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Impact of alternative agricultural trade liberalization strategies on food security in the Sub-Saharan Africa region

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Abstract

Purpose – The aim of this paper is to deal with the linkage between agricultural trade liberalization and food security in Sub-Saharan Africa.

Design/methodology/approach – The analysis uses the GTAP model which is a global dynamic applied general equilibrium model to assess how the multifarious trade and support policies in agriculture affect the poor in the Sub-Saharan African group based on food security concerns. The policy strategies analyzed are two liberalization scenarios based on the proposals made in the present round of agricultural negotiations in terms of market access and export competition, plus a free agricultural trade benchmark scenario.

Findings – The results of alternative trade liberalization strategies on key food security indicators in the SSA region are ambiguous. The impact varies depending on the extent of liberalization and also the comparative advantage of the SSA group at the sectoral level.

Originality/value – Despite several studies on food security, especially after the food crisis in 2008, very little research has focussed on the agricultural trade liberalization impact with a CGE approach.

Keywords Agricultural trade liberalization, Food security, Sub Saharan Africa, Agriculture, Trade

Paper type Research paper

1. Introduction

Many Sub-Saharan African (SSA) countries are highly dependent on the agricultural sector for the livelihood of the population. Agriculture is a source of livelihood for 64 percent of the population in the region; the sector contributes about one-fifth of total gross domestic product, and about 12 percent of the total export earnings for the region. These countries are gifted with abundant land, labour and natural resources indicating existence of comparative advantage in the agriculture sector. With the existence of comparative advantage, one can reasonably expect the continent to be able to feed its citizens. However, food security is of particular concern to many SSA countries [1] and a daily problem for large parts of the population. Many of the countries which faced recurrent food shortage for the period 1998-2002 are found in SSA.

Food security is traditionally discussed in terms of either food self-sufficiency or food self-reliance. The former requires production of food in the quantities consumed domestically, while the latter requires domestic availability. Self-sufficiency rules out imports as a major source of supply while self-reliance has no such restriction. Accepting food self-reliance as the means to achieve food security, it is pertinent to



question the extent to which the liberalization of trade in agriculture including food will impact on developing countries.

Trade policy reform from the World Trade Organization (WTO) negotiations, regional negotiations and/or bilateral agreements resulting in lowering of tariff for instance in agricultural products would lead to an increase in import and declining of price of imported goods thereby enhancing food security. The removal of support, however, is beneficial in the long run as it would enhance competitiveness of agricultural products from African countries. In light of the fact that trade policy plays a great role in the food security of countries, the issue deserves consideration.

The proposed paper is expected to contribute to the empirical literature on the linkages between agricultural trade reforms and food security primarily in SSA, but with possible implications for regional integration dynamics and other developing countries. The contribution will be in the form of conditional statements on the impacts of specified trade reforms on welfare and food security in SSA, given a series of trade reform outcomes depending on changes in agricultural trade negotiations at the WTO, regional level and in border protection in the SSA export markets, and the government trade and fiscal policy choices.

The article examines the food security implications of agricultural trade liberalization under various scenarios using the Global Trade Analysis Project (GTAP)-AGR model. The article will also address the extent to which the realization of the objectives of the trade liberalization in agriculture will help promote food security in food insecure African countries. Accordingly, the next section will look at the linkage between trade liberalization and food security. Section 3 provides some empirical evidence on the subject matter for SSA, define food security and look into the state of food insecurity in SSA countries as well as the causes for food insecurity. The third section touches upon the three pillars of the AoA and their implementation and will also discuss their relationship with food security. The following sections will highlight the state of affairs in the current negotiation and indicate the reforms necessary to be undertaken under the current round of negotiation which aims at enhancing food security in the region. The paper will finalize by making some concluding remarks.

2. Trade liberalization and food security in SSA

The arguments that openness to trade contributes to economic growth and that this can, in turn, be beneficial for poverty reduction and food security, are well grounded in conventional economic theory and have been supported by a number of empirical studies. However, some commentators caution that in studying the correlation between more trade and higher economic growth, researchers need to be careful about implying causality.

Trade policy reform involves a combination of: domestic support measures; export subsidies and tariffs. In each case, there are complications that must be taken into account. This is illustrated below, starting with price supports. The removal of domestic price support on, say, wheat, will lower output of wheat and raise its price in the world markets. Wheat-exporting developing countries will benefit and wheat-importing countries that continue to be importers after the removal of the support will lose and those that switch from being importers to exports may benefit or lose.

The international dimension is significant, since trade policy influences both global food availability (in the case of a major importer or exporter), and national food

availability (through both imports and production). The effect on food imports will be mediated by any implications of trade policy for foreign exchange earnings.

Trade policy will also have implications for food security through the link with incomes and expenditures. Any change in the trade regime will have a direct effect on both rural and urban incomes, and employment, and through these on income distribution. In addition, there will be an effect on government revenues through, for example, a change in the level of revenue from import levies. Both national food availability and government revenues have a significant impact at the household level, affecting household access to food directly and indirectly through household incomes.

Trade liberalization implies a change in the relative prices of traded and non-traded goods and factors in a previously protected sector or economy. The change in relative prices will induce changes in the allocation of resources to different activities and hence changes in both sub-sectoral and aggregate levels of production. In turn, changes in income levels (which are expected to increase in aggregate as resources are used more efficiently) have the potential both to reduce poverty levels and in doing so, to improve the food security status by increasing the access of the poor to food.

In the short-run, agricultural sectors in poor economies are often not well placed to benefit from trade liberalization even when this has had a significant impact on both income levels. This is because of the inflexible structure of production and trade in this sector, often manifested in limited market access and weak institutional development, as well as limited capacity to respond to improved incentives. However, food importers are affected in the short-term via higher import bills. As a result, there is often a hiatus during which the food security situation worsens.

The strategy employed by individual countries to improve their food security status is one of the key factors in understanding the relationship between trade liberalization and food security. Two broad options have generally been followed by countries attempting to achieve adequate levels of food security: food self-sufficiency and food self-reliance:

- (1) Food self-sufficiency, or the provision of a level of food supplies from national resources above that implied by free trade, represents a strategy followed by a wide range of countries. While this approach implies the provision of sufficient domestic production to meet a substantial part of consumption requirements, it does not necessarily imply that all households in the country have access to all the food they require. In a number of countries which are net food exporters, substantial numbers of households are suffering from malnutrition.
- (2) A strategy of food self-reliance reflects a set of policies where the sources of food are determined by international trade patterns and the benefits and risks associated with it. This strategy has become more common as global trade has become more liberal. It is even argued that improved food security, as well as efficiency gains, may be achieved more satisfactorily, even in countries where agriculture remains a major contributor to GDP, by shifting resources into the production of non-food export crops and importing staple food requirements.

The success of these broad options will depend, *inter alia*, on the ability of producers to react to price incentives (particularly important), or of countries to use income gains for improved efficiency of resource allocation in order to procure food on the

international market. The distinction can also be used at the household level to motivate an understanding of individuals' entitlements to food.

Developing countries face a number of other risks associated with trade. Besides the declining terms of trade, a related problem is the volatility of world prices for the primary (especially agricultural) commodities they export. Furthermore, these prices are determined in markets beyond the influence of individual poor countries and typically affected by factors beyond their control. Related to this are supply side risks, especially the sensitivity of output to climatic variability. Droughts and excess rain creating flooding can cause serious damage to agricultural output.

3. Some empirical evidence from SSA

Many developing countries, especially in SSA, have liberalized trade policies since the 1980s. While there is fairly convincing cross-country evidence that exports are associated with growth, the evidence that liberalization increases growth is much weaker.

Much of the export growth (where it occurred) in the 1990s was indeed agriculture-led. However, the evidence for SSA is quite mixed (Table I). Uganda is one of the few cases where incentives were improved for both food and cash crop producers. This did not automatically translate into increased value of exports, largely because world prices are beyond the control of small-country exporters.

Often, the anticipated benefits from trade liberalization do not materialise because only limited or partial reforms are actually implemented, i.e. there is no significant increase in incentives for export. This is especially true of many SSA countries. Furthermore, even when significant trade reforms are implemented, important constraints remain. Many countries face natural barriers to trade arising from geographical remoteness, especially if land-locked, and high transaction costs. In Uganda, for example, transport costs represent an implicit tax equivalent to 24 percent of value added of coffee exports.

Several reasons explain the only limited agricultural export supply response. unilateral trade reforms do not affect the price received by exporters (multilateral liberalization may affect world prices). Devaluation of the exchange rate increases the domestic currency value of a given world price, therefore increases incentives to exporters. There is evidence that farmers do respond to relative (crop) prices, and in particular they will shift into food production if prices increase relative to export crops. However, their ability to increase production and exports to respond to increased incentives will be constrained by farming practices, limited access to inputs, credit and

Sample	Food crops	Cash crops	Exports
Nigeria (1970-1992)		- ve	- ve
Uganda (1986-1997)	+ ve	+ ve	Mix
SSA (1980-1990)			+ ve
Africa (1970-1988)	Mix	Mix	
Cross-country (1980s)	- ve	+ ve	

Notes: Effect is either positive/negative; "Mix" indicates mixed evidence (trade policy reforms impacted differently across sectors/countries or over time)

Source: Adapted from Morrissey (2002)

Table I.
Impact of trade
liberalization, Africa

new technologies. Poor infrastructure and natural barriers act as a tax, often very high, on exports. Delays in implementing institutional reforms have been suggested as one factor limiting export supply response in Uganda.

Another reason why one may not observe an increase in exports (by value if not by volume) is the fallacy of composition, whereby the simultaneous attempt by many countries to expand exports of the same commodity results in a decline in the world price. This is one of the problems faced by countries that are dependent for export earnings on a few primary commodities. While trade liberalization is beneficial, both through improving incentives to exports and providing gains to consumers, it is not a guarantee of economic growth, or even of growth in exports.

There are few systematic analyses of the impacts of trade reforms on food security in SSA, and particularly in West Africa. However, there are countless case studies, usually found in online reports by non-governmental organizations, which generally come to the conclusion that agricultural trade reforms are harmful to food security in poor small-scale farm communities.

Examples of such studies include Posner (2001), Charles *et al.* (2001) and Madeley (2000). The Charles, Longrigg and Tugend study is a consumers international's assessment of the reforms in 13 developing countries. The study concludes that, in many poor countries, increased exposure to agricultural trade reforms weakens food security through increased dependence on food imports and reduced employment opportunities. Madeley (2000) reviews the experience of trade reforms in 27 developing and least-developed countries and reaches a similar conclusion. The main limitation of these case studies is that they rely heavily on isolated situations of a specific community in a given country. These isolated situations rarely reflect the economy-wide impacts of trade reforms. Thus, they constitute a poor proxy of what could be the overall effects of trade reforms. Economy-wide effects must be captured within an economy-wide analytical framework, which is the approach taken in this study.

4. Food security and agricultural trade policy outlook in SSA

The number of hungry people in SSA is increasing, putting the millennium development summit (MDG) goal of halving world hunger by 2015 at risk (SOFA, 2011). Progress in reducing hunger in the next decade is the key to achieving the MDG goals. Before investigating the dynamics of the trade liberalization and food security linkages in SSA, this section provides a background to the agricultural sector and food security situation in SSA while elaborating on the agricultural trade policy of SSA.

Agriculture is at the heart of the most African economies especially those in the Sub-Saharan region and is critical for food self-sufficiency (Table II). Agriculture provides the opportunities to address extreme poverty in Africa. More and more people in Africa have limited access to food and other basic amenities such as potable water, minimum health care and education, effectively limiting the opportunities available to them. Poverty and nutritional status are closely linked.

Based on the State of Food Insecurity Report of the Food and Agricultural Organization (FAO) in 2011, most of the hungry people in the world live in South Asia (SA), SSA, and China. The number of people going hungry has risen in SSA since 1990-1992. As a result, SSA's share of the world's hungry population had from 21 to 25 percent during the same period. The FAO also provides some alarming statistics on the food security situation in SSA as outlined in Table III (FAO, 1999, 2003, 2011).

Agricultural
trade
liberalization

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Commodity group	Prod.	Imports	Cons.	Exports	Exports/ production (%)	Import penetration
Paddy rice	10,502.5	17.9	10,517.1	3.2	0.0	0.2
Wheat	1,149.1	686.4	1,831.9	3.6	0.3	59.7
Cereal grains	5,803.8	380.1	6,058.4	125.4	2.2	6.5
Vegetables, fruits and nuts	10,137.5	220.0	9,517.5	840.0	8.3	2.2
Oilseeds	1,733.8	29.8	1,565.2	198.4	11.4	1.7
Sugar cane and sugar beets	2,337.0	0.2	2,331.2	6.1	0.3	0.0
Plant based fibers	2,915.2	46.0	1,446.6	1,514.6	52.0	1.6
Crops	14,293.3	244.4	8,705.5	5,832.3	40.8	1.7
Bovine cattle, sheep, goats, horses	5,183.3	14.3	5,181.9	15.7	0.3	0.3
Animal products	3,536.0	53.0	3,463.3	125.6	3.6	1.5
Raw milk	1,253.5	1.7	1,253.2	2.1	0.2	0.1

Source: Computed

Table II.
SSA agricultural sector
sizes and ratios

	1990-1992	1995-1997	2000-2002	2005-2007
World	16	14	14	13
Developing regions	20	18	16	16
Northern Africa	<5	<5	<5	<5
Sub-Saharan Africa	31	31	30	26
Latin America and the Caribbean	12	11	10	8
Eastern Asia	18	12	10	10
Southern Asia	21	19	20	21
South-Eastern Asia	24	18	17	14
Western Asia	6	8	8	7
Oceania				
Developed regions	<5	<5	<5	<5
LDCs	34	34	30	26

Source: SOFA (2011)

Table III.
Percentage of
undernourished in
total population

Agricultural trade policy outlook

Since the early 1980s, almost all African governments have embarked on economic reform programs to reduce state intervention in the economy and to allow markets to play a larger role. In the agricultural sector these programs were designed to eliminate price controls on agricultural commodities, disband or privatize state farms and state-owned enterprises, reduce the heavy taxation of agricultural exports, phase out subsidies on fertilizer and other inputs, and allow greater competition in agricultural markets.

The pace and extent of reforms have varied widely across countries, and the reforms have often not been implemented fully. Food markets have been dramatically transformed in some countries (such as Ethiopia, Madagascar, and Tanzania) but only partially so in others (such as Malawi, Zambia, and Zimbabwe). Export markets are much more liberalized than they were in the 1970s, but a number of countries continue to control exports through state-owned enterprises (such as West African cotton producers). Universal fertilizer subsidies and state enterprises that monopolize

fertilizer distribution, once common, are now rare, but fertilizer markets continue to be subject to targeted distribution programs, indirect subsidies, and other forms of intervention (as in Ethiopia, Malawi, and Zambia).

A key issue in the Doha round of WTO trade negotiations, inaugurated in November 2001, is the content of agreements relating to agriculture. Given the importance of agriculture in the lives of poor people in the region, this issue is central for SSA. It is widely recognized that subsidies and border protection by wealthy countries inflict harm on agriculture in developing countries.

Enabling international trade to contribute to economic development in Africa requires facilitating policies at three levels. Multilateral trade rules must constrain subsidies and trade-distorting measures by developed countries. Developing countries also need to limit their use of trade barriers, in exchange for reforms in the developed world, and to facilitate international trade through opportunities in regional blocs.

Regional trade initiatives have proliferated around the world, including Southern Africa. In the last two decades, the Southern Africa region has witnessed a growing number of regional cooperation and regional integration initiatives. In addition to seeking reductions in support and protection by developed countries, African countries feel the effects of their own trade policies. Trade between SSA countries provides about 20 percent of their total agricultural imports. RTAs that lower trade barriers could increase the flow of goods within SSA, yielding benefits to producers and consumers. Reasonable course in unilateral trade policy decisions should be backed up with enabling measures to make it possible for farmers and agriculture-based industries to benefit from international trade access and to strengthen poor groups. Strengthened agricultural trade and enhanced opportunities in rural areas are needed to help Africa's millions of poor people pull themselves out of poverty. Rural people in Africa have little chance of improving their livelihoods without well-functioning international and domestic markets.

5. Research design and methodology

Methodology

Global models of agricultural trade have a long and distinguished history. The introduction of the GTAP database and modeling project represented a significant advance forward as it put modelers and trade policy analysts on common ground. After an initial generation of GTAP based modeling of agricultural trade policy using the standard modeling framework, individual researchers have begun introducing agricultural specificity into the standard modeling framework in order to better capture the particular features of the agricultural economy pertinent to their research questions. This technical paper follows in that same tradition by reviewing important linkages between international trade and the farm and food economy and introducing them into the standard GTAP modeling framework, offering a special purpose version of the model nicknamed GTAP-AGR.

Standard GTAP model characteristics. There are basically two strands of quantitative modelling in policy analysis. One approach is to build issue-specific models, depending on the question at hand. These models will usually be capable of capturing many relevant aspects of one specific policy question, but are of less use in a different policy context. The other approach sets out to construct more general and flexible models, which do not necessarily attempt to capture all detail but are flexible

enough to allow elaborations in face of specific policy questions. Such a modelling framework is provided by the GTAP.

The standard GTAP model is a multi-region, computable general equilibrium model, with perfect competition and constant returns to scale. In the standard GTAP model each single region is modelled along relatively standard lines of multi-sector AGE models. All sectors are producing under constant returns to scale, and perfect competition on factor markets and output markets is assumed.

Firms combine intermediate inputs and primary factors, namely land, labour (skilled and unskilled) and capital. Intermediate inputs are used in fixed proportions, but are themselves constant elasticities of substitution (CES) composites of domestic and foreign components (Figure 1). In addition, the foreign component is differentiated by region of origin (Armington assumption), which permits the modelling of bilateral (intra-industry) trade flows, depending on the ease of substitution between products from different regions.

Primary factors are combined according to a CES function. Regional endowments of land, labour and capital are fixed. Labour and capital are perfectly mobile across domestic sectors.

Land, on the other hand, is imperfectly mobile across alternative agricultural uses, hence sustaining rent differentials. Each region is equipped with one regional household, which distributes income across savings and consumption expenditures according to fixed budget shares. Consumption expenditures are allocated across commodities according to a non-homothetic constant differences of elasticity's (CDE) expenditure function. Furthermore, there is an explicit treatment of international trade and transport margins, and a global banking sector, which intermediates between global savings and consumption. The standard model also gives users a wide range of closure options (i.e. which variables are treated endogenous or exogenous in the model), including a selection of partial equilibrium closures, which facilitate comparison of results to studies

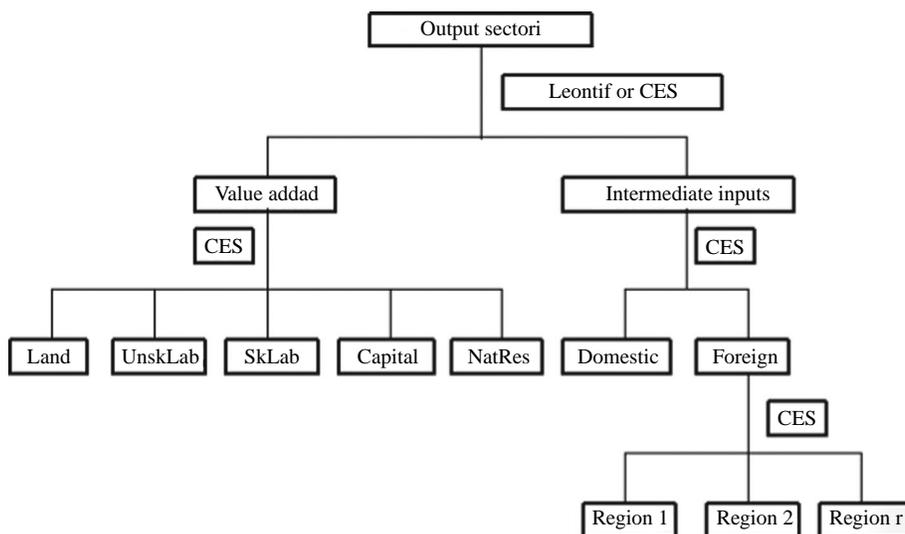


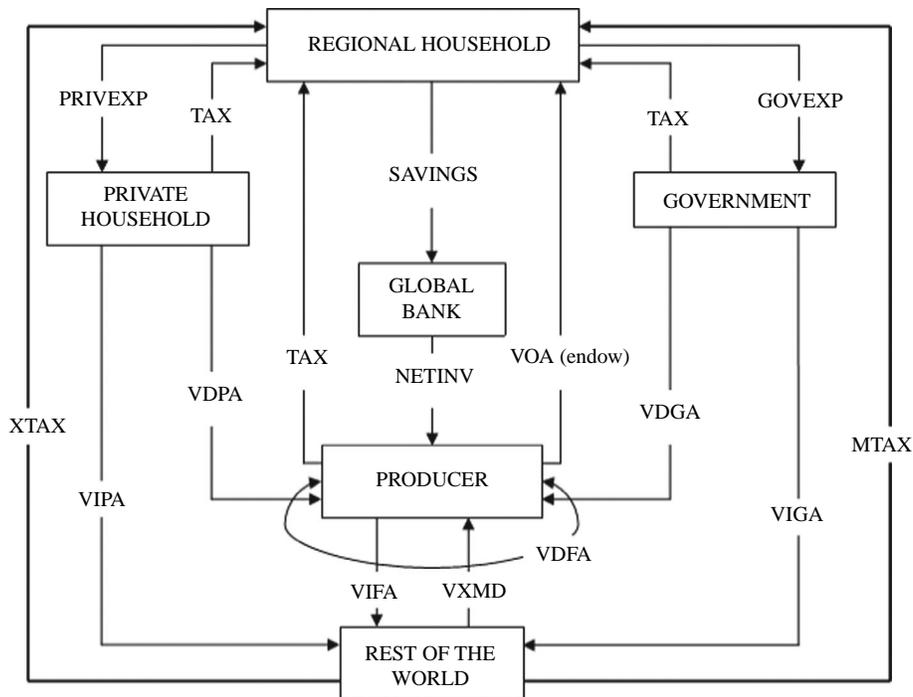
Figure 1.
Production structure of
standard GTAP model

Source: Hertel et al (1997)

based on partial equilibrium assumptions. This model is documented in the GTAP book (Hertel, 1997). The model is implemented using the GEMPACK software suite.

Adaptations of the standard model have been developed by various GTAP users. Such elaborations include increasing returns to scale and imperfect competition, dynamic equilibrium formulations and incorporation of non-continuous policy instruments such as formulated in GATT commitments.

To facilitate the understanding of GTAP's structure, a model displaying the performance of an economy and its interaction with the Rest of the World while considering the presence of taxes and subsidies is provided (Figure 2). A glossary of terms is included with the figure. In this model, regional income comes from payments by firms to purchase the primary factors of production, these being land, capital, labour and



Notes: VOA (endow) – value of output at agent’s prices of endowment commodities; VDFA – value of domestic purchases by firms at agent’s prices; PRIVEXP– private expenditure; GOVEXP – government expenditure; VDPA – value of domestic purchases by private households at agent’s prices; VDGA – value of domestic purchases by government household at agent’s prices; NETINV – the sale of investment goods to satisfy the regional household’s demand for savings; VXMD – value of exports at market prices by destination; VIPA – value of import payments to Rest of the World from private households; VIGA – value of import payments to Rest of the World from government households; VIFA – value of import payments to Rest of the World from firms; XTAX – export tax, converts to fob values; MTAX – import tax

Figure 2.
GTAP structure

Source: Hertel and Tsigas (1997)

natural resources. This income corresponds to the flow of the value of output at agents' prices of endowment commodities (VOA), plus added taxes (TAX), and is allocated to four different categories: private consumption by regional households or families (PRIVEXP); consumption by the government (GOVEXP); the demand for savings (SAVINGS); and a bundle of income for the payment of taxes. Taxes in the model are defined by the difference between the value of output at market price and at agent's price. This computation of income variance allows the model to calculate change in regional income that is then used as an indicator of regional well-being (Hertel and Tsigas, 1997).

The revenue the producers receive is spent on intermediate consumption (VDFA), since firms must combine commodities and intermediate goods to produce goods for the final demand, on payments for imports from the Rest of the World (VIFA), and on payment of taxes (TAXES) to government. In this way, all generated revenue is spent on the purchase of intermediate factors and services from primary factors; therefore, satisfying the zero profit condition, an important assumption for the model's closure, as shown in Figure 2.

To better understand the multiregional model in an open economy, two economies are considered. One of them represents a regional economy and the other the Rest of the World. An open economy gives all agents the opportunity to pursue commercialization, allowing the domestic economy to spend part of its income on an outside financial system (VIPA and VIGA). Tax is the source of income for both the exporting country (XTAX) and the importing country (MTAX). The production sector also interacts with the remaining portion of world economy, represented by the variables VIFA and VXMD.

Data. The GTAP database contains detailed bilateral trade, transport and protection data characterising economic linkages among regions, linked together with individual country input output databases which account for intersectoral linkages among the 57 sectors within each of 113 regions. All monetary values of the data are in USD millions and the base year for Version 7 is 2004. The bilateral trade data are derived from United Nations Trade Statistics and Support – and protection data from various sources (e.g. United Nations Conference on Trade and Development (UNCTAD) Trade Analysis and Information System (TRAINS) database for tariff information, the Organization for Economic Cooperation and Development (OECD's) Producer Support Estimate (PSE) database for agricultural support). Version 7 is fully documented in Badri Narayanan and Walmsley (2008).

Sector-specific modifications: the GTAP-AGR model

The GTAP-AGR version is a variant of the GTAP model that is specifically oriented towards analyzing agricultural markets (Hertel and Keeney, 2005). This version introduces a number of modifications to the way agriculture is handled in the standard GTAP model, based on recent econometric studies – and it seeks to reflect the consensus reached by the OECD in its partial equilibrium agricultural modeling activities (OECD, 2001).

First, GTAP-AGR incorporates a region-specific elasticity of land transformation amongst agricultural uses. While land is specific to agriculture in the GTAP model, the new parameters in GTAP-AGR make land within the agricultural sector less responsive to changes in relative land rents across uses.

Second, the GTAP-AGR model incorporates region-specific labour and capital supply elasticities in constant elasticity of transformation functions that allocate the aggregate endowments of labour and capital between agricultural and non-agricultural sectors. The limited mobility of labour allows for wage differentials

between agriculture and non-agricultural sectors, and the same is true for capital. These factor supply elasticities are based on estimates from the OECD (2001).

Third, the GTAP-AGR model also allows for substitution among farm-owned and purchased inputs, and between the two, by calibrating each sector's constant elasticity of substitution cost function to the region-specific Allen elasticities of substitution provided by OECD (2001) estimates.

Fourth, the livestock production function is modified to capture more realistic substitution possibilities in feed demand, by modeling the substitution possibilities for feedstuffs as an additional CES nest in the sector's cost function. This livestock production function is parameterized based on a three-stage model describing the behavior of European livestock producers, composite feed mixers, and grain producers (Surry, 1990).

Finally, the consumer demand system in the GTAP-AGR model is re-specified, imposing separability of food from non-food commodities, and calibrating the agricultural and food demands to a recent set of price and income elasticities from a cross-country study of international food demand (Seale *et al.*, 2003).

6. Some words of caution about the GTAP-AGR model

While the GTAP-AGR model provides useful insights into trade policy simulation in a computable general equilibrium (CGE) setting there are two important caveats that are worth mentioning. First, there are many parameters in the GTAP model, and they are all uncertain to some degree. Another limitation of the GTAP model is that the quality of information and sensitivity of the results to assumptions do not warrant assertions of a degree of precision in simulations of the future. However, behavioural parameters and elasticities embedded into the model are based on estimates of most prominent research work and official sources. It is up to further research to come forward with more relevant estimates.

7. Experiment design

The agricultural trade liberalization strategies of the SSA region evolves with regard to negotiations at the bilateral level, regional level and multilateral level. In order to assess the impact of agricultural trade liberalization on food security, three experiments are carried out to reflect potential scenarios at the bilateral, regional and multilateral level:

- *Experiment 1 (E1)*: unilateral trade liberalization among SSA through implementation of the regional integration agenda at the continental level which implies a full-fledged FTA (free trade area) among EAC, SADC and COMESA.
- *Experiment 2 (E2)*: economic partnership agreement (EPA) with European Union (EU). The trade agenda of many SSA countries including SA is to establish bilateral trade agreements with the EU. Several countries have already initiated interim EPAs and others are likely to follow suit. A FTA between EU and SSA is thus considered.
- *Experiment 3 (E3)*: this is a multilateral Doha trade liberalization scenario, in which all countries cut tariffs albeit at different rates, which affects trade flows and prices globally. The tariff reduction rules are based on the WTO agriculture texts (December 2008).

8. Empirical results

Based on the availability of variables in GTAP, the following indicators will be used to measure the impacts of trade policies on a country/region's food security:

food production, food import bills, export earnings, household income, land value and wage of unskilled labour, world and domestic market prices and welfare.

Generally speaking, we might expect that the elimination of import tariffs will be pro-poor if the tariffs initially protect sectors that use factors (capital, etc.) that provide a small share of income for the poor. On the other hand, the poor may consume proportionately less of import (or import-competing) goods and thus benefit less from the resulting reduction in the prices of these goods. In this general equilibrium framework, the resulting income and consumption effects will, in turn, feed back into the model and influence the overall results.

We begin with the initial tariff rates and trace the impacts of their elimination through the model, from sectoral supply and demand to factor remuneration and, finally, household income and consumption, bearing in mind that in a CGE model all variables interact and are determined simultaneously.

For the purpose of this study, we present the simulated results only for the major farm level sectors in SSA. These consist of paddy rice, wheat, cereal grains, vegetables, fruits and nuts, oilseeds, sugar cane and sugar beets, plant based fibers, crops, bovine cattle, sheep, goats, horses, animal products and raw milk.

Impact on sectoral food production and trade

Table IV presents sectoral supply and demand effects. In response to the price changes, production of commodities would adjust in line with its comparative advantages and new competitiveness of crops in these countries under different scenarios.

Under the Tripartite FTA, the SSA region expands its production of sugar cane and sugar beets, bovine cattle, sheep, goats, horses quite minimally. However, production of some products contracts such as crops and cereals. Thus, for these commodities, participation in the FTA leads to substitution of low cost imports from non-members for high cost goods from members and the country loses welfare.

In general, there was an increase in the production of agribusiness products within SSA with variation in magnitude among the various commodity groups with the EPA to be in place. The same observation applies with trade liberalization at the

	Production (qo)			Imports (qim)			Exports (qxw)		
	E1	E2	E3	E1	E2	E3	E1	E2	E3
Paddy rice	0	3.91	0.01	3.41	12.1	-6.96	0.88	3,094.9	1.47
Wheat	0.48	-7.52	2.5	1.82	17.51	-7.12	223.99	172.97	17.67
Cereal grains	-0.48	1	0.03	22.6	4.57	-0.42	24.78	2.92	0.49
Vegetables, fruits and nuts	-0.2	0.69	-0.05	8.32	13.57	-0.92	-0.61	13.91	1.33
Oilseeds	1.78	-2.91	0.46	9.78	4.91	-1.55	2.99	-23.2	5.02
Sugar cane and Sugar beets	2.62	53.13	0.18	3.63	18.18	-4.74	-2.6	1,597.02	-3.21
Plant based fibers	0.02	-9.45	-3.95	5.18	3.86	-1.99	-0.91	-15.97	-11.91
Crops	-0.52	-5.08	1.29	85.7	12.1	0.55	1.65	-12.04	3.98
Bovine cattle, sheep, goats, horses	0.56	24.34	-0.08	2.88	13.76	-1.64	-1.05	24.65	5.58
Animal products	1.05	1.43	-0.37	3.77	12.53	-0.78	-0.84	-2.96	0.01
Raw milk	1.4	2.31	-0.18	3.49	22.59	-2.52	-4.28	-33.04	4.34

Note: Experiments E1, E2 and E3 defined in Section 1.6

Source: Simulation results from GTAP-AGR model

Table IV.
Impact on sectoral output
and trade (\$ million)

multilateral level. There is evidence that farmers do respond to relative (crop) prices, and in particular they will shift into food production if prices increase relative to export crops. However, their ability to increase production and exports to respond to increased incentives will be constrained by farming practices, limited access to inputs, credit and new technologies.

Impact of trade volumes

Initial tariff rates are highest in the paddy, other food crop and it is these sectors that experience the greatest increase in import volumes following the elimination of tariffs. These results hold for the Tripartite FTA and EPA which consists of tariff liberalization only.

In the same vein, a reduction in tariffs by the developed importing countries will increase the world price of the product, benefiting exporters, hurting importers and leading to an ambiguous effect on those turning from importers to exporters. But this standard analysis is complicated by the presence of trade preferences. The reduction in the tariff cuts into the preference margin of the beneficiary countries and lowers the profitability of their exports. This can be clearly seen under the EPA scenario for sugar cane, crops and raw milk.

As it can be seen from Table II, under the Doha scenario, imports actually decrease as other support measures in developed countries are removed. SSA agricultural products tend to become more internationally competitive as shown by the increase in exportation of wheat, oilseeds and bovine cattle, sheep, goats, and horses. In summary, trade liberalization engenders a clear sectoral reallocation of resources across the various commodity groups depending on level of tariff rates.

Impact on food import bills and export earnings

Table III presents data on SSA's agricultural exports and imports as affected by liberalization under the three scenarios. Under all three scenarios, SSA's balance of trade in agricultural products improves. The most substantial improvement in trade balance is under the EPA with trade surplus of \$4.9M. This concurs with a priori expectations as EU is the major trading partner for SSA. The scenarios, however, are not similar at the product level. It should be pointed out that unilateral trade reforms under Tripartite FTA do not affect the price received by exporters (multilateral liberalization may affect world prices). This is reflected in the magnitude of change in exports.

Note that tariff liberalization leads to an increase in SSA's agricultural exports and a decrease in its imports. Why do the imports decrease? The agricultural tariff reductions imposed on SSA are minimal and the lower cost of inputs imported for the agricultural sector improves the sector's competitiveness, so fewer agricultural products are imported and more are exported even though the cut in domestic agricultural tariffs is small.

Table V provides the food import bills, the percentage changes in ratios of food import bills in agricultural export earnings and total export earnings. For example, trade liberalizations increases the food import bills in SSA as a result of a higher import prices under all experiments, causing consumption and also imports to contract and domestic production to increase. However, for several commodity groups the lower agricultural export prices discourage the agricultural export much more compared to

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	Imports (VIWCIF)			Exports (VXWFOB)			Imports/exports		
	E1	E2	E3	E1	E2	E3	E1	E2	E3
Paddy rice	3.5	42	-6.59	1.4	3,323.23	-0.01	2.5	0.0	659.0
Wheat	1.82	37.31	-5.52	225.44	186.31	16.4	0.0	0.2	0.3
Cereal grains	23.17	11.95	-1.45	25.2	10.45	-0.9	0.9	1.1	1.6
Vegetables, fruits and nuts	9.56	28.47	-1.97	-0.05	22.77	-0.09	191.2	1.3	21.9
Oilseeds	10.71	13.19	-2.21	3.78	-17.78	3.56	2.8	0.7	0.6
Sugar cane and sugar beets	3.7	69.97	-4.52	-2.08	1,749.18	-4.69	1.8	0.0	1.0
Plant based fibers	5.61	3.17	-3.58	-0.52	-11.88	-13.71	10.8	0.3	0.3
Crops	83.39	33.33	-0.67	1.98	-7.09	2.61	42.1	4.7	0.3
Bovine cattle, sheep, goats, horses	3.84	87.5	-2.4	-0.54	33.96	4	7.1	2.6	0.6
Animal products	4.22	26.5	-1.92	-0.23	3.66	-1.46	18.3	7.2	1.3
Raw milk	3.53	55.56	-2.87	-3.63	-28.02	2.82	1.0	2.0	1.0

Source: Simulation results from GTAP-AGR model

Table V.
Food import bills
and export earnings
(\$ million)

the food imports. On the other hand, with trade liberalization under Doha, SSA experiences a decrease in its food import bill.

As for the ratio of food import bills in total export earnings, there is no consistent direction. But in general, agricultural trade policy reforms lead to the declining of this ratio, with the exception of two scenarios in SSA: manufactured trade reform, combined with agricultural reforms.

Impact on household income and factor prices

Household income is an indicator of poverty and market access to food. Higher income can improve the food security by increasing the purchase power of the households. The changes of household income are reported in Table VI. In SSA, the positive signs of changes under Tripartite FTA and EPA with agricultural reform indicate the potential for improving food security. In other words, there is evidence of a decline in income metric poverty in SSA as a result of these trade reforms, whether carried out unilaterally (Experiment 1) or as part of a bilateral agreement under EPA (Experiment 2).

	E1	E2	E3
Household income	0.22	3.75	-1.57
Factor prices (land, crops)			
Paddy rice	0.53	14.35	0.53
Wheat	1.03	-0.72	1.03
Cereal grains	-0.11	10.89	-0.11
Vegetables, fruits and nuts	0.34	10.78	0.34
Oilseeds	2.67	5.98	2.67
Sugar cane and sugar beets	3.48	77.57	3.48
Plant based fibers	0.49	-3.02	0.49
Crops	-0.15	2.59	-0.15
Bovine cattle, sheep, goats, horses	1.16	39.82	1.16
Animal products	1.76	11.13	1.76
Raw milk	2.19	12.6	2.19

Source: Simulation results from GTAP-AGR model

Table VI.
Changes in real
household income percent
deviated from baseline (y)

These results are in contrast with the outcome under Doha experiment, where there is a -1.57 percent fall in real household income. The main reason for this marked deterioration in income could be from the increased competition and fall in exports as highlighted above.

In order to identify the income distribution effect on food security, it would be useful to look at the change in market price of major primary factors, especially land and labour and the simulation results are reported in Table IV. The results reflect mixed effects, depending on the scenarios. The land prices in other SSA would have significant increases in all scenarios. This result may indicate an improvement in food security for poor, smallholder farmers. However, the most vulnerable and marginalized rural groups in Africa often lack access to land. Ensuring land rights to these farmers can improve their household income and basic level of food security as trade liberalization can increase the land price.

Let us now see how these production effects influence unskilled labour. Agricultural trade liberalization results in increased wages for unskilled labour in all experiments. The impact of trade liberalization in the agricultural sector on unskilled labour wage varies between crops. Wage rate increases in both experiments, though the increase under EPA (E2) is only about half of that in Doha (E3). With labour supply being fixed, this essentially reflects the increase in labour demand due to the expansion of labour intensive agricultural production. In E1 (Tripartite FTA), the contraction in non-agricultural output mutes the increase in labour demand, and hence the wage rate increases by a lesser amount.

Impact on consumption

To assess the impact on food security in households, we also need to examine the changes in consumption pattern consequent to the policy changes. Given tastes and preferences of consumers, changes in consumption pattern can be expected following: a rise in real income levels; and changes in relative prices of different commodities.

We have seen earlier that real incomes of all households have risen under the EPA and Tripartite FTA but falls in the Doha experiment. The price changes have not been much favourable to the poor as seen in the price linkages table reported below.

Within food items, the rise in price of processed foods (which includes vegetable oils and other processed foods) is lower than that of cereals, non-cereal food crops, dairy, meat and fish. It may be noted that processed foods are a major source of fat, while cereals, non-cereal food crops, dairy, meat and fish are major sources of calories and proteins (Table VII).

The impact on total welfare

Table VIII shows the welfare analysis, which is measured by equivalent variation (EV). In general, it can be observed that there are positive welfare gains under all the three trade liberalization scenarios with the most substantial improvement under the EPA experiment and least welfare gains under tripartite initiative.

Welfare can be further decomposed into many components; two of these major components which affect EV are terms of trade and allocative effect. Our results indicate that the decomposition of welfare impacts is much different under the various scenarios. However, it can be noticed from the table above that the terms of trade effect is an important factor in welfare gains/losses under trade liberalization.

	Import price			Consumption			Domestic price		
	E1	E2	E3	E1	E2	E3	E1	E2	E3
Paddy rice	-0.13	-0.22	-0.13	0	2.97	0.08	0.51	7.15	-1.46
Wheat	-0.01	-4.27	-0.01	-0.19	-8.09	4.97	0.45	4.89	-1.08
Cereal grains	-15.11	0.7	-15.11	-1.04	0.96	0.06	0.34	7.32	-1.38
Vegetables, fruits and nuts	-4.23	-6.22	-4.23	-0.16	-0.51	0.02	0.57	7.78	-1.4
Oilseeds	-2.32	2.13	-2.32	1.63	-0.29	-0.07	0.77	7.05	-1.39
Sugar cane and sugar beets	-0.11	0.89	-0.11	2.64	49.1	0.08	0.54	8.96	-1.53
Plant based fibers	-1.2	3.45	-1.2	1.04	-2.39	-1	0.4	4.88	-2.04
Crops	-17.75	-2.28	-17.75	-2.01	-0.28	0.13	0.32	5.63	-1.31
Bovine cattle, sheep, goats, horses	-0.4	-2.57	-0.4	0.56	24.34	-0.1	0.51	7.47	-1.5
Animal products	-1.25	-6.37	-1.25	1.12	1.59	-0.43	0.62	6.82	-1.47
Raw milk	-0.15	-3.89	-0.15	1.41	2.37	-0.1	0.69	7.5	-1.46

Source: Simulation results from GTAP-AGR model

Table VII.
Impact on consumption
(\$ million)

	E1	E2	E3
Welfare	29.0	1,735.4	257.47
Allocative efficiency	17.0	455.4	-129.5
Terms of trade	8.3	1,363.0	444.0

Source: Simulation results from GTAP-AGR model

Table VIII.
Changes in welfare
(\$ million)

9. Conclusions

For many SSA countries, especially the poorest, the relationship between trade reform and food security is likely to provide the foundation of one of the most critical debates of the agricultural trade liberalization negotiations. This paper seeks to provide useful insights to policy makers in SSA on the impact of alternative trade liberalization strategies on food security. Although the food security problem cannot be solved by trade policies alone, a reduction or elimination of trade-distorting policies can contribute considerably to establishing an enabling international environment for trade and development in the poor countries.

International trade can have a significant impact on reducing hunger and poverty in developing countries. Freer trade allows access to larger markets and opens up opportunities for specialization in production and economies of scale. However, free trade can have a negative impact on food security in some developing countries, which are net food importers and/or have a preferential market access to developed countries currently. Non-trade issues like food security and rural development have gained greater prominence in the on-going round of WTO negotiations.

The WTO's agreement on agriculture fundamentally covers three areas: market access, domestic support and export subsidy; each of which has a link with food security. The rules on the three pillars were aimed at creating a fair and market-oriented agricultural trading system. The results indicate that multilateral trade reform could actually worsen the food security situation in the SSA region.

Nonetheless, this concern should not hold the implementation of the current proposals as the short-term negative effects can be ameliorated by resorting to alternative measures such as strengthening the Marrakesh Decision and the extension of meaningful special and differential treatment provisions for these countries. Consistent with parallel studies, the results here show that the welfare of SSA will suffer from trade liberalization as its preferential market access erodes. The impact of multilateral reform on food security is examined under a plausible Doha Scenario. It is to be noted that under this experiment, the results are pro-poor with positive welfare gains and decline in domestic and import price for most commodities.

The strengthening of RECs in Africa through the Tripartite FTA is a laudable initiative to promote food security. The Tripartite FTA is an important step to address the problem of overlapping membership in SSA and removal of trade barriers. There is enormous potential for Africa to feed itself. Of major interest to us is the improvement of production and intra-regional trade in the SSA region as a result of the FTA. The empirical results do confirm that production of agricultural products would increase especially with regard to the major commodity groups identified in this study.

The fact that we are discussing food security in Africa, and that there are many resources available that address the topic, is evidence that multi-stakeholders care about Africa's food security. For it to become a reality, we should take the cue from NEPAD's first strategic objective and facilitate African leadership to take ownership of and responsibility for Africa's development agenda.

Another major trade strategy that has been analysed in this paper concerns the EPAs being negotiated between the EU and ESA states. As this bilateral agreement would deal with both the manufacturing and agricultural sector, the general equilibrium setting adopted in this study to assess the impact on food security is the most relevant one. Actually, the results under the EPA indicate that SSA could gain further market access for certain products where they have comparative advantages. There is also a tendency to have lower import prices for most commodities but increase when elimination of export subsidies and domestic support are taken into account.

Note

1. List of SSA countries: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Brazzaville), Congo (Democratic Republic), Côte d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda.

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