rural	35.5%	30.7%	6.3%	2.7%	6.6%	11.4%	1.2%	5.6%
Urban	32.3%	2.9%	0.6%	5.9%	13.6%	35.8%	0.5%	8.5%
Nairobi	32.3%	0.2%	0.0%	7.4%	8.3%	38.8%	0.6%	12.4%
Mombasa	55.5%	2.3%	0.0%	3.5%	4.4%	29.0%	0.3%	4.9%
High Rainfall	32.7%	24.6%	4.4%	3.3%	12.4%	17.7%	0.5%	4.4%
Semi-Arid North	33.1%	33.5%	8.6%	2.7%	2.6%	12.9%	0.5%	6.1%
Semi-Arid South	31.0%	30.2%	9.6%	2.0%	6.8%	12.7%	2.1%	5.6%
Coast	45.5%	3.7%	0.8%	3.6%	2.4%	25.2%	5.5%	13.3%
Arid North	47.5%	16.7%	4.0%	2.8%	6.1%	8.7%	4.5%	9.7%
Arid South	46.3%	2.4%	0.5%	3.2%	4.0%	11.9%	9.5%	22.1%
Turkana	78.2%	2.4%	0.5%	3.3%	2.2%	6.9%	3.6%	3.0%

Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

The SAM of Kenya 2014 show how households obtain their income, overall and disaggregating by the type of habitat (urban / rural) or region or AEZ of residence. 34.1% of income from compensation to labour, being transfers from the Enterprises (22.3%) and the Land factor (18.2%), both as return on capital, the following main sources of income. Differentiating households according to their urban or rural environment, logically increases in the urban the importance of Non-agricultural Capital

(also from transfers from Enterprises), while Land is a key factor of income in the rural ones. However, in all case, transfers from the Government are relatively unimportant, while those from the Rest of the World are relatively significant in some rural areas, especially in Arid South and Coast, and in the metropolitan area of Nairobi.

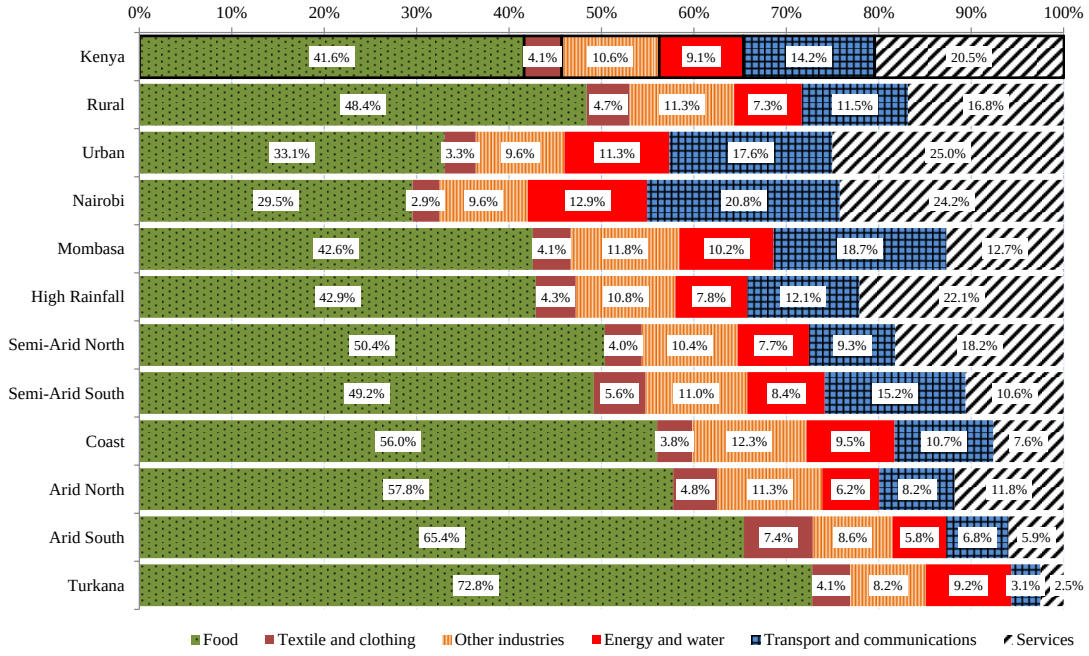
Figure 9. Households consumption pattern. Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

The average consumption pattern in Kenya indicates that 41.6% of household spending corresponds to food products and the second most important one is services, 34.7% of expenditure (14.2% in transport and communications and 20.5% in other services). Energy accounts for 9.1% of expenditure, while 14.7% are industrial and manufactured goods (4.1% textiles and clothing). These patterns are very differnt considering different residential areas, being more relevant spending on food commodities in rural areas, especially in lower income ones, while the reverse trend is observed in services.

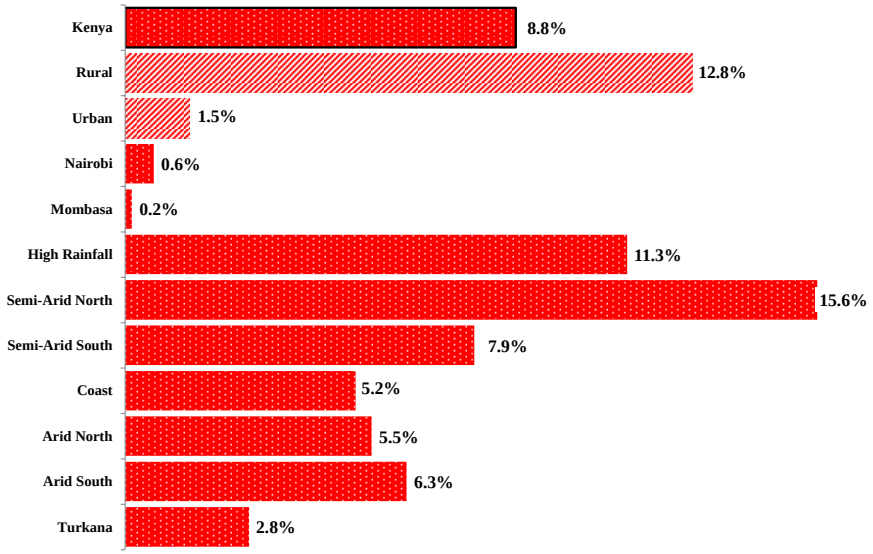
Figure 10. Households consumption patterns (global, by rural/urban habitat and by AEZ). Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

Because of the importance given in the development of the database to the role of households as productive activities, it is relevant to analyse the weight of HPHCs food commodities consumption in consumption. As shown in Figure 11, 8.8% of food commodities demand correspond to activities HPHCs, but this percentage rises to 12.8% among rural households (1.5% among urban), being especially relevant in High Rainfall (11.3%) and Semi-Arid South (15.6%).

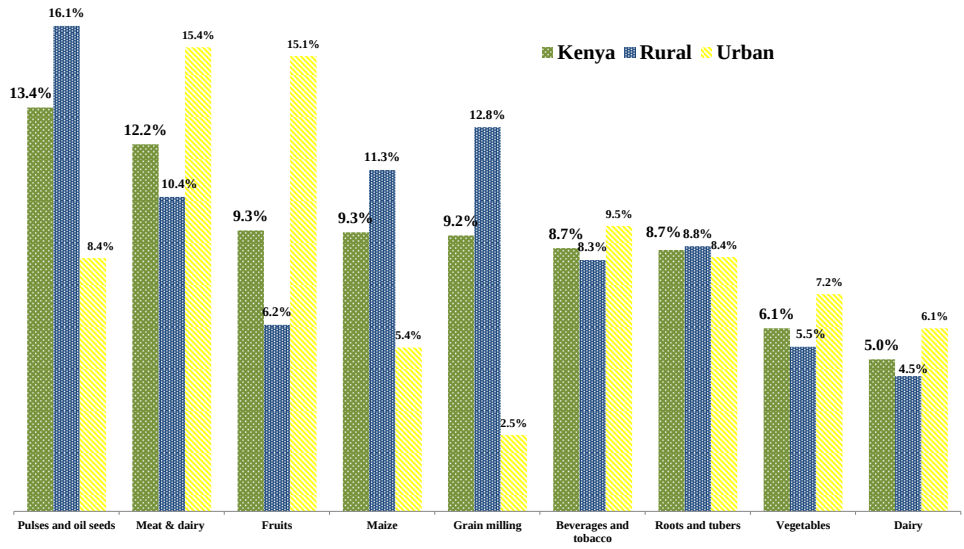
Figure 11. Share HPHC consumption (Kenya, rural/urban and by AEZ).Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

Regarding the specific consumption pattern of food, pulses and oil represent the main part of the budget, especially in rural households (16.1%), followed by meat and dairy products (12.2% of household spending in food in Kenya). In urban areas, this is the main item (15.4% of spending) followed by fruits (15.1%) (Figure 12).

Figure 12. Principal food commodities consumed as share of food consumption (global and by rural/urban habitat). Kenya, 2014.



Data source: Kenya Social Accounting Matrix 2014 (own elaboration)

4. Model

Chapter 4 presents the methodology employed to perform the impact assessment of the main policies presented in the previous section. The method, a brief literature review on studies for Kenya and the database produced for this report are presented in this chapter.

4.1. Computable General Equilibrium Models and Kenya Applications

Computable General Equilibrium (CGE) models are systems of non-linear simultaneous equations representing the constrained optimising behaviour of all agents within the economy as producers, consumers, factor suppliers, exporters, importers, taxpayers, savers, investors or government. This means that they depict the production, consumption, intra-sectoral input and trade of all economies for one country, a region or even all countries worldwide.

Two main families of CGE models have been developed: single-country and global CGE model. Single-country models are based on detailed databases for a country to identify the agents in the economy. The underlying approach to multi-region modelling is the construction of a series of single country CGE models that are linked through their trading relationships.

In the context of macroeconomic analyses of national economic systems some of policy questions, related, for example to sustainability of policies in the sectors of agriculture, social transfer and combating food and nutritional insecurity in developing countries, could be satisfactorily addressed with the development of a variant of a single-country CGE model specially designed to address substantive real developing world issues.

Karingi and Siriwardana (2001) analysed fiscal adjustment and trade liberalization under structural adjustment programmes for Kenya. Results suggest that fiscal austerity through raising indirect taxes and trade liberalization supported by foreign aid inflows achieve the best overall outcomes.

Thurlow et al., (2007) considered the impact and fiscal implications of increasing agricultural spending to 10 percent of the budget in Kenya. The authors explored two potential areas of investment within the agricultural sector, i.e. expenditure on research and extension (R&E) [2] and on irrigation and water management. A dynamic CGE, coupled with a micro-simulations model, was employed to analyse growth and distributional changes in Kenya. Irrigation favours the lowlands and the poorest segment of the population, while investments in R&E favour the midlands and highlands, and have the highest returns in both growth and poverty reduction.

Kiringai and Levin (2008), using a version of the Maquette for MDG Simulations (MAMS) model (Lofgren, Cicowiez, & Diaz-Bonilla, 2013) calibrated for Kenya concluded that the resource requirements are not extremely large to reach the Millennium Development Goals (MDGs) in Kenya if the government succeeds in deepening its reform efforts this could trigger additional aid-flows. Nevertheless, a clear prioritazation would be needed to scale-down investment in the other government sector and increase investments in MDG-sectors. The most delicate sector appears to be the water one where, higher investment is needed compared to what have been invested in the past.

Balistreri et al., (2009) employed a small open economy CGE model to assess the impact of the liberalization of regulatory barriers against foreign and domestic business service providers in Kenya. Authors estimated a substantial gains to Kenya from regulatory liberalization in business services, and additional gains from uniform tariffs. Decompositions revealed that the largest gains to Kenya derive from liberalization of costly regulatory barriers that are non-discriminatory in their impacts between Kenyan and multinational service providers.

Thurlow (2011) employed a dynamic CGE to assess economic conequences of potential outbreaks of avian flue in Kenya. results indicate that economic growth should not be affected but, dur the importance of poultry as income source for porr farmers and major food items, it might significantly worsen poverty situatio of the country.

Mabiso et al., (2012) suggested similar conclusions. Indeed this study scrutinizes investment options across Kenya's three major Agro-Ecological Zones (AEZ) using revised and updated Kenya's SAM with disaggregated activities and households by AEZ. Then CGE model simulations are run to identify priority subsectors and commodities within each AEZ. Results show that Kenya can significantly reduce national poverty if more investments are directed to semi-arid areas' irrigation and road infrastructure. Adopting a subsector approach, adequate investments in maize and root crops in the semi-arid and high rainfall areas would be crictical.

Engida et al., (2015) analysed economy-wide effects of enhancing productivity for the livestock sector in Kenya using the recursive dynamic extension of the so called IFPRI standard model (Lofgren, Harris, & Robinson, 2002). Improving productivity should positively affect macroeconomic factors (e.g., growth in value added, real exchange rate appreciation and increasing exports), higher return to land and labour and consequently reduce poverty.

[2] Research and Extension (R&E) supports agricultural and rural development by enhancing national agriculture research institutions and agricultural and rural extension services through policy advice, technical support, projects/programmes, studies and workshops. It emphasizes the role of information, knowledge and technologies in shaping farmers' decisions.

4.2. STAGE_DEV Model

The variant of the single-country STatic Applied General Equilibrium (STAGE) model (McDonald, 2007), used for this analysis, is part of the integrated Modelling Platform for Agro-economic Commodity and Policy Analysis (iMAP) (M'barek, Britz, Burrell, & Delince, 2012) and (M'barek & Delincé, 2015) established in 2005 in JRC-IPTS-AGRILIFE with the idea of building up a platform to host agro-economic modelling tools financed by the European Commission, to maintain and developed a policy support-oriented platform that disposes of a number of partial equilibrium (PE) and CGE models.

The STAGE model is a member of the class of single country CGE models that are descendants of the approach to CGE modelling described by Dervis et al., (1982). More specifically, the implementation of this model, using the GAMS (General Algebraic Modeling System) software, is a direct descendant and development of models devised in the late 1980s and early 1990s, particularly those models reported by Robinson et al., (1990), Kilkenny (1991) and Devarajan et al., (1994).

The variant of STAGE applied for this study, called STAGE_DEV, is fully documented in Aragie et al. (2017).

To properly model agriculture and food security issues in Kenya, a model should depict key structural characteristics of the economy and of the agricultural sector. Among them one of the most relevant is the **dual role of semi-subsistent agricultural households**, which play the non-separable double role of producers and consumers. The introduction of a **Home Production for Home Consumption (HPHC)** module within STAGE_DEV is a crucial added value of the STAGE-DEV. Indeed HPHC is explicitly modelled to account for the non-separability of the dual roles of producers and consumers.

Closely related to the modelling of HPHC is the issue of modelling household consumption. For a developing country Stone-Geary functions may be preferable since they allow for **subsistence consumption** expenditures, which is the most realistic assumption when there are substantial numbers of very poor consumers In STAGE_DEV, the consumption is modelled with Constant Elasticity of Substitution-Linear Expenditure System (CES-LES) nested structure that allows substitution between "broad" commodity groups (i.e. in the top nest) which are subject to subsistence consumption constraints, while households can substitute between the component commodities (e.g., HPHC and consumption from market) of the "broad" commodity groups.

In terms of **migration**, this version of the model is concerned with internal migration only. The model uses behavioural relationships to depict the migration that can take place between and within rural and urban locations, and hence is a generalised form of the traditional focus on rural-urban migration. The model assumes that individuals/households decide to migrate from places of origin to destination if their relative (expected) incomes/wages change Migration should be looked at as a household decision where members of the household make collective decisions with the objective of maximising/optimising the household's utility. Hence, the household's average, or per capita income, which includes all income sources such as transfers and remittances, is assumed to be used to make migration decisions. It is further assumed that households will decide to migrate permanently to new locations (geographically) as long as the changes in relative average incomes are permanent, with a possibility of return migration or a second round migration if the newly established equilibrium is destabilised, although this is beyond the time horizon of a static model.

Modelling **factor market as segmented** markets is based on empirical observations indicating that labour types within the same classification category receive substantially different wage rates in different activities and these differences are difficult to reconcile solely by appeal to differences in technology and factor ratios. Under segmented factor markets, the factor market within a national economy is recognised not to be single and unified and that it is perceived to be a set of non-competing market segments where the

underlying operations with regard to wage, job security and working conditions differ across segments due to institutional and other barriers. STAGE_DEV relies on a series of labour mobility functions which assume that each type of labour is segmented across different categories of sectors and that labour mobility between segments is imperfect but within segments mobility is perfect. The roles of structural features such as high transaction costs and lack of efficient factor markets on factor mobility are captured by the mobility elasticity. The higher the mobility elasticity, the easier labour moves between segments.

To model migration and segmentation we employ a generalisation of the method developed by McDonald and Thierfelder (2009), used in Polaski et al., (2009) and further refined by Flaig (2014) and Aragie (2015). Migration and segmentation account for persistent urban-rural and regional wage differentials, farm and off-farm wage disparity and continuous urban-rural and internal migration. In both cases, physical units of labour are allowed to transit across regions and/or skill types according to constant elasticity labour supply functions. The factor ownership matrix is updated after any simulation to accommodate migration and segmentation effects.

In addition, we model small-holder agricultural production by exploiting the **multiple-output structure** of STAGE. The original STAGE model allows for a simple modelling of multiple product activities through an assumption of fixed proportions of commodity outputs by activities. This represents a by-product assumption, with commodities differentiated or undifferentiated by the activities that produce them, using CES aggregation to define composite variants of differentiated commodities produced domestically (the same as in Lofgren et al., 2002). STAGE_DEV (based on Ferrari and McDonald, (2017)) adds the option that activities can vary their output mixes in response to changes in commodity prices, by introducing functions that modify the shares of commodity outputs in response to price changes.

The current version of the model allows the researcher to select in a complete flexible way a different **production function** for each activity, including intermediate inputs in the value added function and selecting between CES and Leontief aggregators. For the purpose of this study, the selected structure of the production in agricultural sectors is given in Figure A. 1. The top nest of the production produces the value added by using intermediate inputs, labour, capital and land composites under a CES production function. All factors are composite factors that are produced by the nests below them. Intermediate input nest combines all intermediate inputs using a Leontief production function. A composite seed factor which is produced by commercial and home produced seed by a CES nest is also under this nest. Hence seeds are perfect complements with other intermediate inputs but farmers can substitute home produced seeds with commercial seeds. The labour nest combines different types of labours (i.e. skilled, semiskilled and unskilled) in a CES production function. Composite capital factor is produced by agricultural capital and livestock by a CES production function. Land composite is produced by rainfed land, fertilizers and water-land composite, last two of which are also produced by the nests below them. Fertilizer composite is produced by three types of fertilizers (N, P and K) by a Leontief type production function. Water land composite is produced by irrigated land and water composite which is in turn produced by commercial and home-produced water with a CES nest. Lastly, livestock production sectors also consist of feed factor at the very top nest.

According to this structure, farms can substitute commercial and home-grown seeds of a crop as well as seeds of different crops. Further, home-produced and commercial water, different labour types, and the composites at the top nests are substitutable. Lastly water-irrigated land composite can be substituted by fertilizers or rainfed land. On the other hand irrigated land and water, different fertilizer types, different intermediate inputs and seed composite are perfect complements.

To explicitly incorporate the issues discussed above and in particular HPHC in an analytical model, a consistent way to organised the information in the underlined

database should be found. This requires introducing additional sets of columns and rows as sub-columns and sub-rows as explained in the following section.

5. Policy Issues

This chapter presents the main policy issues and how they are simulated in the modelling exercise. The constraints that we consider in the simulation are infrastructure, and extension services. We first present a brief summary of the implementation of the policies as foreseen by the GoK within their main policy documents. Then in subsequent sections we will describe the main constraints and the policy simulations.

In 2008, the government launched the Kenya Vision 2030, a new long-term development plan aiming at transforming Kenya into a newly industrializing, middle income country by 2030. Vision 2030 identified agriculture as one of the key sectors to deliver a 10% annual economic growth rate envisaged under the economic pillar.

Vision 2030 led to setting up of new strategic document for the agricultural sector named the Agricultural Sector Development Strategy (ASDS). In this document, the agricultural sector goal is to achieve an average growth rate of 7% per year. This new strategy has also taken into account regional and international initiatives such as the Comprehensive African Agricultural Development Programme (CAADP), which recognizes agriculture's contribution to accelerated economic growth in African countries, and the MDGs in which the United Nations' members pledged to reduce extreme hunger and poverty by 2015. The development of the sector is pursued through strategic objectives which are increasing productivity, commercialization and competitiveness of agricultural commodities and firms, developing and managing key factors of production.

ASDS individuates several key constraints and challenges for the Kenyan agriculture, the lack of public resource devoted to the sector by the government being critical. In 2003 under the Maputo Declaration, African Heads of State committed to allocate 10% of annual budgets to the agricultural sector. Kenya has not yet achieved this target. Indeed, this sector was receiving 4.5% of the budget in 2008. This insufficient allocation has reduced human resources and delivered services by public institutions (Government of Kenya, 2010a). The list of additional constraints remains substantial. Among them, the most important can be identified as reduced effectiveness of extension services, low absorption of modern technology and high cost of inputs, limited capital and access to affordable credit, losses due to pests and diseases, low and declining soil fertility. Last but not least, the agriculture is suffering from a chronic inadequacy of infrastructure (e.g., marketing, storage, water storage, etc.).

This policy document lists as well those opportunities that can be exploited to build a robust and dynamic agricultural sector, such as abundant human resources and potential for increasing production, irrigation, yields and value added.

The strategy clearly identifies some of the key issue for the Kenyan agriculture. Very similar conclusions are reached by other policy documents stipulate by the GoK. The National Food and Nutrition Security Policy (FNSP) (Government of Kenya, 2011) outlines the range of priority areas and principles for government interventions to ensure all citizens' right and access to food, to achieve adequate nutrition for optimum health, to increase the quantity and quality of food available, accessible and affordable, and to protect vulnerable populations using innovative and cost-effective safety nets linked to long-term development.

Very similar to the ASDS conclusions, the FNSP recognises as key issues the increased funding to the food and agriculture sectors to 10% of the national budget, the promotion of food storage, support of investment in infrastructure to enable food to move quickly and at a reasonable cost, the facilitation of the competitiveness of Kenya's agriculture sector (regional trade and standard harmonisation), the support of water harvesting through water storage facilities, increased funding for expansion of irrigated agriculture

and drought management, particularly in Arid and Semi-Arid Lands (ASALs) which comprise some 80% of the country and has the highest rate of food insecurity.

Vision 2030 is implemented through successive five-year Medium Term Plans (MTPs). During the first MTP (2008-2012), the agricultural sector recorded an average annual growth rate of 4.3% against the 7% target. This was mainly caused by adverse weather conditions in some years, post-election violence and increasing costs of major inputs such as seeds, fertilizer and fuel. The value of agricultural output increased by KSh. 70,550 million per annum between 2008 and 2011 against a target of KSh. 80,000 million per year as set out in Kenya Vision 2030 and the ASDS (Government of Kenya, 2013). Despite some achievements, Kenya still faced significant constraints including low domestic savings and investments, high unemployment and poverty, high energy costs, high costs of finance, inefficiencies in rail and port operations, rapid population growth rate, high dependence of the country on rain-fed agriculture, low agricultural productivity, a narrow range of exports and the slow growth in their value compared to the growth of imports (Government of Kenya, 2013).

The second MTP (2013-2017) identifies new priorities to reach the long-term objective of Vision 2030. Main priorities of the plan are to increase irrigated field to reduce the country's dependence on rain fed agriculture, to implement new measures to mechanize agricultural production, revive cooperatives and farmer unions. Other priorities deal with the implementation of the fertilizer cost reduction strategy, the access of Kenya's livestock products to regional and international markets, the support to extension services, and the establishment of greenhouses and agro processing plants in the counties.

Another relevant policy for Kenya which is not directly treated within this report is trade. On October 16, 2014, the EAC finalised the negotiations for a region-to-region comprehensive EPA with the EU (still to be signed and ratified) which include and immediate duty-free quota-free access to the EU market for all EAC exports, and an asymmetric opening of the EAC market to imports from the EU. In addition, Kenya is included in the United States' African Growth and Opportunity Act (AGOA), and benefits from the Generalised Scheme of Preferences (GSP) of many developed countries. Lastly, the EAC is currently negotiating a SSA tripartite FTA including the EAC, COMESA and SADC, extended in June 2015 to a continental free trade area with all 54 African Union states.

5.1. Main constraints

Poor infrastructure and lack of extension services are among the main constraints on agricultural production. In this section we briefly describe the policy relevance of these two issues and then explain the way they are incorporated in the policy simulations.

Development of infrastructure remains to be a key challenge to access to regional and international markets. Indeed, poor rural roads and other physical infrastructure have led to high transport costs for agricultural inputs and products, clearly jeopardising the ability of farmers to be competitive. Rural infrastructures are not only in poor condition and inadequate for the development of the rural economy, but also unevenly distributed overt the country, leaving some potentially important agricultural regions with little or no coverage. Adequate investments in railway, road, water supply, transport and storage infrastructures in rural areas are recognised to be critical for stimulating increased agricultural, livestock and fish production, marketing, value added addition and trade.

New investments in infrastructure are a key priority addressed under the 2013-2017 second medium term plan to achieve Vision 2030 objectives (Government of Kenya, 2013). As trade facilitator, investments in infrastructure are a key driver of market integration, nationally, regionally and globally. Beyond air, rail or road networks, investment in infrastructures should target cheaper and adequate electricity, water for households or affordable quality housing.

Access to extension services is another constraint that limits Kenya's agricultural potential. The National Agricultural Sector Extension Programme (NASEP) aims at enhancing access of extension services for farmers. Improving sharing knowledge, technologies and agricultural information is critical to transform subsistence farming to market-oriented one. Such a dynamic shall promote household food and nutrition security by increasing income and reducing poverty (Government of Kenya, 2012). Expanding education or investing in human capital appears also as key policy issues in Kenya, as well as the development of an effective migration policies and an inclusive labour market. Between 2008 and 2012, an annual average of 511,000 jobs (against a target of 740,000 jobs) was created, but about 80% in the informal sector. Within the second MTP, the Government committed to create 1 million new jobs, targeting quality jobs created in the formal sector, and will to increase share of formal sector employment from 12% in 2012 to 40% in 2017 (Government of Kenya, 2013).

5.2. Fertilizers

Low use of fertilizers is a key factor in preventing Kenyan agriculture to reach its potential and harming income generation in rural areas. Hence, increasing the fertilizer use of smallholder farmers has been on the agenda of the Kenyan government for the last couple of decades. Often mentioned as an example of successful private sector-led fertilizer market development in Sub-Saharan Africa (SSA) (Mason, Wineman, Kirimi, & Mather, 2016), Kenya is employing targeted input subsidy programs (ISPs) for inorganic fertilizer and improved seed (Ariga & Jayne, 2009).

A key element of the agricultural strategy is to expand the use of fertilizers and hybrid seeds, especially among smallholder farmers (Morris, et al., 2007; Schroeder, et al., 2013). The liberalization of fertilizer markets in 1990s has been successful in achieving this aim up to a certain point (Freeman & Omiti, 2003). Fertilizer use increased by more than 50% between 2000 and 2010 (Ariga & Jayne, 2011) while fertilizer use per hectares of arable land continued to increase with an impressive rate of 73% between 2010 and 2013 (World Bank, 2014) supported by the National Accelerated Agricultural Inputs Access Program (NAAIAP) (Ariga & Jayne, 2011). The prices of fertilizer have fallen drastically; by almost 50% between 1990 and 2007. Even after the price increase in 2008, due to the upsurge in world prices, they remained lower than pre-1995 levels (Ariga & Jayne, 2011).

The increase in fertilizer use has mostly been sustained by the imports (Ariga & Jayne, 2011), which renders the Kenyan fertilizer markets more vulnerable to fluctuations in international markets. Increasing domestic production of the fertilizer appears as an option to improve food security in the country. In this respect, Kenyan government has launched a roughly 1.1 billion euros fertilizer plant to be constructed in Eldoret in the framework of a fertilizer cost reduction strategy aiming at "stabilizing fertilizer prices and making fertilizer more accessible through local manufacturing, blending and bulk procurement" (Andae, 2015). Furthermore, another factory which would cost about 0.9 billion euros is also being constructed in Nakuru by the private sector. These two factories have a combined capacity of 350.000 tonnes of production which would cover about 70% of the current fertilizer use in Kenya.

Government of Kenya (GoK) employs input subsidy programs such as the National Accelerated Agricultural Inputs Access Program (NAAIAP) (Ariga & Jayne, 2011) to subsidize fertilizers. Subsidies were successful in increasing the fertilizer use but they represent a financial burden on GoK of almost €27 million yearly. Further, the increase in fertilizer use is sustained by imports (Ariga & Jayne, 2011) which are characterized by high trade and transport costs (estimated to be as high as 40% in Kenya). Thus, a significant amount of subsidies is paid to import fertilizers.

Increasing the domestic production of fertilizers appears as a solution to multiple issues. It reduces the price of fertilizers, as they will be produced with lower trade and transport associated costs. Lower prices make fertilizers more accessible for small-holder farmers.

A higher fertilizer use boosts agricultural productivity and production and consequently rural incomes. Lower prices also reduce the need for subsidies, relieving the government budget from this burden. To achieve the objectives, dependency on imports has to be reduced; this would ease the Kenyan vulnerability to fluctuations on world markets.

In this respect, Government of Kenya supported the construction of a roughly €1.1 billion fertilizer plant in Eldoret in the framework of a fertilizer cost reduction strategy aiming at "stabilizing fertilizer prices and making fertilizer more accessible through local manufacturing, blending and bulk procurement" (Andae, 2015). The factory started its blending operations in August 2016 and should double Kenya fertilizer production by 2018. In this phase, the factory is expected to increase the availability of fertilizers in the country but not to lower significantly their market price (due to the dependency on raw materials imports) until the completion of the second phase in 2020 (Mutai, 2016).

We take these two constraints into account in our simulations. In both policy, simulations we run additional sub-scenarios to see how relaxing these constraints (i.e. better market and extension service access) interact with the simulated policies and their contribution to agro-food production and food security.

6. Simulations

6.1. Boosting Fertilizer Production

Scenarios

A main and four policy scenarios are performed to reveal the possible impacts of the new fertilizer factories on the Kenyan economy. In the main scenario, fertilizer factory has a production capacity of 150 thousand tons which is equal to approximately 30% of the current fertilizers consumption (Ariga & Jayne, 2011). The 2014 Kenya SAM estimates the domestic production of fertilizers to be also around 30% of the consumption. The new factory will multiply by two the production of fertilizers in Kenya; thus we increase fertilizer production by 100%. This is achieved with a closure swap where production of fertilizers is set exogenous and the productivity of the fertilizer sectors endogenised. Then, the original closure is restored and the required technical change (which is 35% for N, 43% for P and 50% for K fertilizer production sectors) introduced to achieve 100% increase in the production of fertilizers in all the considered scenarios.

The increase in the investments is assumed to be 5.15 billion Ksh. which equals approximately to the amortization of the investments (i.e. 103 billion Ksh.) invested for the new factory. Foreign savings adjust to keep the saving-investment balance as the factories are financed by foreign direct investment[3]. 80% of the increase in the investment is added to the non-agricultural capital supply of enterprises to avoid any crowding out effect and to better simulate income effects, the remaining 20% is assumed to be used for current accounts such as transaction costs etc... in the investment process.

Closure rules are neoclassical with some modifications to allow for a realistic description of the Kenyan economy. Since the increase in investments is balanced by the increase in foreign savings, foreign savings is kept fixed to the new level (i.e. base year foreign savings plus the new investments for factories) and exchange rate adjusts. Government savings are fixed and government spending adjusts to accommodate change in government income. The model numeráire is the Consumer Price Index (CPI) and Producer Price Index (PPI) is allowed to change to reflect changes in prices. All factors

[3] We conducted sensitivity analysis by changing the source of financing to government and enterprises. Results do not change significantly and we mentioned the differences with footnotes throughout the report.

are fully employed with fixed supplies and flexible wage rates. The fixed supply of labour is updated to reflect changes due to migration and movement across labour types.

Following the main scenario, which is called as *Fertilizer* throughout the text, we simulate 4 policy options as follows:

Subsidy Scenario

The aim of this scenario is to analyse the effects of the removal of the subsidies on fertilizers[4]. Subsidies on fertilizers are removed on top of the shocks introduced in *Fertilizer* scenario. Technically, this is achieved by introducing a 4.78% tax on fertilizers. Current subsidy on fertilizers is around 55%: 50 kg bag of fertilizers are sold around 1600 KSh. with subsidy and around 3500 KSh. without subsidy (Andae, 2015). That would mean $(3500-1600)/50=38$ KSh. subsidy per kg of fertilizers. Government of Kenya announced that subsidies add up to 3 billion KSh. (Andae, 2015) which would mean government subsidizes 79 thousand tons of fertilizers. Then subsidy rate would be:

$$1-\frac{\left(79,000\times 1,600+440,000\times 3,500\right)}{500,000\times 3,500}\approx 4.78\%$$

The closure for this scenario is same as the main scenario.

Protection Scenario

One of the aims of the fertilizer policy is to decrease dependence of Kenya on imported fertilizers. Hence, in this scenario government imposes tariffs to halve fertilizer imports. This is achieved by fixing the fertilizer imports to 50% of their initial level and letting the model finding the necessary tariff rates. The required tariff rates are 49% for N, 37% for P and 22% for K fertilizers.

The only difference in the closure rule for this scenario is swapping of import quantity with tariffs for fertilizers.

Market Scenario

One of the key issues about the fertilizer use in Kenya, especially for the small-holder farmers, is the difficulty to access fertilizer outlets because of poor infrastructure (such as road network) or weakly organized distribution channels. This is reflected in fertilizers prices as high trade margins. This scenario simulates a better access to the fertilizers by reducing trade and transport margins for fertilizers by 30% in exchange for a further increase in investments of 4 billion KSh. to improve infrastructure. This investment is financed by government savings. The government is allowed to change the income tax on households and enterprises to finance these new investments. As delivery of agricultural products to the markets would also become easier thanks to improved infrastructure, also trade margins for these commodities decrease by 30%.

The closure rule is same with the main scenario. However, the part of the investments that is financed by government is added to government savings and hence adjustment in government spending takes this into account.

Extension Scenario

The main benefit of extension services are expected to be a more conscious use of fertilizers and seeds with better farming practices and spread of new techniques and technologies. To simulate the impacts of improved to access to extension services, productivity of fertilizer and seed use increase by 3% and labour use by 3%. The government has to pay the cost to reach farmers. Annual cost of reaching one farmer is

[4] Due to lack of data, we impose a uniform distribution of subsidies across regions.

assumed to be 520 KSh. as reported in (Muyanga & Jayne, 2006) and we assume that extension services reaches 7.5 million families with a cost of 4 Billion KSh. This additional 4 Billion KSh. investment is also assumed to be financed by government as in the previous scenario.

The closure rule is same as the *Market* scenario.

Results

The effect of simulated policies on macroeconomic indicators is minimal (Table A. 6). *Fertilizer*, *Market* and *Extension* scenarios improve macroeconomic condition while protection and subsidy scenarios deteriorate them. However under all scenarios the changes are mostly lower than 1%.

Doubling the production of fertilizer **decreases the supply price by around 22%** (Table 3) which is a significant decline but still lower than the targeted reduction in price by GoK. However, increasing demand for fertilizers limits the transmission of price fall to the market prices since **imports still dominate the fertilizer consumption**. This is consistent with the immediate developments after the opening of the factory. As reported by Mutai (2016), GoK does not expect an immediate fall in the prices of fertilizers as the blending activities depends heavily on imported inputs. The decline of domestic prices increases Kenyan fertilizer exports to more than 16% of the production from 10% in the base. This is relatively modest compared to the targeted amount due to the increase in domestic demand from the farming sectors. Hence demand for imports declines only slightly. **New factories can only accommodate the domestic demand leaving a relatively low margin for exports and imports continue to be the most important source of supply**.

Table 3: Fertilizer production, consumption, price and trade

	Base	Fertilizer	Subsidy	Protection	Market	Extension
	level	*% change from base*	*% change from fertilizer scenario*			
Production	7.82	100.0	-4.7	-14.5	2.7	2.9
Consumption	26.45	37.4	-7.5	-44.7	3.9	4.9
Supply Price	1.00	-22.0	-1.3	-4.1	0.7	0.8
Purchaser Price	1.04	-8.0	-0.5	15.2	-0.7	0.3
Export	0.27	224.2	-0.9	-2.8	1.2	0.4
Import	18.90	17.2	-8.7	-57.3	4.5	5.9
Exports/Production	10.07	64.0	2.7	9.4	-0.9	-1.8
Import/Consumption	209.61	-15.8	-1.0	-21.8	0.3	0.7

Source: Model Results

Removal of *Subsidies* adversely affects fertilizer sectors by reducing production by 4.7% compared to the *Fertilizer* scenario. The declining demand due to lower subsidies reduces imports significantly with a further decline around 9%. The supply and purchase prices of fertilizers decline but the decline in the former is higher than the latter as some part of demand reduction is compensated by slightly increasing exports.

Highest impact on fertilizer production is observed under *Protection* scenario. First, government needs to impose around 30% tariff on fertilizers to halve their imports compared to the main scenario. Supplier price of fertilizers decreases by more than 4%. However the purchaser's price increase by more than 15% due to increasing price of imported fertilizers. This causes fertilizer consumption to fall by almost 45%, also below the base year level. Hence introduction of tariffs for fertilizers serves only to substitute the domestic production with imports and worsens fertilizer use by the domestic sector. Exports declines by 9% although shrinking domestic demand allows Kenya to export a higher share of domestic production.

Increased availability of fertilizers benefits **export oriented agricultural** producers **more** (Table 4 and Table 5; Table A. 7 for sector details) who are already using relatively higher levels of fertilizers. Increase in the production of other crops is limited. The increase in the production of export oriented agricultural commodities is mostly due to higher production of export oriented farmers (Table 5). Sugarcane, coffee, tea and tobacco production are the activities that increase their production the most once the *Fertilizer* production is doubled. Cotton production by semi-arid North regions increases around 3.5% at the expense of cotton plantations' production (-1.9%) (Table A. 7). However, as most of the cotton is produced by farms in the semi-arid North, production of cotton increase by 2.1%. **Benefits to small-holder farmers are quite limited since their fertilizers use is low** in the base year.

Removing the *Subsidy* on fertilizers harms almost all sectors. The impact is generally limited as export oriented producers, who are the main beneficiaries from increasing fertilizer production, do not receive fertilizer subsidies. The *Protection* in fertilizer markets has more significant impacts on production. The production falls behind base year levels for all commodities. Export oriented crops are among the most affected group with a production decline of almost 3% compared to the baseline (and 6.3% decline compared to the *Fertilizer* scenario).

Table 4: Agri-Food Production by market orientation

		Base	Fertilizer	Subsidy	Protection	Market	Extension
		billion Ksh	*% change from base*	*% change from fertilizer scenario*			
Total	Agri-Food	2363.21	0.8	-0.2	-1.2	0.4	1.5
	Agriculture	1721.08	0.9	-0.2	-1.6	0.4	1.7
	Crop	1332.98	1.0	-0.2	-1.9	0.3	1.8
	Export Crops	328.40	2.7	-0.6	-6.3	-1.8	3.5
	Food Staples	1004.58	0.5	-0.1	-0.5	1.1	1.2
	Livestock	388.10	0.5	-0.1	-0.4	0.4	1.5
	Food	642.13	0.4	-0.1	-0.3	0.5	0.9
HPHC	Agri-Food	300.41	0.4	-0.1	-0.4	0.8	1.7
	Agriculture	289.30	0.4	-0.1	-0.4	0.8	1.7
	Crop	219.35	0.5	-0.2	-0.5	0.7	1.5
	Export Crops	219.35	0.5	-0.2	-0.5	0.7	1.5
	Food Staples	69.95	0.4	-0.1	-0.3	1.3	2.2
	Livestock	11.12	0.4	-0.1	-0.3	1.1	1.8
Marketed	Agri-Food	2062.79	0.8	-0.2	-1.4	0.3	1.5
	Agriculture	1431.78	1.0	-0.2	-1.8	0.3	1.7
	Crop	1113.63	1.1	-0.2	-2.2	0.3	1.8
	Export Crops	328.40	2.7	-0.6	-6.3	-1.8	3.5
	Food Staples	785.23	0.5	-0.1	-0.5	1.2	1.1
	Livestock	318.15	0.5	-0.1	-0.4	0.2	1.3
	Food	631.01	0.4	-0.1	-0.3	0.5	0.8

Source: Model Results

Table 5: Production by regions and activity type

		Base *billion KsH*	Fertilizer *% change from base*	Subsidy	Protection	Market	Extension
				% change from fertilizer scenario			
Small Holder Marketed	Nairobi	12.9	0.2	0.2	0.2	0.8	-0.9
	Mombasa	4.7	0.9	0.0	-0.6	-0.2	0.3
	High Rainfall	695.4	0.5	-0.2	-0.4	0.7	1.5
	S.Arid North	106.3	0.5	-0.2	-0.5	0.5	1.3
	S.Arid South	94.2	0.4	-0.2	-0.3	1.9	3.1
	Coastal	113.2	0.6	-0.2	-0.6	0.1	1.2
	Arid North	12.7	0.5	-0.1	-0.4	-0.3	3.5
	Arid South	5.4	0.2	-0.1	-0.2	0.6	2.3
	Turkana	1.0	0.3	-0.1	-0.2	0.4	5.0
	Total	1045.8	0.5	-0.2	-0.4	0.7	1.6
Small Holder HPHC	Nairobi	2.7	0.2	0.2	0.3	0.9	-1.0
	Mombasa	1.3	0.9	0.1	-0.6	-0.1	0.2
	High Rainfall	199.2	0.5	-0.2	-0.4	0.7	1.4
	S.Arid North	33.6	0.5	-0.2	-0.5	0.5	1.1
	S.Arid South	44.6	0.4	-0.1	-0.3	1.9	2.9
	Coastal	11.6	0.5	-0.2	-0.5	0.1	0.9
	Arid North	5.8	0.5	-0.1	-0.4	-0.1	3.3
	Arid South	11.0	0.2	-0.1	-0.2	0.8	2.2
	Turkana	2.8	0.3	-0.1	-0.2	0.5	4.6
	Total	312.7	0.4	-0.1	-0.4	0.8	1.7
Export Oriented	High Rainfall	151.3	2.8	-0.6	-6.6	-2.2	3.7
	S.Arid North	44.6	2.6	-0.6	-6.3	-2.3	3.6
	S.Arid South	1.8	2.6	-0.6	-6.2	-1.6	3.2
	Total	197.7	2.8	-0.6	-6.5	-2.2	3.6
Market Oriented	Food Crops	201.2	0.6	0.2	-0.6	2.1	-0.5
	Cotton	0.3	-0.8	0.0	2.7	2.3	-1.2
	Sugar	6.4	2.3	-0.7	-5.8	-2.0	3.5
	Coffee	7.3	4.0	-0.5	-8.5	-1.9	3.6
	Tea	99.9	2.7	-0.6	-6.5	-2.5	3.9
	Tobacco	1.8	2.5	-0.6	-5.9	-1.5	3.1
	Other Crops	14.9	0.6	0.1	-1.1	8.2	-0.2
	Livestock	48.6	0.6	0.0	-0.2	-0.9	0.3
	Dairy	23.3	0.6	-0.1	-0.4	-0.7	1.0
	Total	7087.1	0.2	0.0	-0.2	-0.1	0.1

Source: Model Results

The *Protection* scenario harms coffee producers the most, as their production declines by 7.3% compared to the *Fertilizer* scenario. Impacts on other export and market oriented producers are also quite significant: production of other export commodities declines by 6%, both in plantations and in the export oriented small farms. The decline in the production of those commodities allows cotton production to expand by 2.7%. The impact on food staple production of smallholders' is quite small.

Market and *Extension* scenarios, which simulate **complementary policies targeting small holder farmers**, generally improve agricultural production significantly. This indicates the importance of complementary policies to eliminate the constraints on agricultural production.

Under the assumptions of *Market* scenario, crops and food staples production increases more than 1% at the cost of export oriented crops' production which decline by almost

2%. Vegetables and wheat are the commodities with highest increase. On the other hand, export oriented production generally declines around 2% with the exception of other crops (i.e. mostly cut flowers) whose production increases more than 8%. Increase in the production mostly follows from the smallholder farms in semi-arid south. Self-consumed production mostly increases in Nairobi, arid and semi-arid south regions. The increase in food staples production is mostly due to market oriented production while livestock and processed food production mostly increases due to HPHC production. Export oriented small farmers' production declines significantly as the competitiveness of the smallholders increase due to higher market access. Increasing productivity of small-holder farmers due to better access to extension services allows them to compete further for the inputs, even to the degree where this starts to harm export-oriented producers' production.

Trends in the production of food staples under the *Extension* scenario are mostly similar to the *Market* scenario but, export oriented production is not adversely affected from the expansion of smallholder production under the *Extension* scenario. Further, both HPHC and market oriented livestock and processed food production also increase despite the increasing competitiveness of smallholder farmers.

The difference between *Market* and *Extension* scenario points out the **importance of and (need for) breaking the backward technology trap**. The *Market* scenario enables **small-holder farmers to expand** their activities a**t the cost of export crop producers due to the competition for factors**: They become more competitive and able to use more of the factors in the economy. On the other hand, when a **factor saving technological** change is introduced, the **competition for factors disappears** and both types of agricultural activities can expand.

Exports of agricultural commodities follow the trends in production (Table 6; Table A. 8 for sector detail). Under the *Fertilizer* scenario, exports of main export commodities, particularly **coffee and cotton**, expand in line with the increasing production. The results do not change much under the *Subsidy* scenario: higher exports are generally maintained for export oriented crops with exports of other crops and livestock production going back to base. However, **exports decline** significantly after the introduction of *Protection* for fertilizers: **coffee, cotton, sugar, tea and tobacco** are the most affected crops. This suggests that protection on fertilizers harms agricultural trade significantly.

Under the *Market* scenario, exports of maize, wheat and oilseeds increase while rice and vegetable exports decline; leaving the food staple exports almost unchanged compared to *Fertilizer* scenario. Livestock and processed food exports increase more than 1% by benefiting from the abundant inputs supplied by increasing small holder production. Export oriented crops' trade declines as their production falls. Most affected crop is cotton with 4% decline in exports. Only other crops (mostly cut flowers) increase their exports almost by 8%, as their production substitutes other export crops' production since small holder farmers do not produce other crops.

Exports of all agricultural commodities increases under the E*xtension* scenario as small-holder production do not crowd-out big farmers in input markets. Export crops are leading with %3.5 to 5% increases. Maize, wheat and vegetables are the most increasing food staples. Processed food exports also increase significantly, thanks to cheaper inputs.

Table 6: Export and Imports

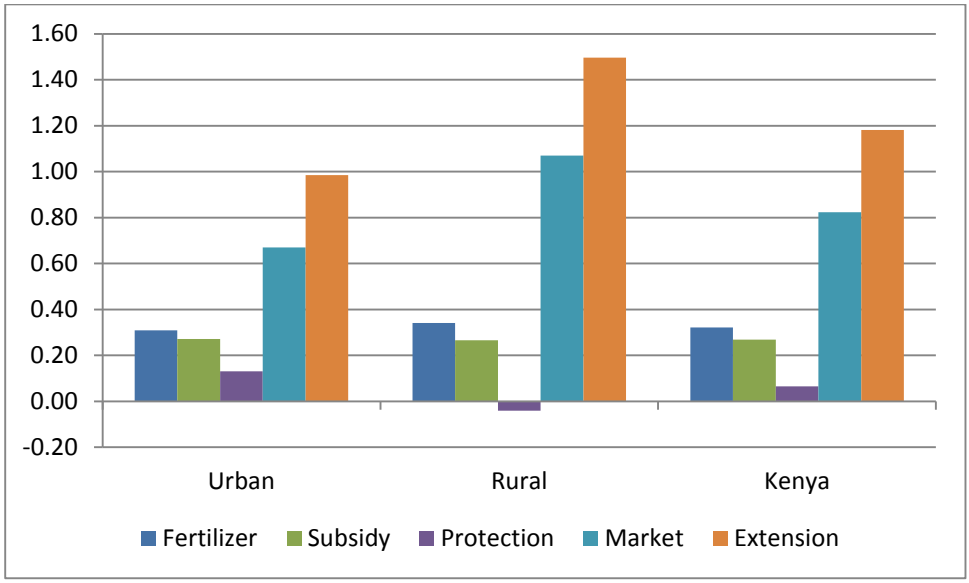
		Base	Fertilizer	Subsidy	Protection	Market	Extension
		Level	*% change from base*	*% change from fertilizer scenario*			
Exports	Total	954.32	0.9	-0.2	-2.0	-0.2	1.0
	AgroFood	377.25	2.3	-0.5	-5.4	-1.5	3.3
	Agriculture	349.09	2.4	-0.6	-5.8	-1.7	3.4
	Crops	348.10	2.4	-0.6	-5.8	-1.7	3.4
	Food Staples	34.87	0.4	-0.2	-0.6	-0.2	2.0
	Export Crops	313.23	2.7	-0.6	-6.3	-1.9	3.6
	Livestock	0.99	0.4	-0.4	-0.5	1.3	2.4
	Food	28.16	0.4	-0.2	-0.4	1.1	1.5
	Other	577.07	0.1	0.0	0.3	0.7	-0.6
Imports	Total	1975.97	0.5	-0.1	-1.0	-0.1	0.5
	AgroFood	243.06	0.6	0.0	-0.7	1.0	0.5
	Agriculture	202.12	0.6	0.0	-0.7	1.3	0.6
	Crops	201.02	0.6	0.0	-0.7	1.3	0.6
	Food Staples	176.19	0.5	0.0	-0.3	1.5	0.4
	Export Crops	24.83	1.6	-0.4	-3.6	-0.1	1.6
	Livestock	1.10	0.5	0.2	-0.1	-0.7	-0.4
	Food	40.94	0.5	0.0	-0.3	-0.2	0.3
	Other	1732.92	0.5	-0.1	-1.0	-0.3	0.5
Trade Balance	Total	-1021.66	0.0	0.0	0.0	0.0	0.0
	AgroFood	134.19	5.4	-1.5	-13.5	-5.9	8.0
	Agriculture	146.97	5.0	-1.3	-12.4	-5.6	7.1
	Crops	147.08	5.0	-1.3	-12.4	-5.6	7.1
	Food Staples	-141.32	0.5	0.1	-0.3	1.9	0.0
	Export Crops	288.40	2.8	-0.6	-6.6	-2.0	3.7
	Livestock	-0.11	1.8	4.7	4.1	-18.1	-26.5
	Food	-12.78	0.8	0.6	0.0	-2.9	-2.5
	Other	-1155.85	0.7	-0.2	-1.7	-0.7	1.0

Source: Model Results

Changes in imports mostly follow the exports. Although there are big changes in the imports of export crops, their base levels are quite small and hence can be ignored. For the food staples, the changes in imports are modest under all scenarios but the *Market* scenario, where a significant increase is observed. Pulses & oilseeds, Rice and wheat are leading the change. Although percentage change is also significant for vegetables and root & tubers, their import levels at the base is small. The increasing exports despite the increasing production of food staples is mostly due to the increasing demand for food staples by the rural households whose income and thus consumption increase significantly thanks to better access to the markets.

Doubling fertilizer production has a limited impact on nutrition (Figure 13 and Figure 14). Per capita calorie, fat and protein intake do not change significantly. All households are better off however increase in per capita intake of rural households is relatively higher. Note that the increase in the capital stock of fertilizer sector generates higher incomes for the households in the urban areas which in turn helps them to increase their food consumption.

Figure 13: Per capita calorie intake: Rural vs Urban according to regions (% change from base)

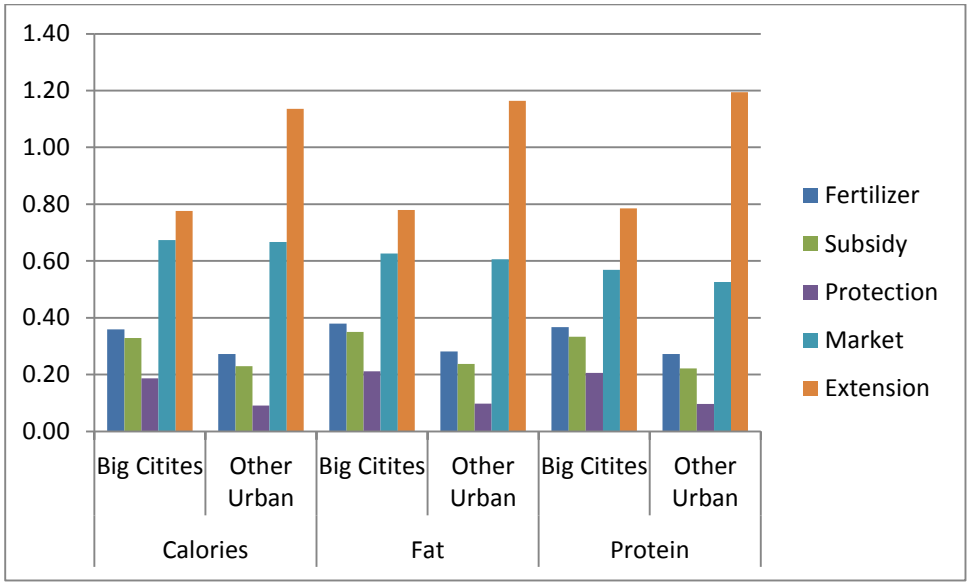


Source: Model Results

The *Protection* scenario makes all households worse-off, especially the rural households, who are likely to be seriously affected from the increasing fertilizer prices due to *Protection*. The declining agricultural production implies both income loss and less availability of food from home-production home-consumption activities which in turn worsens the per capita calorie intake.

Under the *Market* scenario national calorie intake increases more than 0.8%, with rural households benefiting significantly more compared to the urban households. The *Extension* scenario is the most beneficial both to the rural and urban households. The comparison of big cities (i.e. Nairobi and Mombasa) with other urban areas shows that benefits under the *Market* scenario and the *Extension* scenario are mostly in semi-arid and high rain-fall regions. Note that arid urban households can significantly increase their nutritional intake under the *Extension* scenario compared to the Market scenario which implies that technological change is a vital policy target for nation-wide food and nutrition security.

Figure 14: Per capita nutrition indicators: Big cities vs. Others (% change from base)



Source: Model Results

7. Conclusion

Low use of fertilizers is a key factor in preventing Kenyan agriculture to reach its potential and harming income generation in rural areas. Hence, increasing the fertilizer use of smallholder farmers has been on the agenda of the Kenyan government for the last couple of decades. To analyse the impact of the construction of fertilizer plant in Eldoret, in the framework of a fertilizer cost reduction strategy, on food and nutrition safety in Kenya we employ an economy-wide computable general equilibrium model.

The opening of the fertilizer factory will increase fertilizer availability in Kenya. Nevertheless, results suggest that increasing domestic production of fertilizers do not fully achieve the objectives of reducing rural poverty and increasing agricultural production. These objectives are more likely to be reached with the contribution of complementary policies that help small-holder farmers to overcome the backward technology trap and give them better access to input and output markets.

Main results suggest that, doubling the fertilizer production benefit Kenyan agricultural sector mostly through the export crops who are the main users of fertilizers. Thus, households producing export crops benefit most from the increasing fertilizer production. On the other hand, to help small-holder farmers, Kenyan government should pursue some complementary policies such as increasing the market access for fertilizers and agriculture by improving the rural infrastructure or improving the extension services to train small-holder farmers about fertilizer and land use. Small-holder farmers are likely to lag behind other farmers without such policies that will improve their productivity and market orientation. Results suggest that trying to protect the fertilizer markets by introducing an import tax would harm export oriented producers of Kenya.

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Annex 1: Kenyan indicators

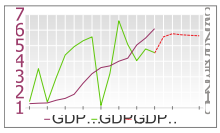
2.1 Macroeconomic indicators

2.1.1 Economic Indicators

After the poor performance of the 1990s and 2000s, since 2010 Kenya's economic growth experienced a remarkable acceleration (African Development Bank, 2011). Real GDP growth rose to 8.4% in 2010, from the poor 3.3% in 2009 and 0.2 % in 2008. Poor performances were likely due to the impact of the global financial and economic crisis. Real GDP then slowed down and recorded a 5.7% in 2013 and 5.3% in 2014. Nevertheless, in next years the economy is expected to keep growing robustly, with real GDP of 6.9% in 2015 and 7.0% in 2019, according with IMF forecasts (Figure 1).

Average growth in Kenya between 2011 and 2014 (5.4%) exceeded the averages for both Sub- Saharan Africa (4.6%) and lower-middle income countries (4.1%) (World Bank Group, 2015).

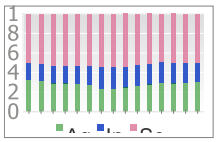
Figure 15 Real GDP dynamics



Data source: DataM - WB World development indicators/IMF World economic outlook database, April 2015
* IMF World economic outlook forecast

Over the last fifteen years, the contributions made to economic growth by individual sectors have not shown appreciable changes. Since 2000, services are the main pillar of Kenya's economy, accounting for more than 50% of GDP. The share of services initially increased from 50.7% in 2000 to 55% of GDP in 2006 and then decreased to 50.4% of GDP in 2014. Conversely, agriculture contribution to GDP firstly contracted from 32.4% in 2000 to 23.2% in 2006 and then slightly increased to 30.3% of GDP in 2014. Meanwhile, the industry share of GDP increased from 16.9% in 2000 to 19.4% in 2014 (Figure 2).

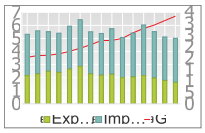
Figure 16. GDP contribution by sectors (% of GDP)



Data source: DataM - WB World development indicator

Trade in goods and services accounted for an average of 55.4% of GDP over the period 2000 to 2014. Imports have grown smoothly, from 31.7% of GDP in 2000 to 33.9 in 2014, while exports have first increase from 21.6% of GDP in 2000 to 28.5 % in 2005 and then steadily declined to 16.4% in 2014. As a consequence, over last ten years imports share of GDP increased to reach the double of exports contribution to GDP leading to a large balance of trade deficit in Kenya in 2014 (Figure 3).

Figure 17 Openness to trade



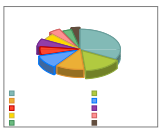
Data source: DataM - WB World development indicator

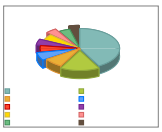
In 2013, mineral fuels, lubricants and related materials (SITC Section 3) accounted for 33% of Kenya's imports, followed by 22% of machinery and transport equipment (SITC Section 7), 16% of nuclear reactors, boilers and machinery and 10% of chemicals and related products (SITC Section 5) (Figure 4). Last figure on destinations for imports dates back to 2013 when the major destinations were India, China and United Arab Emirates (Table 1).

In the same year, Kenya's major exports were composed of 54% of foods (SITC sections 0), 16% of tobacco, chemicals and mineral fuels, lubricants and related materials (SITC Section 1-3-5), 16% of live trees and other plants and 13% of crude materials (except

fuels) and animal and manufactured goods and articles (SITC Section 2-6-8) (Figure 4). In 2013, major destinations for exports were Uganda, the United Kingdom and the United Republic of Tanzania (Table 1).

Figure 18. Major imports and exports of Kenya (2013)





Data Source: DataM - UN COMTRADE-HS 2007

Table 7. Kenya's major destinations for Imports and Exports (2013)

	Imports (Million KSh)		**Exports** (Million KSh)	
1	India	258,230	Uganda	65,362
2	China	182,356	United Kingdom	37,613
3	United Arab Emirates	117,360	United Rep. of Tanzania	40,496
4	Japan	83,720	Netherlands	32,578
5	South Africa	70,724	USA	29,936
6	USA	57,412	United Arab Emirates	25,144
7	United Kingdom	49,020	Pakistan	24,130
8	Indonesia	45,041	Democratic R of Congo	18,437
9	Saudi Arabia	41,423	Egypt	17,001
10	Germany	37,488	Somalia	16,940

Data Source: Kenya National Bureau of Statistics

In 2013, Africa accounted for 44.9% of Kenyan exports. Europe was the second leading destination of exports with the bulk destined to European Union (EU). Asia was the major origin for imports accounting for 61.2%. The trade balance worsened by 18.7% from a deficit of KSh 911.0 billion in 2013 to a deficit of KSh 1,081.1 billion in 2014 (Kenya National Bureau of Statistics, 2015a).

Narrowing the field to trade with EU Member States, Kenya key trade partner is the United Kingdom, both in terms of imports and exports. In 2013, Kenya exported to UK KSh 37,613 million and imported KSh 49,020 million. However, the value of trade with UK declined in the 2010-2013 period.

Value of imports from EU increased by 6.4 % from 2010 to 2013 (Table 2). On the other hand, the export from Kenya to EU has declined by 1.8% over the same period. Among the top five EU trade partner countries, exports from Kenya decreased in value in UK, Germany, and France while increased in Netherlands and Belgium.

Table 8. Values of Kenya trade with EU in 2010-2013 and top five trade partners

	Imports	Million KSh		Exports	Million KSh	
		2010	2013		2010	2013
	EU 28	166,646	207,628	EU 28	97,922	104,645
1	United Kingdom	37,869	49,020	United Kingdom	40,211	37,613
2	Germany	26,367	37,488	Netherlands	26,868	32,578
3	Netherlands	18,465	24,788	Germany	7,715	8,244
4	France	18,652	20,666	Belgium	4,159	6,193
5	Italy	11,981	20,324	France	5,093	5,379

Data Source: Kenya National Bureau of Statistics

The exchange rate is showing stability even if in the last year show a moderate depreciation towards the currency of the most relevant trade partner. The exchange rate stability was supported by foreign exchange inflows through remittances, sale of foreign exchange to commercial banks, and sustained foreign investor participation in the Nairobi stock exchange market (Kenya National Bureau of Statistics, 2015a). In 2014, the Kenya Shilling weakened by 0.9 per cent against major world currencies. Within the East African Community (EAC), the Kenya Shilling depreciated against Rwandese Francs and Ugandan Shilling by 3.1% and 1.7%, respectively, in 2014. The Kenya Shilling however appreciated by 7.4% against the Tanzanian Shilling during the same period. (Kenya National Bureau of Statistics, 2015a).

In 2014, the balance of payments position improved from a surplus of KSh 31.8 billion in 2013 to a surplus of KSh 126.1 billion, due to the increased international reserves (largely resulting from the sales of the Eurobond). The current account deteriorated by 30.2% from a deficit of KSh 411.7 billion in 2013 to a deficit of KSh 536.1 billion in 2014, due to the widening trade deficit. The financial account surplus increased by 67.6% from KSh 424.1 billion in 2013 to KSh 710.6 billion in 2014, due to increased capital flows (Kenya National Bureau of Statistics, 2015a).

In terms of trade policy, Kenya is an active member of World Trade Organization (WTO) where it has made commitments in both goods and services. Kenya is a member of the EAC [5], the most important trade and investment destination for Kenya. The EAC established a Customs Union in 2005 which was fully-fledged with zero internal tariffs as from 2010. The EAC, in fast tracking its economic integration process, ratified a more far-reaching common market protocol in July 2010. In November 2013, EAC Members signed a protocol on a monetary union (DG TRADE, 2015).

Kenya is also member of the Common Market for Eastern and Southern Africa (COMESA) where 14 countries including Kenya out of the 19 member states are implementing the Free Trade Area (FTA). Additionally, COMESA, EAC and the Southern Africa Development Community (SADC) are in the progress of coming up with a Tripartite FTA. Kenya is negotiating the Tripartite FTA as EAC bloc (World Trade Organisation, 2012).

On 16 October 2014, the EAC finalised the negotiations for a region-to-region Economic Partnership Agreement (EPA) with the EU. It is expected to be signed and ratified by October 2016. The agreement covers trade in goods and development cooperation. It contains a chapter on fisheries which aims to reinforce cooperation on the sustainable use of resources. The agreement foresees further negotiations on services and trade-related rules in the future. The agreement foresees immediate duty-free quota-free

[5] The EAC is a regional organization mandated by the Governments of Burundi, Kenya, Rwanda, Tanzania and Uganda.

access to the EU market for all EAC exports and partial and gradual ("asymmetric") opening of the EAC market to imports from the EU (DG TRADE, 2015).

The tariff profile of Kenya shows that the most protected sector is the agricultural one where more than 60% of the Most-favoured nations (MFN) tariff line are between 15 and 25% and some peak tariffs (3,2%) between 50 and 100% are still present (Table 3). These 3.2% line with the highest MFN concentrate more than 13% of agricultural imports of Kenya. on the other hand, imports of non-agricultural product are freer to enter Kenya and more than 40% of the tariff line are duty free (Table 3).

Table 9. Frequency distribution of tariff lines and import values (in %)

			Duty-free	0 ≤ 5	5 ≤ 10	10 ≤ 15	15 ≤ 25	25 ≤ 50	50 ≤ 100	> 100
Agricultural products	**MFN applied**	**2014**	15.4	0	16.2	0	64.2	1	3.2	0
	Imports	**2013**	32.9	0	22.1	0	21.2	10.7	13.1	0
Non-agricultural products	**MFN applied**	**2014**	40.5	0	22.8	0	36.2	0.4	0	0
	Imports	**2013**	69.7	0	11.5	0	18.2	0.6	0	0

Data: WTO Tariff profile 2015

A closer look within the sector shows that the most protected agricultural product are cereals and preparations (mainly rice) with a MFN of 75% while sugar products need to pay a MFN of 100% to enter Kenya (Table 4). On the other hand, in key products like chemicals and machinery more than 70% of the tariff lines are duty-free.

Table 10.Tariffs and imports by product groups

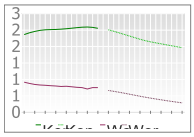
Product groups	**MFN applied duties**			**Imports**	
	Average	**Duty-free in %**	**Max**	**Share in %**	**Duty-free in %**
Animal products	23.1	7.7	25	0	28.2
Dairy products	51.7	0	60	0.2	0
Fruit, vegetables, plants	22.1	8.4	25	0.6	7
Coffee, tea	19.6	16.7	25	0.3	7.2
Cereals & preparations	23.4	10.3	*75*	4	0
Oilseeds, fats & oils	11.6	20.5	25	4.3	84.4
Sugars and confectionery	33.7	5.9	*100*	1.3	6.1
Beverages & tobacco	25.3	0	35	0.9	0
Cotton	0	100	0	0	100
Other agricultural products	10.9	38.2	25	0.3	31.6
Fish & fish products	24.7	0.3	25	0.1	0
Minerals & metals	10.5	36.6	35	14.8	62
Petroleum	4.3	61.4	25	25.3	100
Chemicals	3.9	77.9	25	11.2	81.4
Wood, paper, etc.	14	25.5	25	2.5	9.7
Textiles	19.5	6.9	*56*	3.5	13.7
Clothing	25.1	0.2	50	0.4	0
Leather, footwear, etc.	12.7	21.1	25	1.8	13.6
Non-electrical machinery	3.2	75.2	25	9.7	75
Electrical machinery	10.8	35.4	35	7	66.3
Transport equipment	6.2	61.8	25	9.2	35.2
Manufactures, n.e.s.	14.7	31.4	40	2.6	63.6

Data: WTO Tariff profile 2015

2.1.2 Population and labour force Indicators

Population in Kenya has been growing constantly since 2000 and it accounted for almost 45 million in 2014 up from about 31 million in 2000. According to the UN projections (medium variant) Kenyan population should reach 100 million by 2053 (UNDESA, 2015). Population growth was relatively stable in the last 15 years; it increased from 2.5% in 2000 to 2.64% in 2014, meaning that it augmented by only 0.14% in 15 years. The positive trend of Kenya's population growth is contrasted by the negative trend of the world population that indeed has been decreasing since 2000 and is projected to keep on declining until 2030. Nevertheless, also Kenya's trend is expected to reverse as the population growth is projected to decline to 2.17% in 2030 (Figure 5).

Figure 19 Population growth



Data source: DataM - WB World development indicators/ UN Population world prospect

In 2014, 42.1% of the Kenya's residents were under 15 years while in 2000 they were 44.3%. Conversely, people aged between 15 and 64 years rose from 53% in 2000 to 55% in 2014. People aged more than 65 years made up 2.8% of the resident population, the same percentage than in 2000 (Table 5).

Table 11. Population structure

	2000	2002	2004	2006	2008	2010	2012	2014
Population	31,065,820	32,691,980	34,437,460	36,286,015	38,244,442	40,328,313	42,542,978	44,863,583
0-14 years (%)	44.3	43.7	43.1	42.8	42.7	42.6	42.4	42.1
15-64 years (%)	52.9	53.5	54.1	54.5	54.6	54.7	54.9	55.1
> 65 years (%)	2.8	2.8	2.8	2.7	2.7	2.7	2.7	2.8

Data source: DataM - WB World development indicators

Population distribution by age groups was last measured in 2009 Census of the Kenyan population. The median age group of the population in Kenya was 15-19 years and it has not changed from 1999. In 2009, over 70% of the population was under 30 years old and 43% under 15, making policies addressed to children and youths pivotal for Kenya's development (Figure 6).

As on the latter date, the base of the pyramid broadened, reflecting a higher distribution of population at the youngest age groups. It is possible to notice slightly more boys in the younger age groups than girls; however, the ratio tends to reverse in the upper age groups. The pyramids also show that there are not large imbalances between males and females in Kenya at any age group.

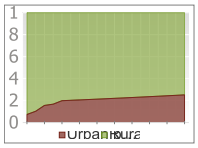
Figure 20 Population pyramids, by age groups

Data source: DataM - UN population

Data source: DataM - UN Population

Kenya's population mainly lives in rural areas. In 2014, rural population accounted for nearly 75%. Nevertheless, in last 50 years urban population increased noticeably, passing from about 7% in 1960 to 25% in 2014, showing that urbanization is a growing phenomenon also in this country (Figure 7). The estimated average annual rate of change of the urban population is constantly around 3 to 4% until 2050 where the urban population is estimated to reach 43.9% of the population (UNDESA, 2015).

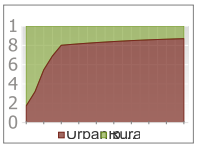
Figure 21 Urban and rural population in Kenya



Data source: DataM - WB World development indicators

With respect to other EAC countries, urbanization growth rate in Kenya does not differ substantially. Among EAC countries, Tanzania is facing the highest urbanization growth rate: 30% of the population in the country was urban in 2014. On the other hand, Burundi has one of the lowest percentages of urban population not only among EAC countries but in the entire African continent (11% of urban population in 2014). It is also interesting to compare Kenya's rate of urbanization with the African country with the highest urban population: Gabon (Figure 8).

Figure 22. Urban and rural population in Gabon



Since 2000, unemployment in Kenya has been marginally decreasing. From 2000 to 2013, both males and females' rate of unemployment declined from 8.7% to 8.1% and from 11% to 10.5%, respectively. Meanwhile, also youth unemployment (people ages 15-24) declined but still remain quite high, showing a rate of 17.1% in 2013 (Table 6).

Table 12 Unemployment rate, youth and total (% of labour force-modelled ILO estimate)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Female, youth	17.6	17.3	17.6	17.4	17.2	17.1	17.1	17.0	17.5	17.4	17.1	17.2	17.3	17.3
Male, youth	16.9	16.8	16.9	16.9	16.8	16.8	16.8	16.8	16.9	16.8	16.8	16.8	16.8	16.8
Youth	17.3	17.0	17.2	17.1	17.0	16.9	16.9	16.9	17.2	17.1	16.9	17.0	17.0	17.1
Female	11.0	10.9	11.0	10.9	10.8	10.7	10.7	10.7	10.7	10.6	10.6	10.5	10.5	10.5
Male	8.7	8.6	8.6	8.6	8.5	8.5	8.5	8.4	8.3	8.3	8.3	8.2	8.1	8.1
Total	9.8	9.7	9.7	9.6	9.6	9.5	9.5	9.5	9.4	9.4	9.3	9.3	9.2	9.2

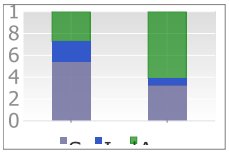
Data source: DataM - WB World development indicators

The performance of the labour market remained modest with employment growing at 5.9% to an estimated 14.3 million jobs in 2014. The informal sector, which constituted 82.7% of the employment, created 693.4 thousand new jobs in 2014 (Kenya National Bureau of Statistics, 2015a).

The majority of Kenyan workers are involved in the agriculture sector. In 2005, Kenya showed an important imbalance between workforce and GDP contribution by sector: a large 61% of the workforce involved in the agriculture sector contributed to only 27% of the GDP (World Bank). On the other hand, 32% of the employees in the services sector accounted for approximately 54% of the GDP (Figure 9).

The share of population employed in agriculture has been estimated by different institutions with different results. The World Bank estimated that in 2005 61.1% of labour force was employed in agriculture while, according to International Labour Office (ILO), out of 11.85 million of labour force, 75% is in agriculture. Also, KNBS estimated from their last KIHBS (2005/2006) that agriculture provided employment to an estimated 70% of the labour force.

Figure 23 Workforce and GDP contribution by sector (2005)



Data source: DataM - WB World development indicators

2.1.2 Government Indicators

Kenya public spending has not recorded significant fluctuations since 2000 (Table 7). The share of the education expenditure in the economy increased from 5.2% of GDP in the 2000 to 7.0% in 2006 and then declined to 5.5% in 2010. Despite the contraction in 2010, Kenya's public spending on education was still notable especially if compared with other Sub-Saharan countries (World Bank). A slight growth was registered in public spending on Information and Communication Technology (ICT). The share of ICT expenditure increased from 5.4% in 2003 to 5.8% of GDP in 2009, according to the World Bank. At the same time, health expenditure as share of GDP has declined gradually from 2.2% in 2000 to 1.9% in 2013, while the ratio of military spending to GDP firstly increased and then decreased to 1.3% in 2013, registering the same value than in 2000 (Table 7).

Table 13. Public expenditure as percentage of GDP

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Education	5.2	5.2	6.2	6.5	6.8	7.3	7.0				5.5				
ICT				5.4	5.5	5.8	5.2	5.5	5.8	5.8					
Health	2.2	2.1	1.9	1.9	1.8	1.8	1.9	1.9	1.7	2.0	1.7	1.7	1.8	1.9	
Military	1.3	1.5	1.6	1.7	1.6	1.7	1.5	1.5	1.6	1.6	1.6	1.5	1.7	1.6	1.3
Research & Development								0.4			1.0				

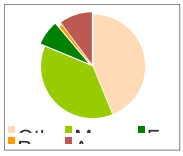
Data source: DataM - WB World development indicators

2.2 Agricultural Indicators

Agriculture is the major driver of Kenya's economy and central to the Government development strategy. The majority of the workforce in Kenya engages in agriculture, which accounts for more than a fourth of Kenya's GDP (Figure 9).

Although agriculture represents a vital economic activity for the country, less than 12% of the land area is used for cultivation. Forest area accounts for 7.5%, meadows and pastures for roughly 37% and the rest of the land (around 44%) is not devoted to agriculture (FAO – Aquastat and land) (Figure 10).

Figure 24. Land use composition (1000 ha) in 2013



Data source: FAO - Aquastat and land

Agriculture is mainly rain-fed, only 12% is indeed equipped for irrigation, representing less than 2.4% of annual and permanent cropland. Despite it might seem a small number, the efforts the Government put in irrigation development are conspicuous and as a result the area equipped for irrigation almost doubled from 2000 to 2013 (FAO – Aquastat and land) (Table 8).

Table 14. Evolution of irrigated agriculture (1000 ha)

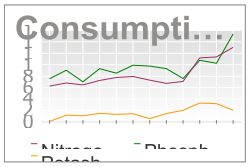
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Annual and permanent cropland	5371	5539	5518	5574	5692	5702	5754	5770	5785	5985	6020	6330	6430	6330
Area equipped for irrigation	85	87	90	103	103	115	125	130	135	145	150	150	150	150
Area irrigated		12	7	30	11	11	12.5	9.6	9.1	10.1				
Share of irrigated land	*0.0%*	*0.2%*	*0.1%*	*0.5%*	*0.2%*	*0.2%*	*0.2%*	*0.2%*	*0.2%*	*0.2%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*

Data source: FAO - Aquastat and land

An impressive growth was also experienced by fertilizer use that doubled between 2002 and 2013. The national consumption has followed a steady growth path since 2002, increasing from 27.3 to 52.5 kg per hectare of arable land (World Bank).

This figure on fertilizer use includes nitrogenous, potash, and phosphate as fertilizers. When analysing the trend of each of the major fertilizer product, heterogeneous tendency shows up (Figure 11). Nitrogen and phosphate fertilizers' consumption followed an increasing trend from 2002 to 2013 but with drop in 2007-2009 and a notable boost since 2010. On the other hand, the use of potash fertilizer followed an irregular trend: first augmented from 2002 to 2007, then decreased in 2008 and then increased again to 2011 and finally declined (Figure 11). The reduction of fertilizer's consumption in 2007-2010 could probably be attributed to the escalation in the world prices of fertilizers since 2007. The rise of their use after 2009 is mainly due to the considerable amounts of fertilizer the Government of Kenya imported to be distributed to vulnerable farmers.

Figure 25. Trend on consumption of fertilizers



Data source: FAOSTAT

Agriculture plays a vital role in the Kenyan economy also as a source of employment. Agriculture represents the main employment activities for women. According to last figures (2005), approximately 70% of women were engaged in agriculture (as share of female employment). In comparison with women, fewer men are involved in the sector being 54% the share of men employed in agriculture (as share of male employment) (World Bank WDI).

Agriculture is also the largest contributor to Kenya's GDP. According to World Bank WDI, the agriculture value added for 2014 accounted for about 30% of GDP, showing an improvement over the 2005 value of 27% (Table 9). This positive trend may be mainly related to the increasing Government expenditure in the sector. In 2011, Kenya's Government invested in agriculture US$336 million, 75 million more than in 2010 (FAOSTAT).

The important contribution of the sector to the national GDP is even more evident if comparing it with other major sectors like manufacturing, industry and services. Moreover, agriculture's contribution to GDP is the only one increasing over time: it augmented considerably to 30.3% in 2014 from 27.8% in 2010 (Table 9).

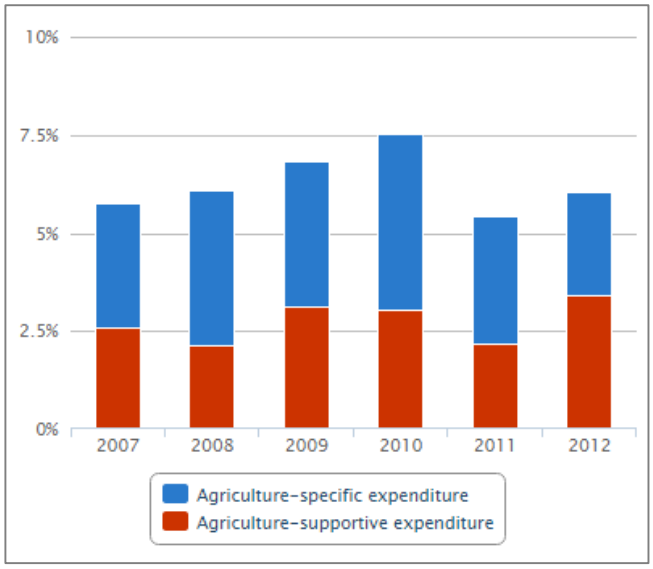
Table 15. Contribution to GDP of Kenya for selected sectors (%)

	2010	2011	2012	2013	2014
Agriculture	27.8	29.3	29.1	29.4	30.3
Industry	20.8	21.0	20.7	20.1	19.4
Manufacturing	12.6	13.1	12.3	11.9	11.1
Services	51.4	49.7	50.2	50.5	50.4

Data source: DataM - WB World development indicators

Despite agriculture represents one of the main contributors to the national GDP and its development one of the main objectives of the "Kenya Vision 2030", in the last 10 years the Government has always allocated public expenditures below the Maputo target of 10% (Figure 12).

Figure 26. Share of expenditure allocated to the food and agriculture sector



Data source: FAO - MAFAP

Although the reduced budget allocation in the sector in 2011 and 2012, the agricultural production increased in the same years (Table 10). Nevertheless, in 2013 food production in terms of thousands of tons marginally decreased compared to 2012. The food items that decreased the most were the major staple foods; in particular roots and tubers (that kept on declining in 2014), followed by cereals and milk.

Table 16. Trend of agricultural production (1000T)

	2000	2002	2004	2006	2008	2010	2012	2013	2014	Share 2013
Total	**11,791**	**13,609**	**14,425**	**17,940**	**17,963**	**20,364**	**21,167**	**20,636**		100%
Milk	2,709	3,250	3,915	4,184	4,229	4,822	4,967	4,944		24%
Roots and Tubers	1,643	1,996	2,328	3,827	4,574	3,897	4,734	3,890	3,268	19%
Cereals	2,591	3,046	3,199	3,937	2,866	4,347	4,712	4,537	4,345	22%
Fruits, excl. melons	2,388	2,515	2,493	2,654	3,366	3,473	3,067	3,163		15%
Vegetables and Melons	1,558	1,634	1,509	1,956	1,839	2,527	2,106	2,390		12%
Pulses	478	671	440	747	417	594	936	1,047	1,055	5%
Beef and Buffalo Meat	257	319	350	430	458	464	411	425		2%
Eggs Primary	61	50	60	67	77	93	96	98		0.5%
Sheep and Goat Meat	65	78	76	80	84	88	81	84		0.4%
Other	902	1,168	982	1,381	1,088	1,298	1,580	1,712		8%

Data source: FAO - FAOSTAT

The major agricultural items produced in the country include milk, sugarcane, cattle meat, roots and tubers, fruits and vegetables, tea and maize. In 2013, the top five agricultural products, in terms of production quantity (1000T) were sugar cane, roots and tubers, cow milk and maize. When considering the value of production (current million USD) the top five agricultural products in the same year were cow milk, maize, tea, cattle meat and camel milk (FAOSTAT) (Table 11).

Table 17. Key food and agricultural commodities production (2013)

Rank	Commodity	Production (1000 T)
1	Sugar cane	6674
2	Roots and Tubers	3890
3	Cow milk	3750
4	Maize	3593
5	Fruits	2857
6	Vegetables and Melons	2390
7	Potatoes	2193
8	Bananas	1398
9	Pulses	1047
10	Camel milk	937

Data source: FAO - FAOSTAT

More than one-half of Kenya's exports are composed of agrifood commodities (Figure 13). In 2013, the export of agricultural and fishery products accounted for € 2.3 billion, showing a significant improvement from € 1.8 billion in 2008 (10). Overall, the value of the main agricultural and fishery products export (except tobacco) increased over the same period.

Table 18. Key exports of agricultural and fishery products in value (1000 EUR)

Commodity	2008	2009	2010	2013
Agricultural and fish products	1,854,572	1,820,400	2,244,285	2,353,943
Tea	633,404	640,949	877,736	917,209
Coffee	103,885	144,280	156,499	143,666
Leguminous vegetables	33,666	29,623	56,601	95,404
Dried leguminous vegetables	9,012	2,139	26,271	40,971
Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens	16,148	20,687	24,082	32,700
Unmanufactured tobacco; tobacco refuse	31,430	35,933	22,782	28,426
Ginger, saffron, curcuma, curry and other spices	4,108	3,534	2,798	8,481
Milk and cream	3,428	4,625	5,670	6,386
Seeds, fruit and spores	3,129	4,846	5,477	6,160

Data source: UN - COMTRADE

The key crops exports include tea, coffee, leguminous vegetables and tropical fruits. Tea is the leading export commodity in Kenya and in 2013 contributed to € 917 million, generating 39% of the agricultural and fishery products export earnings (UN – COMTRADE) (Figure 13). Coffee exports account approximately 6% of the agricultural exports and the value of the exports slightly increased since 2008. On the other hand, leguminous vegetables (fresh and dried) exports have increased substantially in five years, from about € 42 million in 2008 to more than € 135 million in 2013 (Figure 13). Among all the agricultural products, Kenya mainly exports tea and coffee; the former does not represent a top product (in quantity) and the latter not even in the top ten lists.

Figure 27. Top five agricultural and fishery products exports and imports in 2013 (excl. cut flower)

Data source: UN – COMTRADE

Kenya mainly imports non-food products. Cereals and animal or vegetal fats and oils account for nearly 10% of imports (Table 13). In 2013, the value of agricultural and fish products imports was € 1.43 billion, of which € 182 million of cereals (Table 13). The cereals most imported were wheat and rice that were valued at € 300 million in 2013, or nearly 22% of all the agricultural and fish products imports (Table 13). Other key crops imports include tobacco, cotton and dried leguminous vegetables, together accounting for approximately 11% of agricultural and fish products imports.

Overall, the value of the major crops imports increased in the five years' time range. Cotton and maize are the exceptions as their value significantly decreased by 24% and 70%, respectively, the over the same period. The value of many products imports doubled in five years, including rice imports that increased from € 58 million in 2008 to € 123 million in 2013. The request for sorghum and tea boosted and the imports of the commodity increased from € 606 thousands and € 2.9 million in 2008 to € 25 and 14 million in 2013, respectively (Table 13).

Table 19. Key imports of agricultural and fishery products in value (1000 EUR)

Commodity	2008	2009	2010	2013
Agricultural and fish products	912,277	1,154,787	1,127,469	1,433,017
Wheat and meslin	136,865	128,516	165,712	192,945
Rice	58,774	68,989	75,673	123,371
Unmanufactured tobacco; tobacco refuse	38,626	26,656	46,342	70,682
Cotton	66,438	43,017	50,774	50,481
Dried leguminous vegetables	12,694	28,117	22,011	25,902
Sorghum	606	17,485	2,209	25,180
Maize	65,450	315,193	52,023	20,027
Tea, whether or not flavoured	2,965	3,255	13,019	14,445
Other oil seeds and oleaginous fruits	5,317	5,586	4,835	10,603

Data source: UN – COMTRADE

2.3 Food and nutrition security

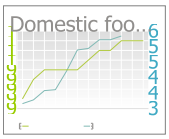
Recently, Kenya has been facing severe food security issues due to several factors including high global food prices, high poverty, frequent droughts and high costs of food production. As a consequence, a relevant proportion of the population have no access to an adequate amount of safe and nutritious food.

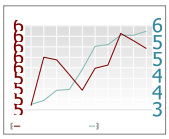
Sharply rising prices are of concern to the poorest sections of the population, particularly when net food buyers, that normally spend a large part of their household income on the purchase of food. The consequence of the surge in the price of food indeed could have turned into an increase number of poor in the population and/or a worsening of their conditions through increased hunger and malnutrition (Heady & Fan, 2008).

Poverty in Kenya is a major driver of food insecurity and contributes to a negative impact on food access. About a half (47%) of the population live below the national poverty line; they persistently live at the same level since decades (World Bank WDI). The inequality in the country is one of the highest in Africa: the World Bank estimates that 62% of the country's wealth is controlled by only 8,000 people in a country whose population is over 40 million (Beegle, Christiaensen, Dabalen, & Gaddis, 2016). One of the root causes of the high poverty rate relates to the high food prices. Kenya's domestic food price index (an indicator of the relative price of food in a country) increased indeed of 2 points in ten years: from 3.7 in 2004 to 5.8 in 2013 (FAO Food security). Despite

such adverse statistics, the intakes of energy and proteins in the country's population (globally) kept on growing over the same period (FAO Food security) (Figure 14). This figure is at macro level and it does not take into account the social inequities.

Figure 28. Comparison between the domestic food price index and energy and protein supply indicators



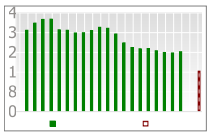


Data source: DataM – FAO Food security

Data source: DataM – FAO – Food Security

On the other hand, according to the 2015 Food Balance Sheet (FBS) (Kenya National Bureau of Statistics - Annex 2) the population diet lacks diversification as the consumption of some food groups (especially vegetables rich in carbohydrates) is predominant. Population diet is mainly based on the consumption of cereals, milk, starchy roots, fruits, vegetables and pulses. The energy intake is mainly attributed to consumption of cereals followed by pulses that account for 43.3% and 11.3% of the calories intake. Cereals and pulses are also the main sources of proteins, representing 36.4% and 24.2% of protein intake.
Overall, vegetable foods are the base of the population diet and accounts for 88.6% and 63.6% of the energy and fat supply, while animal products account for 25.8% of the protein intake, meaning that vegetable products are also the main source of proteins.
Undernutrition is still widespread among the population and even though the prevalence of undernourishment dropped by 26% from 1991 to 2013, more efforts are needed to achieve the target of halving it, as foreseen by the MDGs (Figure 15) (see also sub-chapter 2.4.4).

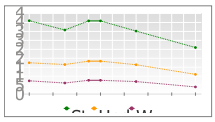
Figure 29. Prevalence of undernourishment in population and MDG target



Data source: DataM – WB - World development indicators

Similarly, the prevalence of undernutrition among children under five has decreased over the same period and in particular since 2000 (Figure 16). Stunting, underweight and wasting, the three forms of growth failure have been decreasing almost constantly since 2000. The percentage of stunting (height-for-age) among children aged 0-5 years is the indicators that declined the most if considering the number of people, from 41% in 2000 to 26% in 2014. The percentage of children aged 0-5 years underweight (weight-for-age) decreased of approximately 40% over the same period: from 18% to 11%. In 2014, the percentage of children under 5 years of age affected by wasting (weight-for-height) in Kenya is 4%, having decreased from 7% in 2000 (FAO Food security) (Figure 16).

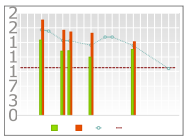
Figure 30. Prevalence of malnutrition among children under 5



Data source: DataM – FAO Food security

As a result of this positive trend in the reduction of malnutrition, Kenya achieved the Millennium Development Goals (MDGs) target of halving the prevalence of underweight children under-five years of age by 2015 (Figure 17).

Figure 31. Underweight prevalence of children under five



Data source: DataM – WB - World development indicators

Reduced malnutrition also positively affected the Global Hunger Index (GHI). The index prepared by the International Food Policy Research Institute (IFPRI) focuses on four indicators: undernourishment, prevalence of wasting, stunting and mortality rate in children under five. The 2015 GHI score for Kenya was 24, showing an improvement over the 2005 value of 36.6. Nevertheless, Kenya ranks poorly and hunger in the country is still considered serious (von Grebmer, et al., 2015). The situation is not better in the other EAC countries. Indeed, even though all of them improved their GHI score over the 10 years range, they rank worse than Kenya (for Burundi no data available) (Table 14).

Table 20. 2015 Global Hunger Index of EAC countries

	2005	2015
Kenya	36.6	24.0
Rwanda	44.5	30.3
Tanzania	36.4	28.7
Uganda	32.2	27.6

Data source: IFPRI - GHI

The enhancement of the food utilization conditions is also attributable to an improvement of the access to sanitation facilities and water sources. However, World Bank data show that in Kenya there are big rural and urban disparities in the access to improved water sources. Rural population experienced an important progress in the access to improved water sources in the past 15 years, from 43% in 2000 to 57% in 2015. On the other hand, urban population experienced a decline in the access to improved water sources, from 88% to 82% (World Bank WDI) (Figure 18). Even though the access to improved water sources increased considerably in rural areas, to date nearly 43% of rural population still have not access and Government investments in improving it are indispensable.

Concerning access to improved sanitation facilities, data show a slight growth from 2000 to 2015. The proportion of rural and urban population having access to improved sanitation facilities increased from 26.5% and 28.5% respectively in 2000 to 29.7% and 31.2% in 2015 (World Bank WDI) (Figure 18). Also in this area more investments in the improvement of sanitation facilities would largely improve people access to them.

Figure 32. Proportion of the rural and urban population using improved sanitation facilities and water sources

Data source: DataM - WB World development indicators

Investments are also essential in the urban and rural transport infrastructure, as proper roads are pivotal to guarantee access to markets. In Kenya, rural roads in some areas are missing or not adequate hindering the access of people to markets and not allowing farmers to bring their products to the urban areas to be sold. Road and rail infrastructure in Kenya are really poor, especially if compared with the average of all developing countries (Table 15). Road and rail density are approximately the half of developing countries data and the prevalence of paved road slightly more than a third. The improvement of these infrastructures over time seems not to take place. On the contrary, both road and rail density marginally decreased in the 2009-2010 period.

Table 21. Road and rail infrastructure in Kenya and in developing countries (per 100 Km^2 of land area)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Paved roads over total (%)	12.0	14.0	14.1	14.3	14.1	14.4	14.4	14.6	14.6	14.3	14.3	
Road density	11.0	10.9	10.9	10.9	10.9	11.0	11.0	11.0	11.0	10.7	10.7	
Rail-lines density	0.5	0.5	0.5		0.5	0.3	0.3					
Developing Countries												
Paved roads over total (%)							40.1		42.8	45.1	46.2	46.8
Road density	16.1	18.4	18.6	18.9	18.9	19.0	19.3	19.7	20.0	20.2	20.4	
Rail-lines density							0.6		0.6			

Data Source: FAO - Food security

2.4 Social indicators, Millennium Development Goals and Food and Nutrition security situation

2.4.1 Human development index and inequality

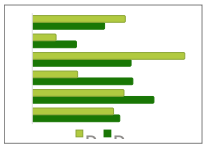
Although Kenya is considered one of the most advanced economies in the African continent, the Human Development Index (HDI) of the United Nations Development Programme (UNDP) of 0.548 ranked Kenya 145 out of 188 countries. Kenya is listed among "low human development" countries. Nevertheless, Kenya's HDI has increased

marginally in last five years, from 0.529 in 2010 to 0.548 in 2014, but consistently over the 2000 value of 0.447. However, if considering the inequality-adjusted HDI (taking into account inequality in all HDI dimensions) the 2014 HDI falls to 0.377 due to inequality in the HDI dimensions. Inequality is also assessed by the country's income distribution, through the Gini index. World Bank last estimated Gini index of Kenya at 48.51 in 2005, reflecting a high inequality in the distribution of family income.

2.4.2 Health

Spending in health is very low in Kenya. In 2013, only 4.5% of the GDP was spent on health, the lowest share in EAC. Private share of the healthcare spending accounted for 2.6% and the public one for 1.9, indicating a private sector involvement in funding and providing health services in Kenya (World Bank – World Development Indicators WDI) (Figure 19). In EAC countries health expenditure as percentage of GDP increased over time, from 5.2% in 2000 to 8.1% in 2013, whereas in Kenya it slightly decreased, from 4.7% in 2000 to 4.5% in 2013 (World Bank WDI).

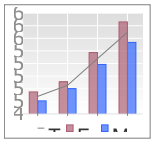
Figure 33. Public and private health expenditure as % of GDP in Kenya and the other EAC countries (2013)



Data source: DataM - WB World development indicators

According to the latest World Bank (2013), life expectancy at birth in Kenya was 59.4 years for men and 62.6 years for women with an average life expectancy of 61 years. The life expectancy of Kenyans has increased by more than 10 years between 2000 and 2013 and the gap between women and men life expectancy has widened in favour of women (World Bank WDI) (Figure 20).

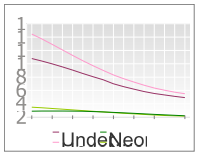
Figure 34. Life expectancy at birth



Data source: DataM - WB World development indicators

Neonatal and under-five mortality rate have been decreasing since 2000 in Kenya as well as in EAC countries (Figure 21). Neonatal mortality rate in Kenya slightly declined, from 29‰ in 2000 to 23‰ in 2014. On the other hand, under-five mortality rate was reduced by more than one half, with a fall from 108‰ in 2000 to 51‰ in 2014 (World Bank WDI). According to the State of The World's Children 2015 (UNICEF, 2015), the Under-Five Mortality Rank of Kenya is 33 (out of 194 countries) in descending trend from 37 in 2003. One of the reasons of the drop of those deaths is that childhood vaccination coverage against major infections in Kenya rises consistently in one decade. Except for tuberculosis, the country experienced a rise in the proportion of infants vaccinated against polio, measles, Hepatitis B and DPT3 from 67%, 72%, 73% and 73% respectively in 2003 to 82%, 93%, 83% and 76% in 2013 (UNICEF, 2015).

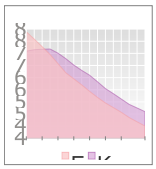
Figure 35. Neonatal and under-5 mortality rate



Data source: DataM - WB World development indicators

Maternal mortality rate has fallen considerably in Kenya and EAC countries during last 15 years, from 759 and 839 deaths per 100,000 live births respectively in 2000 to 510 and 468 deaths per 100,000 live births in 2015 (modelled estimate – World Bank WDI) (Figure 22). One of the reasons behind this reduction is linked to the rise of the births attended by skilled health staff, from 42% in 2005 to 44% in 2013 (UNICEF, 2015). However, this figure hides socio-economic inequities based on families' wealth: 81% of women of richest 20% households and only 20% of poorest 20% households received skilled birth attendance in 2013 (UNICEF, 2015).

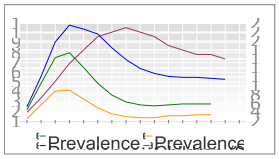
Figure 36. Maternal mortality ratio



Data source: DataM - WB World development indicators

The prevalence of HIV/AIDS in Kenya is alarming and represents a prominent health concern: 6% of people aged 15-49 were infected with HIV in 2013, being 2.2% of young people (15-24 years). Rates of infection amongst young women are higher than those of men (2.7% to 1.7% in 2013), reflecting the vulnerability of women to HIV infection (UNICEF, 2015). The spread of HIV/AIDS reached the peak in 1996 and then the upward trend reversed and stabilized in 2006-2008 (World Bank WDI) (Figure 23). The number of children infected with HIV in Kenya followed a similar trend than the rate of infection, but it reached the top in 2004 and came down less sharply. The consequences of HIV/AIDS are devastating for children. In addition to their own infection with HIV, they are also affected by their parents' infection or death. In 2013, there were 1,100,000 AIDS orphans in Kenya, out of a 2,500,000 children orphaned to all causes (UNICEF, 2015).

Figure 37. Prevalence of HIV/AIDS in the population



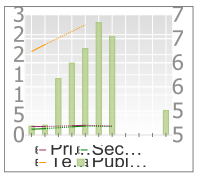
Data source: DataM - WB World development indicators

2.4.3 Education

In Kenya, the trend in education spending as a percentage of GDP had increased in the first five years of 2000, but after 2005 it fell consistently. The country experienced a considerable rise from 2000, when government expenditure on education was 5.2%, reaching the peak at 7.3% in 2005. Afterwards, Kenya has reduced spending on education as a percentage of GDP to 5.5% (World Bank WDI) (Figure 24).

According to the World Bank, public spending on education per student in primary and secondary as a percentage of GDP per capita was at 22.37% and 21.17% in 2006. Government expenditure per pupil in primary did not varied consistently, from 21.4% in 2000 to 22.4% in 2006; on the other hand, government expenditure per pupil in secondary increased from 14% in 2000 to 21% in 2006 (World Bank WDI). The highest public spending on education relative to GDP per capita was observed in tertiary education where expenditure per student was 274% of GDP per capita in 2004 (World Bank WDI) (Figure 24).

Figure 38. Government expenditure on education per student (primary, secondary, tertiary) and total as % of GDP



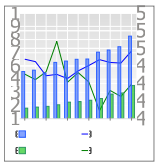
Data source: DataM - WB World development indicators

Kenya has been experiencing an increase in the school enrolment both in primary and secondary education since 2000 (Figure 25). Pupils enrolled in primary education raised from 5 million in 2000 to 8.1 million in 2012 and in secondary education it doubled, from 1.9 million in 2000 to 3.8 million in 2012 (World Bank WDI). In 2012, the net school enrolment in primary and secondary school in Kenya was 83.6% and 56%, higher than those registered in 2000, when net school enrolment was 65.4% and 33.3%. Female enrolment shows a positive trend in primary education and a negative one in secondary education. Females show slightly lower enrolment than males in primary school (49.8%) and the relationship between male and female enrolment marginally widens in secondary education, being 52% of male students and 48% female. This trend reflects a gender bias in accessing higher grade of education. A higher social disparity in education access is evident if considering wealth quintile.

The greatest disparity exists among the poorest and richest households in Kenya with primary school net attendance ratio being 71.8% and 95.8% for the poorest 20% and richest 20% (UNICEF, 2015).

The high enrolment ratio in primary school in Kenya partially explains the high literacy rate in the country. In Kenya the ratio of people able to read and write was 72.2% in 2013, being one of the highest adult literacy rates of the sub-Saharan region where the average is 62% (UNESCO).

Figure 39. School enrolment



Data source: DataM - WB World development indicators

2.4.4 Millennium Development Goals

Despite the significant achievements on many of the MDG targets, Kenya seems not able to reach most of them by 2015. A general picture cannot be provided as a number of targets were last measured more than five years ago. Nonetheless, comments can be drawn for the majority of the targets, being data collected in recent years (Table 16).

MDG 1: Eradication of Extreme Poverty and Hunger

The first target of MDGs is far from being achieved. In Kenya, the percentage of population earning below $1.90 per day has increased from 23.1% in 1992 to 33.6% in 2005 instead of being halved.

The employment-to-population ratio for males (15+) was 67% while that of females (15+) was 56% in 2014 which are well below the MDG target of 100% by 2015. Moreover, since 1990 the country has been experiencing a downward trend that is even more pronounced if considering young people figures (15-24 years).

On the other side, Kenya has made important progress in reducing children underweight, achieving the target of halving the underweight prevalence of children under-five years of age. Although not met yet the target, progress is on track in the reduction of malnutrition prevalence in the population: the percentage of undernourishment in Kenya has fallen from 33% in 1991 to 24.3% in 2013, a decline of more than 25%.

MDG 2: Achieve Universal Primary Education

Kenya is rapidly moving towards universal primary education. Since 1998, Kenya has been showing accelerated progress in the net enrolment rate of around 50% of primary school age pupils.

Few data on the primary completion rate are available and according to them pupils starting grade 1 who reach grade 5 was 91%in 2005.

The literacy rate of people aged 15-24 was 93% in 2010. Kenya experienced a drop in youth literacy rates, from 93% to 82% between 2000 and 2007, and then a recovery to the starting value of 93%.

MDG 3: Promote Gender Equality and Empower Women

Kenya has reached gender parity in primary education with the ratio of female to male enrolment reaching 100% in 2012. Notable progress has been done for the enrolment of female in tertiary education, from 54% in 2000 to 70% in 2009. Notwithstanding, secondary education did not show remarkable variation over the same period and recorded a value of 93% in 2012.

The share of women in wage employment in the non-agricultural sector has considerably increased, from 21% in 1990 to 36% in 2013, showing a variation greater than 70%.

The proportion of seats held by women in the national Parliament impressively increased, from 1% in 1990 to 20% in 2015.

MDG 4: Reduce Child Mortality

Kenya has not reached the target of reducing by two third the under-five mortality rate, but impressive progress has been made over 25 years, from 10.2 deaths per 100 live births in 1990 to 4.9 in 2015.

The infant mortality rate also decreased enormously, being almost halved, from 6.6 deaths per 100 live births in 1990 to 3.6 in 2015.

Kenya experienced significant fluctuations in the immunization against measles over the 25 years to 2015, where the proportion of one-year-old children immunized was 78% in 1990, 90% in 1998, 73% in 2004, again 90% in 2008 and back to 79% in 2015.

MDG 5: Improve Maternal Health

The maternal mortality ratio (modelled estimate) declined from 687 deaths per 100,000 live births in 1990 to 510 in 2015, very far from the MDG target of 172 deaths per 100,000 in 2015.

The proportion of births attended by skilled birth attendants has not revealed any improvement over the years, being equal to 44% in 2009, same value than 1998.

MDG 6: Combat HIV/AIDS, Malaria and Other Diseases

Kenya has made important progress in reversing the trend and prevalence of HIV/AIDS. Nevertheless, reducing the spread of HIV in young people (15-24 years) remains challenging. The prevalence of HIV/AIDS reached the peak in 1996, when nearly 11% of the population (15-49 years) was infected and since then the trend has reversed sharply back and in 2011 stabilized at around 5.5%.

Outstanding progress has also been made in the proportion of population with advanced HIV infection with access to antiretroviral drugs: from 2% in 2004 to 55% in 2014.

A downward trend is observed in the incidence of tuberculosis, but only since 2004.

MDG 7: Ensure Environmental Sustainability

Forest cover in Kenya has fallen from 8.3% of land area in 1990 to 6.2% in 2000 and since then has increased to reach 7.6% in 2013

Carbon dioxide emissions increased impressively in eleven years, from 5,800 kt in 1990 to 13,500 kt in 2011. Methane and nitrogen dioxide emissions also increased but only marginally.

Kenya has not increased the proportion of terrestrial and marine areas protected in the country, being stable at 12% since 1990.

Although the target of halving the population without access to improved water sources has not been met, prominent progress has been made at the national level, from 57.2% in 1990 to 36.8% in 2015. Access to an improved sanitation facility is still a big challenge in the country and the ratio of population without access to improved sanitation facilities was still 70% in 2015. Nonetheless, the prevalence rate gradually decreases since 1990, showing a marginal drop of 7%, from 75.4% in 1990 to 69.9% in 2015.

MDG 8: Develop a Global Partnership for Development

ODA flows received as a percentage of Kenya's gross national income (GNI) fell from 14% in 1990 to 6% in 2013.

Kenya's debt services as percentage of exports has dropped consistently, from 35.4% in 1990 to 4.4% in 2010 and since then it has reversed and increased sharply to 11% in 2014.

Kenya experienced notable progress on technology indicators. Internet users were 43.4% in 2014, having impressively increased from 0.3% in 2000. Similarly, the number of Internet users has grown even much faster over the same period, from 0.4% to 73.8%.

Table 22. Overview of MDGs targets (whose data are in DataM)

Goal	Target	Indicator	Value	Target	Year
MDG 1 Eradication of Extreme Poverty and Hunger	Target 1.A: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	Proportion of population below $1.25 (PPP) per day	47%	22.4%	2006
	Target 1.B: Achieve full and productive employment and decent work for all, including women and young people	Employment-to-population ratio	67% (Male 15+) 56% (Female 15+)	100%	2014
	Target 1.C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	Proportion of population below minimum level of dietary energy consumption	24.3%	16.5%	2013
		Prevalence of underweight children under-five years of age	11.0%*	11.2%	2014
MDG 2 Achieve	Target 2.A: Ensure that, by 2015, children	Net enrolment ratio in primary	85%	100%	2012

Universal Primary Education	everywhere, boys and girls alike, will be able to complete a full course of primary schooling	education			
		Proportion of pupils starting grade 1 who reach last grade of primary	91%	100%	2005
		Literacy rate of 15-24 year-olds, women and men	93%	100%	2010
MDG 3 Promote Gender Equality and Empower Women	Target 3.A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015	Ratios of girls to boys in primary, secondary and tertiary education	Primary 1.0% Secondary 0.93% Tertiary 0.7% (2009)	>0.97; <1.03	2012
		Share of women in wage employment in the non-agricultural sector	36%	>0.97%; <1.03%	2013
		Proportion of seats held by women in national parliament	20%	30%	2015
MDG 4 Reduce child mortality	Target 4.A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	Under-five mortality rate	4.9%	3%	2015
		Infant mortality rate	3.6%		2015
		Proportion of 1 year-old children immunised against measles	79%		2014
MDG 5 Improve Maternal Health	Target 5.A: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio	Maternal mortality ratio (estimate)	510	172	2015
		Proportion of births attended by skilled health personnel	44%		2009
	Target 5.B: Achieve, by 2015, universal access to reproductive health	Contraceptive prevalence rate	46%	100%	2009
		Adolescent birth rate	18		2009
		Antenatal care coverage (at least one visit)	92	100%	2009
MDG 6 Combat HIV/AIDS, Malaria and Other Diseases	Target 6.A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS	HIV prevalence among population (male and female aged 15-24 years and total aged	Female= 2.8% Male= 1.7% Total= 5.3%		2013 2013 2014

		15-49)			
	Target 6.B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it	Proportion of population with advanced HIV infection with access to antiretroviral drugs	55%	100%	2014
	Target 6.C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	Notified cases of malaria (per 100,000 people)	30,307		2008
		Use of insecticide-treated bed nets (under-5)	46.7%		2009
		Tuberculosis case detection rate	80%		2014
		Incidence of tuberculosis (per 100,000 people)	246		2014
MDG 7 Ensure Environmental Sustainability	Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	Proportion of land area covered by forest	7.6%		2013
		Consumption of ozone-depleting substances emissions	13,567.9 kt (CO2) 27,477.3 kt of CO2 eq. (Methane) 11.364,2 kt of CO2 eq. (NO2)		2011 2010 2010
	Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	Freshwater withdrawal as % of total actual renewable water resource	9%		2003
		Proportion of terrestrial and marine areas protected	12%		2012
		Proportion of species threatened with extinction	Bird 39 Fish 70 Mammal 30 Plant 222		2015
	Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	Population without access to improved water sources	36.8%	28.6%	2015
		Population without access to improved sanitation facilities	69.9%	37.7%	2015
MDG 8 Develop a Global Partnership for	Target 8.A: Develop further an open, rule-based, predictable, non-discriminatory	Net ODA received (% of imports of goods, services and	5.9%		2013

Development	trading and financial system Target 8.B: Address the special needs of the least developed countries Target 8.C: Address the special needs of landlocked developing countries and small island developing States (through the Programme of Action for the Sustainable Development of Small Island Developing States and the outcome of the twenty-second special session of the General Assembly) Target 8.D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term	primary income) Net ODA received (% GNI) Net bilateral aid flows from DAC donors, Total Total debt service (% GNI) Total debt service (% of exports of goods, services and primary income)	17% 2195.56 (current US$ millions) 2% (2014) 11% (2014)		
	Target 8.F: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications	Fixed-telephone subscriptions per 100 inhabitants	0.4		2014
		Mobile-cellular subscriptions per 100 inhabitants	73.8		2014
		Internet users per 100 inhabitants	43.4		2014

Annex 2: Food Balance Sheet 2014

Table A. 1: 2014 Food Balance sheet (population is 42,961,000)

Products	DOMESTIC SUPPLY (1000 MT)					DOMESTIC UTILIZATION (1000 MT)						PER CAPUT SUPPLY			
												PER YEAR FOOD	PER DAY		
	Prod.	Imports	Stock changes	Exports	Total D.S.	Feed	Seed	Processed	Waste	Oth.Util.	Food		Calories	Proteins	Fats
	1000 Metric Tons											Kg	units	grams	grams
Grand total													2257	66	44
Vegetable prod.													2000	49	28
Animal prod.													256	17	16
Cereals (excl. beer)	4394	2387	545	85	7240	113	80	355	618	0	5055	118	977	24	6
Starchy roots	3892	1	0	5	3888	0	104	2	311	0	3471	80.8	201	2	0
Sugar crops	6478	0	0	0	6478	0	0	4150	0	0	2328	54.2	42	0	0
Sugar & Sweeteners	572	179	-20	19	712	0	0	34	0	0	678	15.8	153	0	0
Pulses	874	7	433	1	1313	0	10	0	134	0	1168	27.2	255	16	1
Treenuts	33	0	0	6	27	0	0	0	1	0	23	0.5	4	0	0
Oilcrops	179	9	0	16	172	10	2	82	8	0	71	1.6	23	1	2
Vegetable oils	35	536	0	80	491	0	0	0	0	258	232	5.4	130	0	15
Vegetables	2214	115	0	228	2100	0	0	0	223	0	1948	45.3	27	1	0
Fruits	3530	57	0	252	3335	0	0	6	370	0	3034	70.6	113	1	1
Stimulants	495	5	5	500	4	0	0	0	0	0	10	0.2	0	0	0
Spices	256	3	0	3	256	0	0	0	0	0	256	6	55	2	3
Alcoholic beverages	553	7	0	2	558	0	0	0	0	0	557	13	19	0	0
Meat	435	1	0	8	428	0	0	0	0	0	530	12.3	64	5	5
Offals	76	0	0	0	76	0	0	0	0	0	76	1.8	5	1	0
Animal fats	17	4	0	1	20	0	0	13	0	3	4	0.1	2	0	0
Milk (excl butter)	4078	26	0	11	4093	17	0	347	327	0	4218	98.2	173	9	9
Eggs	71	0	0	0	71	0	5	0	11	0	56	1.3	4	0	0
Fish & sea food	175	37	0	23	189	0	0	0	0	0	192	4.5	8	1	0
Miscellaneous	18	7	2	14	13	0	0	7	0	3	3	0	1	0	0

Data source: Extracted by Kenya National Bureau of Statistics, 2015

Table A. 2: Estimated average relative nutritional coefficients of model commodities

	Calories	Protein	Fat
Wheat	2681	0.080	0.012
Maize	3132	0.083	0.034
Rice	3394	0.065	0.005
Other cereals	2653	0.064	0.023
Roots & tubers	947	0.019	0.000
Pulses & oil seeds	2682	0.086	0.231
Fruits	537	0.006	0.020
Vegetables	222	0.011	0.002
Beef	1887	0.145	0.139
Dairy	619	0.029	0.035
Poultry	1532	0.123	0.077
Sheep, goat and lamb for slaughter	1742	0.141	0.130
Other livestock	1500	0.143	0.098
Fishing	673	0.103	0.024
Sugar & bakery & confectionary	2681	0.080	0.012
Beverages & tobacco	413	0.004	0.000
Other manufactured food	1706	0.074	0.052

Annex 3: Kenya SAM data

Table A. 3: Kenya SAM 2014 activities and commodities

HPHC commodities	***Marketed commodities***	***Representative Households Groups as activities***	***Activities***
Maize	Maize	***Food***	Food crops
Wheat	Wheat	Nairobi	Cotton
Rice	Rice	Mombasa	Sugarcane
Other cereals	Other cereals	High Rainfall	Coffee
Roots and tubers	Roots and tubers	Semi-Arid North	Tea
Pulses and oil seeds	Pulses and oil seeds	Semi-Arid South	Tobacco
Fruits	Fruits	Coast	Others crops
Vegetables	Vegetables	Arid North	Livestock
Beef	Cotton	Arid South	Dairy
Dairy	Sugarcane	Turkana	Fishing
Poultry	Coffee		Mining
Sheep, goat…	Tea	***Cash crops***	Meat and dairy
Other livestock	Tobacco	High Rainfall	Grain milling
Fishing	Others crops	Semi-Arid North	Sugar and bakery…
Sugar and bakery…	Beef	Semi-Arid South	Beverages and tobacco
Beverages and tobacco	Dairy		Other manufactured food
Other manufactured food	Poultry		Textile and clothing
Water	Sheep, goat…		Leather and footwear
	Other livestock		Wood and paper
	Fishing		Printing and publishing
	Forestry		Petroleum
	Mining		Chemicals
	Meat and dairy		Fertilizers Nitrogen
	Grain milling		Fertilizers Phosphorus
	Sugar and bakery…		Fertilizers Potassium
	Beverages & tobacco		Metals and machines
	Other manufactured food		Non-metallic products
	Textile and clothing		Other manufactures
	Leather and footwear		Water
	Wood and paper		Electricity
	Printing and publishing		Construction
	Petroleum		Trade
	Chemicals		Hotels
	Fertilizers Nitrogen		Transport
	Fertilizers Phosphorus		Communication
	Fertilizers Potassium		Finance
	Metals and machines		Real estate
	Non-metallic products		Other services
	Other manufactures		Administration
	Water		Health
	Electricity		Education
	Construction		
	Trade		
	Hotels		
	Transport		
	Communication		
	Finance		
	Real estate		
	Other services		
	Administration		
	Health		
	Education		

Table A. 4a: Districts of Kenya by Agro Ecological Zones in Kenya SAM 2014

Nairobi	Mombasa	High Rainfall	High Rainfall	Semi-Arid North	Semi-Arid South	Coast	Arid North	Arid South	Turkana
Nairobi	Mombasa	Kiambu	Bondo	Nyeri	Taita Taveta	Kilifi	Isiolo	Tana River	Turkana
		Kirinyaga	Nyando	Mbeere	Kitui	Kwale	Marsabit	Garissa	
		Muranga	Bomet	Mwingi	Makueni	Lamu	Moyale		
		Nyandarua	Keiyo	Nyambene	Kajiado	Malindi	Mandera		
		Thika	Kericho	Tharaka	Narok		Wajir		
		Maragua	Koibatek	Laikipia	Trans Mara		Baringo		
		Embu	Marakwet	West Pokot			Samburu		
		Machakos	Nakuru						
		Meru Central	Nandi						
		Meru South	Trans Nzoia						
		Gucha	Uasin Gishu						
		Homa Bay	Buret						
		Kisii	Bungoma						
		Kisumu	Busia						
		Kuria	Mt. Elgon						
		Migori	Kakamega						
		Nyamira	Lugari						
		Rachuonyo	Teso						
		Siaya	Vihiga						
		Suba	Butere/Mumias						

Table A. 4b: Provinces (old) of Kenya by Agro Ecological Zones in Kenya SAM 2014

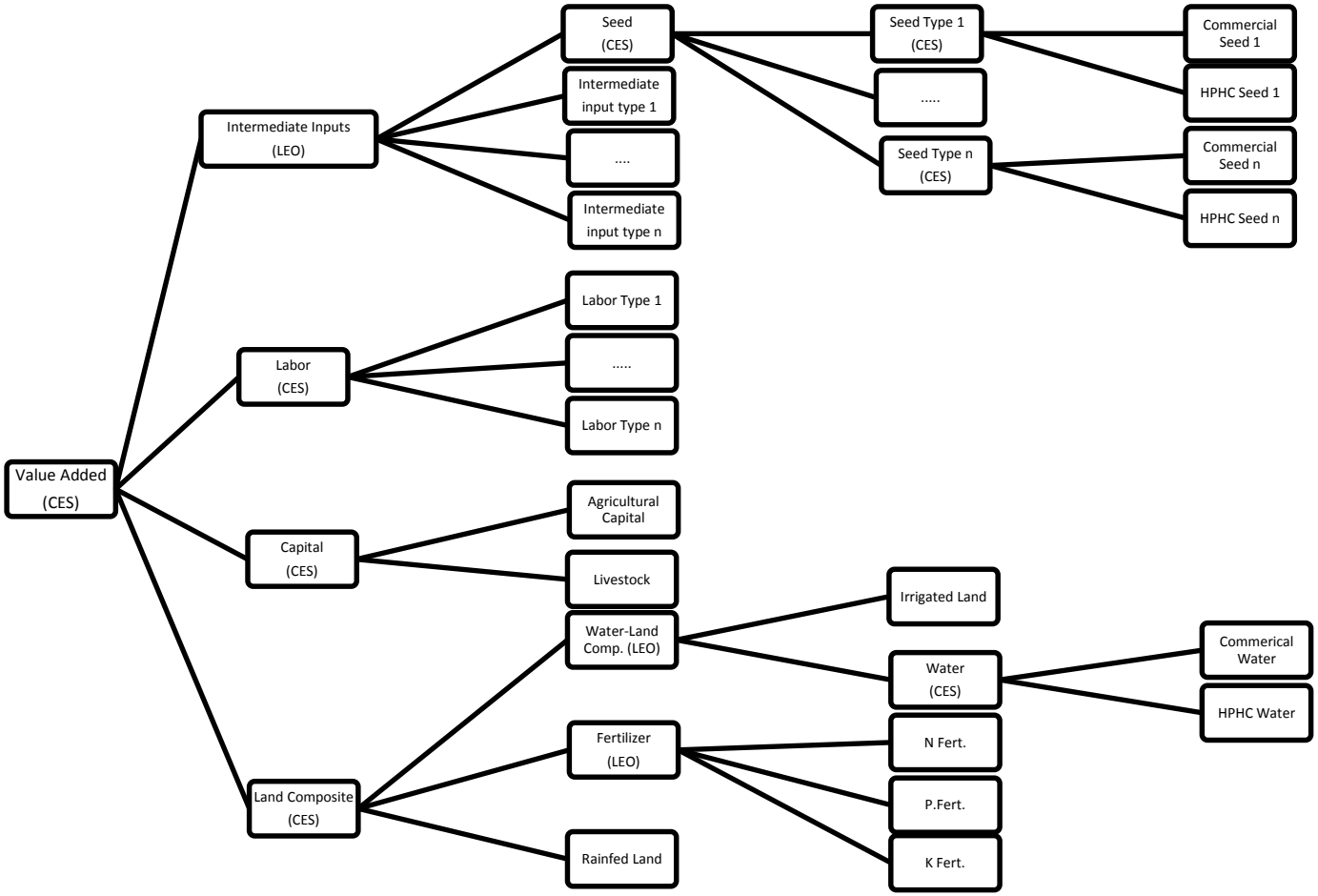
Nairobi	Mombasa	High Rainfall	High Rainfall	Semi-Arid North	Semi-Arid South	Coast	Arid North	Arid South	Turkana
Nairobi	Coast	Central	Rift Valley	Central	Coast	Coast	Eastern	Coast	Rift Valley
		Eastern	Western	Eastern	Eastern		North Eastern	North Eastern	
		Nyanza			Rift Valley	Rift Valley		Rift Valley	

Table A. 5: Kenya SAM 2014 (abbreviate version). Kshs '000 million

	ch	cm	m	ahf	ahc	a	flab	fland	flivst	fcap_ag	fcap_na	hh	enter	gov	dirtax	indtax	saltax	facttax	imptax	i_s	row	Total
HPHC commodities (ch)				150.7								161.1								0.9		313
Marketed commodities (cm)			292.5	293.9	50.1	3,158.5						4,162.0		750.4						1,144.2	954.0	10,806
Margins (m)		292.5																				292
Households as activities food (ahf)	312.7	1,045.8																				1,358
Households as activities cash-crops (ahc)		197.7																				198
Activities (a)		7,087.1																				7,087
Labour factor (flab)				92.7	14.6	1,545.9															15.9	1,669
Land factor (fland)				536.2	113.7	206.8																857
Livestock (flivst)				141.2		33.6																175
Capital agricultural (fcap_ag)				98.7	19.3	77.3																195
Capital non-agricultural (fcap_na)				45.1		1,912.3																1,957
Households (hh)							1,600.2	856.1	174.7	195.2	455.4		1,048.5	41.6							324.3	4,696
Enterprises (enter)								0.3			1,501.0			505.4								2,007
Government (gov)															554.0	152.7	207.0	7.9	160.7		25.7	1,108
Direct taxes (dirtax)												311.6	242.4									554
Indirect taxes (indtax)						152.7																153
Sales taxes (saltax)		207.0																				207
Factor taxes (facttax)							6.6	0.3	0.1	0.1	0.9											8
Imports taxes (imptax)		160.7																				161
Save/Investment (i_s)												51.3	715.8	-213.9							592.0	1,145
Rest of the World (row)		1,815					62					10		25								1,912
Total	313	10,806	292	1,358	198	7,087	1,669	857	175	195	1,957	4,696	2,007	1,108	554	153	207	8	161	1,145	1,912	

Annex 4: Production Structure of the Agricultural Sectors

Figure A. 1: Production Structure of the Agricultural Sectors



Annex 5: Food and Nutrition Security Working Glossary

The following terms are drawn from the EC-FAO Food Security Programme (EC-FAO, 2012).

Food and Nutrition Security

Food and nutrition security exists when all people, at all times, have physical, social and economic access to food which is consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life (Committee for World Food Security, July 2012).

1) Availability: The quantity of food that is physically present in the area of concern, through domestic production, commercial imports and food aid. This may be aggregated at the regional, national, district or community level. Food availability alone is not enough to ensure food security.

2) Access: The degree to which available food can be sourced through markets, own production, or other means. Households or individuals' ability to secure adequate resources for acquiring appropriate foods (in terms of macronutrients, micro nutrients and cultural acceptability) for a nutritious diet.

3) Utilization**:** Refers to (a) physical utilization of food at the household level (including food storage, food preferences, food preparation, feeding practices, and water requirements), and (b) biological utilization of food at the individual level (health, hygiene, nutrition, sanitation).

4) Stability**:** Refers to the continuity of availability, access and utilization over time. It is emphasized in the World Food Summit definition of food security by the phrase 'all people, at all times'. Major factors that affect stability include climatic uncertainties, uneven income earning opportunities, crop disease, etc.

Malnutrition

It refers to all deviations from adequate nutrition, including undernutrition and over-nutrition, resulting from inadequacy of food (or excess food) relative to need and or disease. Categories of malnutrition are as follows:

1. Acute Malnutrition (Wasting): Results in low weight in relation to height/length and/or the presence of oedema. It is often the result of a crisis or food emergency. The key indicator for acute malnutrition is the proportion of children under-five with weight less than two standard deviations below the median. In its most severe form (> 3 standard deviations) is known as wasting.

2. Chronic Malnutrition (Stunting): Food consumption is inadequate to support normal growth. It is due to chronic or temporary nutritional deficiencies during critical times (energy and/or micronutrients), and/ or it also can be the result of repeated exposure to infections or even to generally poor living conditions. It is often poverty related. It is reflected by growth retardation, meaning a height-for-age score below one, two or three Standard Deviations from the reference population (mild, moderate and severe stunting respectively).

3. Growth retardation (Underweight): A combination of stunting and wasting, this indicator measures the prevalence of children that have a low weight in relation to other

children of their age. The same metric, the Z-score and cut-points -1, -2 and -3 are used to define mild, moderate and severe underweight status are used.

4. Micronutrient Deficiencies: Inadequate intake of critical micronutrients (minerals and vitamins) as a result of poor diet or food utilization. Micronutrient deficiencies increase risks of infectious diseases and weaken immune systems.

5. Undernutrition: An aggregate measure of all forms of inadequate food intake at the population level, arising from the deficiency of one or more nutrients, including both macro and micronutrients. For children, undernutrition is assessed anthropometrically by measuring growth failure which encompasses stunting, wasting, and underweight, or combinations thereof. Among adults, undernutrition is measured by weight loss.

6. Overnutrition: Excessive consumption of macronutrients, resulting in excess body weight and/or poor physical and metabolic function. Obesity refers to an advanced form of overnutrition. Causes include dietary, economic, social and lifestyle related factors.

Cut-off points of malnutrition

Malnutrition is measured on the basis of SD or Z scores below the growth standards of the United States National Center for Health Statistics as published by the World Health Organization.
The WHO Global Database on Child Growth and Malnutrition uses a Z-score cut-off point of <-2 SD to classify low weight-for-age, low height-for-age and low weight-for-height as moderate and severe undernutrition, and <-3 SD to define severe undernutrition. The cut-off point of >+2 SD classifies high weight-for-height as overweight in children.

Since only 2.3% of the children in a well-nourished population are expected to fall below the cut-off, prevalence above that percentage suggests that there is a nutritional problem in the population assessed.

Annex 6: Additional Tables and Figures for Model Results

Table A. 6: Macroeconomic indicators, Fertilizer scenarios

	Base	Fertilizer	Subsidy	Protection	Market	Extension
	billion Ksh	*% change from base*	*% change from Fertilizer scenario*			
GDP	5197.01	0.1	0.00	-0.1	0.1	0.1
Total Domestic Demand	4323.16	0.1	0.0	-0.1	0.1	0.1
Total Government Consumption	750.40	0.3	0.1	0.2	-0.1	0.2
Total Investment	1145.10	0.4	0.0	0.0	0.2	0.0
Total Savings	1145.10	0.4	0.0	0.0	0.2	0.0
Household Savings	51.28	0.0	0.1	0.2	0.1	-0.1
Government Savings	-213.90	0.0	0.0	0.0	-0.9	0.0
Foreign Savings	591.96	0.8	-0.1	-0.2	0.1	0.2
Trade Deficit	1021.66	0.5	-0.1	0.0	0.1	0.2
Imports	1975.97	0.4	-0.1	-0.5	0.4	0.2
Exports	954.32	0.2	-0.2	-1.2	0.6	0.2
Household Income	4686.01	0.1	0.0	-0.1	0.1	0.1
Government Income	1083.48	0.2	0.0	0.1	0.0	0.1
Import Tax Revenue	160.67	0.2	0.0	1.7	0.1	0.1
Direct Tax Revenue	554.01	0.1	0.0	-0.1	0.0	0.1

Source: Model Results

Table A. 7: Production at sector level, Fertilizer scenarios

	Total Production						HPHC						Marketed					
	Base	Fer	Sub	Pro	Mar	Ext	Base	Fer	Sub	Pro	Mar	Ext	Base	Fer	Sub	Pro	Mar	Ext
	billion Ksh	*% change from base*	*% change from fertilizer scenario*				*billion Ksh*	*% change from base*	*% change from fertilizer scenario*				*billion Ksh*	*% change from base*	*% change from fertilizer scenario*			
Maize	256	0.4	-0.1	-0.4	1.0	1.0	50	0.4	-0.1	-0.4	0.5	1.0	206	0.4	-0.1	-0.4	1.1	1.0
Wheat	36	0.5	-0.1	-0.5	1.3	1.7	6	0.4	-0.2	-0.4	1.2	1.9	30	0.5	-0.1	-0.5	1.3	1.6
Rice	7	0.5	-0.1	-0.5	1.0	1.3	1	0.4	-0.1	-0.4	0.6	1.8	6	0.5	-0.1	-0.5	1.1	1.2
Oth. cereals	45	0.5	-0.1	-0.5	1.0	1.3	8	0.4	-0.1	-0.4	1.0	2.0	37	0.5	-0.1	-0.5	1.0	1.1
Roots & tub.	162	0.5	-0.1	-0.5	1.1	1.3	47	0.5	-0.2	-0.5	0.6	1.6	115	0.5	-0.1	-0.5	1.3	1.1
Pul. & oil seeds	159	0.5	-0.1	-0.5	1.0	1.1	39	0.5	-0.1	-0.5	0.7	1.5	120	0.5	-0.1	-0.5	1.1	1.0
Fruits	202	0.5	-0.1	-0.5	0.9	1.2	41	0.5	-0.2	-0.5	0.7	1.8	161	0.5	-0.1	-0.5	1.0	1.0
Vegetables	138	0.5	-0.1	-0.5	1.4	1.5	28	0.5	-0.2	-0.5	0.8	1.7	111	0.5	-0.1	-0.5	1.5	1.5
Total Food Staples	1005	0.5	-0.1	-0.5	1.1	1.2	219	0.5	-0.2	-0.5	0.7	1.5	785	0.5	-0.1	-0.5	1.2	1.1
Cotton	2	2.1	-0.5	-5.0	-1.6	2.9	0						2	2.1	-0.5	-5.0	-1.6	2.9
Sugarcane	34	2.7	-0.6	-6.4	-2.2	3.6	0						34	2.7	-0.6	-6.4	-2.2	3.6
Coffee	20	3.3	-0.6	-7.3	-2.1	3.6	0						20	3.3	-0.6	-7.3	-2.1	3.6
Tea	250	2.7	-0.6	-6.5	-2.3	3.7	0						250	2.7	-0.6	-6.5	-2.3	3.7
Tobacco	7	2.7	-0.6	-6.4	-1.9	3.4	0						7	2.7	-0.6	-6.4	-1.9	3.4
Others crops	15	0.6	0.1	-1.1	8.2	-0.2	0						15	0.6	0.1	-1.1	8.2	-0.2
Total Export Crops	328	2.7	-0.6	-6.3	-1.8	3.5	0						328	2.7	-0.6	-6.3	-1.8	3.5
Total Crop	**1333**	**1.0**	**-0.2**	**-1.9**	**0.3**	**1.8**	**219**	**0.5**	**-0.2**	**-0.5**	**0.7**	**1.5**	**1114**	**1.1**	**-0.2**	**-2.2**	**0.3**	**1.8**
Beef	168	0.5	-0.1	-0.4	0.4	1.4	30	0.4	-0.1	-0.3	1.5	2.4	138	0.5	-0.1	-0.4	0.1	1.2
Dairy	126	0.5	-0.1	-0.4	0.5	1.5	23	0.4	-0.1	-0.4	1.2	1.9	103	0.5	-0.1	-0.4	0.3	1.4
Poultry	25	0.5	-0.1	-0.4	0.2	1.2	5	0.5	-0.1	-0.5	0.6	1.6	20	0.5	-0.1	-0.4	0.1	1.1
Bovine	46	0.5	-0.1	-0.4	0.4	1.7	8	0.4	-0.1	-0.3	1.4	2.3	38	0.5	-0.1	-0.4	0.2	1.6
Other livestock	24	0.5	-0.1	-0.4	0.2	1.4	4	0.3	-0.1	-0.3	0.2	2.6	20	0.5	-0.1	-0.5	0.2	1.1
Total Livestock	**388.1**	**0.5**	**-0.1**	**-0.4**	**0.4**	**1.5**	**70**	**0.4**	**-0.1**	**-0.3**	**1.3**	**2.2**	**318**	**0.5**	**-0.1**	**-0.4**	**0.2**	**1.3**
Total Agriculture	**1721.1**	**0.9**	**-0.2**	**-1.6**	**0.4**	**1.7**	**289**	**0.4**	**-0.1**	**-0.4**	**0.8**	**1.7**	**1432**	**1.0**	**-0.2**	**-1.8**	**0.3**	**1.7**
Fishing	29	0.5	-0.1	-0.4	0.2	1.1	5	0.4	-0.1	-0.3	1.1	1.9	23	0.5	-0.2	-0.4	0.1	0.9
Meat & dairy	208	0.3	0.0	-0.2	0.1	0.4	0						208	0.3	0.0	-0.2	0.1	0.4
Grain milling	175	0.4	0.0	-0.4	1.1	0.9	0						175	0.4	0.0	-0.4	1.1	0.9
Sug. & bake. & conf.	50	0.5	-0.1	-0.4	0.4	1.2	1	0.4	-0.1	-0.3	1.5	1.8	48	0.5	-0.1	-0.4	0.3	1.2
Bev. & tobac.	168	0.5	-0.1	-0.4	0.4	1.1	4	0.5	-0.1	-0.4	1.1	1.7	164	0.5	-0.1	-0.4	0.4	1.1
Oth. Manuf. food	13	0.5	-0.1	-0.4	1.0	1.3	0	0.5	-0.1	-0.4	0.7	1.2	13	0.5	-0.1	-0.4	1.0	1.3
Total Food	**642**	**0.4**	**-0.1**	**-0.3**	**0.5**	**0.9**	**11**	**0.4**	**-0.1**	**-0.3**	**1.1**	**1.8**	**631**	**0.4**	**-0.1**	**-0.3**	**0.5**	**0.8**
Total Agri-Food	**2363**	**0.8**	**-0.2**	**-1.2**	**0.4**	**1.5**	**300**	**0.4**	**-0.1**	**-0.4**	**0.8**	**1.7**	**2063**	**0.8**	**-0.2**	**-1.4**	**0.3**	**1.5**

Source: Model Results

Table A. 8: Trade flows at Sector level, Fertilizer scenarios

	Exports						Imports						Balance					
	Base	Fer	Sub	Pro	Mar	Ext	Base	Fer	Sub	Pro	Mar	Ext	Base	Fer	Sub	Pro	Mar	Ext
	billion Ksh	*% change from base*	*% change from fertilizer scenario*				*billion Ksh*	*% change from base*	*% change from fertilizer scenario*				*billion Ksh*	*% change from base*	*Difference from fertilizer scenario (bil Ksh)*			
Maize	0.3	1.1	-0.4	-1.3	1.1	4.1	18.9	-0.2	0.3	0.5	1.1	-2.0	-18.5	0.0	-0.1	-0.1	-0.2	0.4
Wheat	0.6	0.4	-0.2	-0.4	1.1	2.5	36.7	0.5	0.0	-0.5	1.6	0.8	-36	-0.2	0.0	0.2	-0.6	-0.3
Rice	0.1	0.4	-0.2	-0.5	-1.0	1.7	24.3	0.5	0.0	-0.4	3.3	0.7	-24	-0.1	0.0	0.1	-0.8	-0.2
Oth. cereals	0.1	0.5	-0.3	-0.7	0.6	1.9	2.6	0.5	0.1	-0.3	1.5	0.2	-3	0.0	0.0	0.0	0.0	0.0
Roots & tub.	0.0	0.3	-0.2	-0.6	-0.1	1.7	0.1	0.7	0.0	-0.4	2.7	0.6	0	0.0	0.0	0.0	0.0	0.0
Pul. & oil seeds	7.6	0.4	-0.2	-0.6	1.2	1.3	90.4	0.6	0.0	-0.4	1.0	0.7	-83	-0.5	0.0	0.3	-0.9	-0.6
Fruits	1.7	0.4	-0.3	-0.8	-0.1	1.6	2.7	0.7	0.1	-0.2	2.1	0.4	-1	0.0	0.0	0.0	-0.1	0.0
Vegetables	24.5	0.3	-0.2	-0.5	-0.6	2.3	0.5	0.7	0.1	-0.3	4.9	0.3	24	0.1	0.0	-0.1	-0.2	0.6
Total Food Staples	34.9	0.4	-0.2	-0.6	-0.2	2.0	176.2	0.5	0.0	-0.3	1.5	0.4	-141	-0.7	-0.1	0.4	-2.7	0.0
Cotton	0.4	3.6	-0.8	-8.8	-3.9	5.4	6.8	0.1	0.0	0.5	1.6	-0.5	-6	0.0	0.0	-0.1	-0.1	0.1
Sugarcane	25.1	2.8	-0.7	-6.7	-2.3	3.8	7.7	2.1	-0.5	-4.9	-1.1	2.4	17	0.5	-0.1	-1.3	-0.5	0.8
Coffee	19.2	3.3	-0.6	-7.4	-2.1	3.7	2.8	2.3	-0.5	-5.4	-1.0	2.5	16	0.6	-0.1	-1.3	-0.4	0.6
Tea	250.0	2.7	-0.6	-6.5	-2.3	3.7	3.5	2.3	-0.6	-5.6	-0.9	2.6	246	6.8	-1.6	-16.1	-5.8	9.2
Tobacco	4.0	2.9	-0.7	-6.8	-2.2	3.7	3.9	2.0	-0.4	-4.8	-0.9	2.3	0	0.0	0.0	-0.1	0.0	0.1
Others crops	14.6	0.6	0.1	-1.1	7.9	-0.2	0.1	-0.2	0.0	0.3	44.9	-0.5	15	0.1	0.0	-0.2	1.1	0.0
Total Export Crops	313.2	2.7	-0.6	-6.3	-1.9	3.6	24.8	1.6	-0.4	-3.6	-0.1	1.6	288	8.0	-1.8	-19.0	-5.8	10.7
Total Crop	**348.1**	**2.4**	**-0.6**	**-5.8**	**-1.7**	**3.4**	**201.0**	**0.6**	**0.0**	**-0.7**	**1.3**	**0.6**	**147**	**7.3**	**-1.9**	**-18.6**	**-8.5**	**10.7**
Beef	0.0	0.4	-0.3	-0.4	1.2	2.2	0.0	0.7	0.1	-0.4	-1.0	0.3	0	0.0	0.0	0.0	0.0	0.0
Dairy	0.2	0.3	-0.3	-0.5	1.6	2.5	0.2	0.7	0.1	-0.4	-1.0	0.4	0	0.0	0.0	0.0	0.0	0.0
Poultry	0.0	0.5	-0.4	-0.8	0.8	2.9	0.8	0.5	0.2	0.1	-0.6	-0.7	-1	0.0	0.0	0.0	0.0	0.0
Bovine	0.3	0.4	-0.4	-0.5	1.4	3.1	0.0	0.6	0.1	-0.4	-0.9	0.0	0	0.0	0.0	0.0	0.0	0.0
Other livestock	0.4	0.4	-0.3	-0.5	1.1	1.8	0.1	0.6	0.1	-0.4	-0.7	0.5	0	0.0	0.0	0.0	0.0	0.0
Total Livestock	**1.0**	**0.4**	**-0.4**	**-0.5**	**1.3**	**2.4**	**1.1**	**0.5**	**0.2**	**-0.1**	**-0.7**	**-0.4**	**0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Agriculture	**349.1**	**2.4**	**-0.6**	**-5.8**	**-1.7**	**3.4**	**202.1**	**0.6**	**0.0**	**-0.7**	**1.3**	**0.6**	**147**	**7.3**	**-1.9**	**-18.6**	**-8.5**	**10.7**
Fishing	8.8	0.4	-0.3	-0.4	0.5	1.2							9	0.0	0.0	0.0	0.0	0.1
Meat & dairy	0.3	0.2	-0.1	-0.1	1.0	0.7	0.5	0.5	0.1	-0.3	-0.9	0.2	0	0.0	0.0	0.0	0.0	0.0
Grain milling	0.5	0.5	-0.2	-0.5	3.7	1.7	5.6	0.3	0.1	-0.3	-1.5	0.1	-5	0.0	0.0	0.0	0.1	0.0
Sug. & bake. & conf.	7.3	0.4	-0.2	-0.4	1.1	1.8	5.1	0.6	0.1	-0.4	-0.7	0.4	2	0.0	0.0	0.0	0.1	0.1
Bev. & tobac.	4.7	0.3	-0.3	-0.3	1.6	1.7	2.9	0.6	0.1	-0.4	-0.8	0.5	2	0.0	0.0	0.0	0.1	0.1
Oth. Manuf. food	6.5	0.4	-0.2	-0.4	1.2	1.6	26.8	0.5	0.0	-0.3	0.3	0.2	-20	-0.1	0.0	0.0	0.0	0.0
Total Food	**28.2**	**0.4**	**-0.2**	**-0.4**	**1.1**	**1.5**	**40.9**	**0.5**	**0.0**	**-0.3**	**-0.2**	**0.3**	**-13**	**-0.1**	**-0.1**	**0.0**	**0.4**	**0.3**
Total Agri-Food	**377.3**	**2.3**	**-0.5**	**-5.4**	**-1.5**	**3.3**	**243.1**	**0.6**	**0.0**	**-0.7**	**1.0**	**0.5**	**134**	**7.2**	**-2.0**	**-18.7**	**-8.1**	**11.1**

Source: Model Results

Table A. 9: Change in CPI, Fertilizer scenarios

		Fertilizer *% change from base*	Subsidy	Protection	Market	Extension
			% change from fertilizer scenario			
Sectors	Total	0.0	0.0	0.1	-0.2	-0.1
	Agricultural	-0.6	0.6	-0.3	0.8	0.7
	Food	-0.4	0.4	-0.1	0.6	0.5
HH Type	Rural	-0.5	0.5	-0.1	0.6	0.5
	Urban	-0.3	0.4	-0.2	0.5	0.4
Regions	Nairobi	-0.3	0.3	-0.2	0.4	0.4
	Mombasa	-0.3	0.3	-0.2	0.4	0.4
	High Rainfall	-0.4	0.4	-0.1	0.6	0.5
	S.Arid North	-0.5	0.5	-0.1	0.6	0.6
	S.Arid South	-0.5	0.5	-0.2	0.6	0.5
	Coastal	-0.5	0.5	-0.2	0.7	0.5
	Arid North	-0.5	0.5	-0.1	0.6	0.5
	Arid South	-0.4	0.5	-0.1	0.6	0.5
	Turkana	-0.5	0.5	-0.1	0.7	0.6

Source: Model Results

Table A. 10: Factor Prices, Fertilizer scenarios

		Base Level	Fertilizer *% change from base*	Subsidy	Protection	Market	Extension
				% change from fertilizer scenario			
Land	Average	0.18	-0.19	0.33	0.84	0.26	0.36
	Irrigated	2.31	-0.18	0.35	1.00	0.27	0.38
	Non-Irrigated	0.10	-0.26	0.40	0.98	0.34	0.44
Labour	Average	0.92	0.31	-0.39	-0.49	-0.51	-0.43
	Skilled	0.96	0.03	-0.38	-0.51	-0.47	-0.43
	Semi-skilled	0.90	0.45	-0.45	-0.50	-0.58	-0.48
	Unskilled	0.92	0.47	-0.35	-0.46	-0.47	-0.37
	Nairobi	0.94	0.20	-0.21	-0.39	-0.31	-0.24
	Mombasa	0.91	-0.05	-0.36	-0.44	-0.42	-0.42
	High Rainfall	0.93	0.37	-0.44	-0.53	-0.58	-0.48
	Semi-Arid North	0.92	0.37	-0.47	-0.58	-0.62	-0.51
	Semi-Arid South	0.89	0.41	-0.44	-0.41	-0.47	-0.44
	Coast	0.97	0.23	-0.31	-0.41	-0.38	-0.34
	Arid North	0.93	0.37	-0.61	-0.54	-0.64	-0.63
	Arid South	0.93	0.21	-0.52	-0.40	-0.54	-0.55
	Turkana	0.47	0.07	-0.16	-0.10	-0.16	-0.16

Source: Model Results

List of abbreviations

AEZ: Agro-Ecological Zones

AGOA: United States' African Growth and Opportunity Act

ASALs: Arid and Semi-Arid Lands

ASDS: Agricultural Sector Development Strategy

CAADP: Comprehensive African Agricultural Development Programme

CES: Constant Elasticity of Substitution

CET: Constant Elasticity of Transformation

COMESA: Common Market for Eastern and Southern Africa

COP21: United Nations Framework Convention on Climate Change

DG DEVCO: Directorate-General for International Cooperation and Development

EAC: East African Community

EC: European Commission

EPA: Economic Partnership Agreement

ERS: Economic Recovery Strategy for Wealth and Employment Creation

EU: European Union

CES: Constant Elasticity of Substitution

CGE: Computable General Equilibrium Model

CPI: Consumer Price Index

FAO: Food and Agriculture Organization of the United Nations

FBS: Food Balance Sheet

FNSP: National Food and Nutrition Security Policy

FTA: Free Trade Area

GAMS: General Algebraic Modeling System

GDP: Gross Domestic Product

GHI: Global Hunger Index

GHG: Greenhouse Gas

GLOBE: A SAM Based Global CGE Model using GTAP Data

GoK: Government of Kenya

GSP: Generalised Scheme of Preferences

HPHC: Home Production for Home Consumption

HDI: Human Development Index

IFPRI: International Food Policy Research Institute

ILO: International Labour Office

iMAP: integrated Modelling Platform for Agro-economic Commodity and Policy Analysis

IOT: Input Output Table

IPTS: Institute for Prospective Technological Studies

ISPs: Input Subsidy Programs

JRC: Joint Research Centre
KNBS: Kenya National Bureau of Statistics
KIPPRA: Kenya Institute for Public Policy Research and Analysis
Ksh: Kenyan Shilling
LES: Linear Expenditure Systems
LULUCF: Land-Use, Land-Use Change and Forestry
MAMS: Maquette for MDG Simulations Model
MDGs: Millennium Development Goals
MFN: Most Favoured Nations
MTCO2 Eq.: Metric tons of carbon dioxide equivalent
MTP: Medium Term Plan
NASEP: National Agricultural Sector Extension Policy
NGOs: Non-Governmental Organisations
PE: Partial Equilibrium
PPI: Producer Price Index
RHG: Representative Household Groups
R&E: Research and Extension services
SADC: Southern Africa Development Community
SAM: Social Accounting Matrix
SITC: Standard International Trade Classification
SRA: Strategy for Revitalizing Agriculture
SSA: Sub-Saharan Africa
STAGE: STatic Applied General Equilibrium model
SUT: Supply and Use Table
UNDP: United Nations Development Programme
UNESCO: United Nations Educational, Scientific and Cultural Organization
UNDESA: United Nations Department of Economic and Social Affairs
UNICEF: United Nations Children's Fund
USD: United States Dollar
WB: World Bank
WDI: World Development Indicators
WTO: World Trade Organization

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