The impact of the increasing world food prices on the agricultural trade sector of the Sudan

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ABSTRACT

The objective of this study was to assess the responses of economic variables (supply and demand) to the world high prices and their consequences on the agricultural trade of Sudan, in addition to estimate the impact of liberalization policies. In this study a multi-market, partial equilibrium model is used as a main tool to assess policy and the price impact on the agricultural crop markets of the Sudan. Partial equilibrium models are the most widely used models to assess the effect of various policy interventions on agricultural sector. The high world prices has a positive impact on the agricultural markets supplies. This improvement is reflected in the growth of local supplies of the import substitutes of wheat and rice. With regard to the demand for agricultural goods, rising prices incapacitate consumers access to staple food that is reflected by the noticeable decrease in the quantity demanded for most of the agricultural goods especially the imported and locally produced cereals. Regarding the impact on trade, agricultural crop markets are showing improvement under the high prices scenario; evident by the increase in export growth rate of 335.9%. Following the recommendations of the World Bank to lower domestic prices through reducing tariffs and other taxes on key staples, the liberalization scenarios are introduced to the model. Under these scenarios, market supplies would show positive responses at lower rates. The demand of major cereals will fall at lower levels than that with the existence of taxes.

INTRODUCTION

Agriculture is the most important sector in Sudan's economy. It contributed an average of about 43% of the country's gross domestic product (GDP) during the period 1999-2006. The sector provides employment for about 70 percent of the country's population, and provides inputs to many major manufacturing industries (Abdelkarim and Alfahal, 2007). Historically agriculture generated the bulk of Sudan's foreign exchange earnings through a diversified basket of exports which can be broadly classified into three categories that include field crops, animal and forest exports. The share of agricultural exports in total country's exports is declining because of the growing exports of oil sector; this share has declined to only 4.4% in 2008 compared to14.6% in 2001. Sudan enjoys the preconditions for a strategy of boosting its agricultural exports, which started to decline in terms of value each year since its peak in 2004 of $569 million to an estimated $508.9 million in 2008 (Table 1).

The major imported food item in Sudan is wheat. Due to its low and variable domestic production, imports of wheat and wheat flour in terms of wheat equivalent have been escalating, reaching about 1.183 million tons in 2008 compared to about 0.52 million tons in 2001. The value of imported wheat has increased from US$ 109.6 million in 2001to US$ 715.3 million in 2008 (Table 1). Total cereal production in the country has ranged over the last five years between 4 and 6 million tones. It accounts for about 65% to total annual grain requirements (El-Dukheri, 2007).

Table 1. Agricultural exports and wheat imports in Sudan (2001-2006).

Year	Agricultural exports (million US$)	Share of agricultural exports in total exports (%)	Wheat imports quantity (million tons)	Wheat imports value (million US$)
2001	240.6	14.9	0.52	109.7
2002	356.2	18.8	1.03	199.3
2003	410.3	16.1	0.90	190.5
2004	590.7	16.5	1.06	255.6
2005	578.8	12.0	1.45	373.9
2006	569.4	10.0	1.36	336.5
2007	412.3	4.6	1.13	363.6
2008	508.9	4.4	1.18	715.3

Source: Bank of Sudan annual reports (2001-2008)

During 2007 and 2008, the world market prices of food have reached unprecedented levels. In 2007, the international food price index rose by nearly 40%, compared with 9% the year before, and in the first three months of 2008, prices increased further by about 50% between January 2007 and January 2008. Wheat nominal prices rose by 240% and real prices by 172%. Wheat export prices from USA climbed from $375/ton in January to $425/ton in February 2008 (Von Braun *et al.*, 2008). The expected growth in global demand for agricultural commodities has outstripped the growth in supply. As a consequence, the trend in prices has been positive. The tendency towards higher prices than in the past may be expected to continue for the next few decades (Witzke *et al.*, 2009).

The Food and Agriculture Organization (FAO) has attributed the dramatic increase in food world market prices to factors related to both supply and demand of food in the world. Regarding the supply side, weather related production shortfalls, the declining stock levels and the increasing fuel costs are the main factors that have negatively affected the supply of food in the world. On the demand side, the increasing demand for agricultural commodities for biofuels production and the changing structure of food demand in emerging economies are considered as major factors that have increased world food prices (FAO, 2008).

To lower domestic prices, the World Bank has recommended an option that includes reducing tariffs and other taxes on key staples. Many countries impose tariffs on food imports, so as to encourage domestic production and boost domestic revenue. In times of sharply increasing prices, reductions in tariffs and taxes can provide some relief to consumers, albeit at a fiscal cost. The revenue loss from reducing tariffs can be significant and the fiscal implications of combining this with additional social protection expenditures may well require cutbacks in lower priority areas (World Bank, 2008).

Despite the liberalization and privatization policies adopted by the government and declaration of supporting agricultural sector, heavy taxes are still imposed on agricultural production and export in different kinds. A number of government agencies at both local and national levels impose taxes, charges, and fees that raise the cost of international trade e.g. administration fees, transportation fees, production fees and other domestic taxes such as Zakat, State support fees, ports fees, profits tax and others. For example, local taxes and fees charged on major export crops can also make up large shares of export prices that reach 17% for sesame and 15–20 % for groundnuts (World Bank, 2008).

The main objectives of the study were to:

1- Assess the responses of economic variables (Supply and demand) to the high world prices and their consequences on agricultural trade of the country.
2- Analyze what could have happened if liberalization policies were rotated around reducing tariffs and export taxes.

METHODOLOGY

A multi-market model for Sudan agricultural crop markets: General features and equations

In this study, a multi-market partial equilibrium model is used as a main tool to assess policy and the price impact on the agricultural crop markets of the Sudan.

The strength of partial equilibrium modeling as a way of understanding the Sudanese agricultural market rests on several reasons. Firstly, using partial equilibrium analysis is empirically not complicated and the analysis thereof reasonably approximates the general effects of trade policy changes where weak links between commodities and their supplier or output sectors may exist (Perali, 2003). Secondly, partial equilibrium analysis provides useful information on the impact of trade and policy changes at very detailed product and sectoral levels, hence allowing for the utilization of widely available trade data (Lang, 2006; Thurlow and Holden, 2005; Wubeneh, 2006).

In this study, Sudan economy is modeled as a small open economy on both the import and export sides of the agricultural commodities. The model under consideration takes the normal specification of a standard partial equilibrium model; it is static and consists of a set of demand and supply equations for each commodity with the level of supply and demand determined by factors including prices, income, demand and supply shift variables and various other assumptions about policies (Jechlitschka *et al*.,
2007). In specifying supply and demand functions for each product market, domestic prices for one market help to determine the quantity supplied and demanded not only in that market but also in the other markets through cross-market price linkages. Price transmission equations in the model establish links between producer price (for producers of exportable products and of import-substitute products) and the consumer price and the world market price.

Ten key agricultural crops (wheat, rice, sorghum, millet, sesame, groundnut, sugar, gum arabic, cotton and livestock) are considered in the model. The major exports crops are sorghum, millet, sesame, groundnut, sugar, cotton, gum arabic and livestock, while, wheat and rice are the main import

substitutes. The model has been extended to calculate the impact of high world food prices on agricultural trade.

The supply component equations

The supply of each commodity is represented by the quantity produced which is a function of its own price and the prices of the competing commodities. The product supply equations are represented as follows:

$$q_i^s = c_i * (p_i^s)^{\varepsilon_{ii}} * \prod_{j \neq i} (p_j^s)^{\varepsilon_{ij}}, \qquad i, j = 1,....10 \qquad (1)$$

where:

q_i^s denotes the amount of the i[th] commodity supplied.

c_i is the supply calibration coefficient of the i[th] commodity.

p_i^s is the supply price of the i[th] commodity.

p_j^s is the supply price of the j[th] commodity.

ε_{ii} is the supply price elasticity of the i[th] commodity.

ε_{ij} is the supply cross price elasticity of the products j[th] that are competing with the i[th] commodity.

j is the set of relevant competing substitutes of the i[th] commodity.

The demand component equations

On the other hand, the demand (consumption) quantity of a commodity is set to depend on its own price, the prices of close consumption substitutes or complementary commodities and the consumer per capita income. So, the system of the demand function can be expressed as follows:

$$q_i^d = b_i * (p_i^c)^{\eta_{ii}} * \prod_{j \neq i} (p_i^c)^{\eta_{ij}} * I^{\mu_i}, \qquad i, j = 1,....10 \qquad (2)$$ where:

q_i^d denotes the amount of the i[th] commodity demanded.

b_i is the demand calibration coefficient of the i[th] commodity.

p_i^c is the demand price of the i[th] commodity.

I is per capita income.

η_{ii} is the demand price elasticity.

η_{ij} is the cross price elasticity of the i[th] commodities that are complementary or substitutes for the j[th] commodities.

μ_i is the income elasticity of the i[th] commodity.

Price transmission in the model

The illustration of the price-linkage equations assumes that the government could control the domestic price through price policy measures. Also, it assumes that the movements of producer and consumer prices are connected to the world price movements (for exportable products and import-substitute products).

Producer and consumer prices of the export and import-substitute commodities are shown by the following equations:

(i) Producer price

$$p_i^s = p_i^w(1+r_i)*(1-t^p) \quad (3)$$

(ii) Consumer price

$$p_i^c = p_i^w(1+r_i)*(1+t^c) \quad (4)$$

where:

p_i^s is the producer price for commodity i.

p_h^c is the consumer price for commodity i.

p^w is the world price of commodity i.

t^p is the domestic rate of the producer's tax.

t^c is the domestic rate of the consumer's tax.

r_i is the protection rate of the commodity.

Trade indicators

In order to assess the effect of the high world food prices on the major agricultural crop markets of the Sudan, selected trade indicators used by the United Nations are implemented. Simple and composite indices are established as recognized approaches in monitoring progress in achieving various policy goals or in benchmarking various policy options. The indicators include growth rate of exports, export propensity, import penetration, marginal propensity to import and export/import coverage.

Growth rate of exports

The growth rate of exports is one of the most common indicators used when assessing the progress of an economy in any area of economic activity. Often the rate is calculated at level of product groups to identify 'dynamic sectors.' The growth rate calculates the annual compound percentage change in the value of exports between two periods. The growth rate is a percentage, and can take a value between -100 % (if trade ceases) and + ∞. A value of zero indicates that the value of trade has remained constant.

$$\text{Growth rate of exports} = \left[\left(\frac{\sum X_j^1}{\sum X_j^0}\right)^{\frac{1}{n}} - 1\right]*100 \quad j = 1,\ldots, 8 \quad (5)$$

where:

$\sum X_j^0$ is the bilateral total export flow of the commodities in the start period.

$\sum X_j^1$ is the bilateral total export flow of the commodities in the end period, and n is the number of periods (not including the start).

Export propensity

The index shows the overall degree of reliance of domestic producers on foreign markets. The index provides an indicator of vulnerability to certain types of external shocks (e.g., increase or falls in export prices or changes in exchange rates). The ratio is expressed as a percentage and it ranges from zero (with no exports) to 100 (with all domestic production exported).

Export propensity = $\frac{\sum X_j}{GDP} * 100$ $j = 1,\ldots, 8$ (6)

where:

$\sum X_j$ are total bilateral exports of cotton, sorghum, sesame and ground nut and millet in the markets under study, and GDP is agricultural gross domestic product of the country (the covered commodities in the model).

Import penetration

The import penetration rate shows to what degree domestic demand (the difference between GDP and net exports) is satisfied by imports. Calculated at the sectoral level it is termed the self-sufficiency ratio. The ratio ranges from zero (with no imports) to 100 percent when whole domestic demand is satisfied by imports only (no domestic production and no exports).

Import penetration = $\frac{\sum M_i}{GDP - \sum X_j + \sum M_i} * 100$ $j = 1,\ldots, 8$ and i=1,2 (7)

where:

$\sum X_j$ is total bilateral exports of the country under study.

$\sum M_i$ is total bilateral imports of wheat.

GDP is the agricultural gross domestic product of the country (the covered commodities in the model).

Marginal propensity to import

The marginal propensity to import (MPM) measures the extent to which imports are induced by a change in incomes. Moreover, higher MPM reduces the multiplier effect of an increase in GDP. The ratio ranges between 0 (with no part of extra GDP spent on additional imports) to 1 when the whole extra GDP created is spent on imports.

Marginal propensity to import = $\frac{\Delta \sum M_i}{\Delta GDP}$ (8)

where:

$\Delta \sum M_i$ is the change in imports (wheat) of the country under study.

$\Delta \sum GDP$ is the change in agricultural gross domestic product of the country (for the covered commodity markets in the study).

Export/import coverage

This index is an alternative to the normalized trade balance. It tells whether or not a country's imports are fully paid for by exports in a given year. The values for this index range from 0 when there are no exports to + ∞ when there are no imports. A ratio of 1 signals full coverage of imports with exports (trade balance).

$$\text{Export/import coverage} = \frac{\sum X_j}{\sum M_i} \quad (9)$$

where:

$\sum X_j$ is the bilateral total export flow.

$\sum M_i$ is the bilateral total import flow in the end period.

Scenarios

Three policy scenarios are formulated to analyze the impact of world high food prices on Sudan's agricultural markets and agricultural trade sector. The first scenario simulates the increasing world prices of food of 2008 where all commodities have experienced price rise compared to the base year of 2006 except sugar and gum arabic. The second scenario is partial liberalization scenario. Under this scenario, the taxes in the base period were reduced by 50% for the covered commodities on the model. The third scenario is full liberalization scenarios under which the taxes in the base period were reduced by 100% for the covered commodities on the model.

RESULTS AND DISSCUSSION

The supply response

Table 2 shows a summary of the supply responses of the major Sudanese commodity markets to the world market prices under the scenarios of no intervention, partial liberalization and full liberalization policies.

The import substitute crops markets of wheat and rice show significant supply increase in response to high world prices under the prevailing system of taxes. Thus, wheat supply could increase by 23.6% relative to the basic model in the first scenario which represents the supply under the 2008 world prices without policy intervention. However, this increasewould slow down under policy intervention in the second and the third scenarios of partial liberalization and full liberalization where wheat supply would increase by only 16.4% and 12.8%, respectively. Similarly, rice supply increases by 23.8%, 22% and 20.3% in the three scenarios, respectively. This is attributed to the noticeable increase in producer prices in the first scenario compared to the second and the third scenarios in which producer price would decrease due to the cut in value added tax (VAT) by 50% and 100%, respectively.

The supply of exported cereals (sorghum and millet) reveal different responses. Under the first scenario, sorghum supply could increase by only 2.1%. This could be attributed to less increase of its international prices compared to the competing crop markets especially sesame and groundnut, while its supply could decrease by 0.5% and by 2.1% in the second and third scenarios, respectively. In the same direction, the supply of millet response showing slight differences among the three scenarios. The exported oil crop markets of sesame and ground nuts expose in general an increasing trend in supply response in the three scenarios. This is attributed to the high increase in producer prices and the removal of taxes in the second and third scenarios which are higher relative to those of competing crops. The changes in the supply quantities of sugar and gum arabic show negative response because they, unlike other crops in the model, have experienced a fall in their world prices compared to the base year. However, in the second and third scenarios they responded positively to the liberalization policies since tax removal would result in higher producer prices. Cotton supply was reflected in a negative supply response in all scenarios because its world price increase is minimal relative to its competitive crops,

especially, wheat. Livestock supply would respond positively to the price and to tax elimination in the second and the third scenarios.

Table 2. Changes in supply, effect of world market prices (first scenario) and the liberalization scenarios.

Market	Basic scenario	Without policy intervention		Partial liberalization		Full liberalization	
	supply (1000 ton)	Supply (1000 ton)	% change	Supply (1000 ton)	% change	Supply (1000 ton)	% change
Wheat	416	514.3	23.6	484.4	16.4	469.4	12.8
Rice	1	1.2	23.8	1.2	22.0	1.2	20.3
Sorghum	4327	4416.6	2.1	4304.9	-0.5	4236.5	-2.1
Millet	675	718.5	6.4	715.2	6.0	718.7	6.5
Sesame	400	433.5	8.4	440.5	10.1	450.2	12.6
GN	555	579.1	4.3	604.2	8.9	625.5	12.7
Sugar	728.1	715.8	-1.7	741.8	1.9	742.9	2.0
Gum arabic	11.6	10.2	-11.9	13.2	13.7	13.2	14.0
Cotton	394	373.2	-5.3	367.4	-6.7	364.8	-7.4
Livestock	50390	50974.1	1.2	51234.1	1.7	51468.1	2.1

Cotton in thousand bale, livestock in thousand head
Source: Author own results

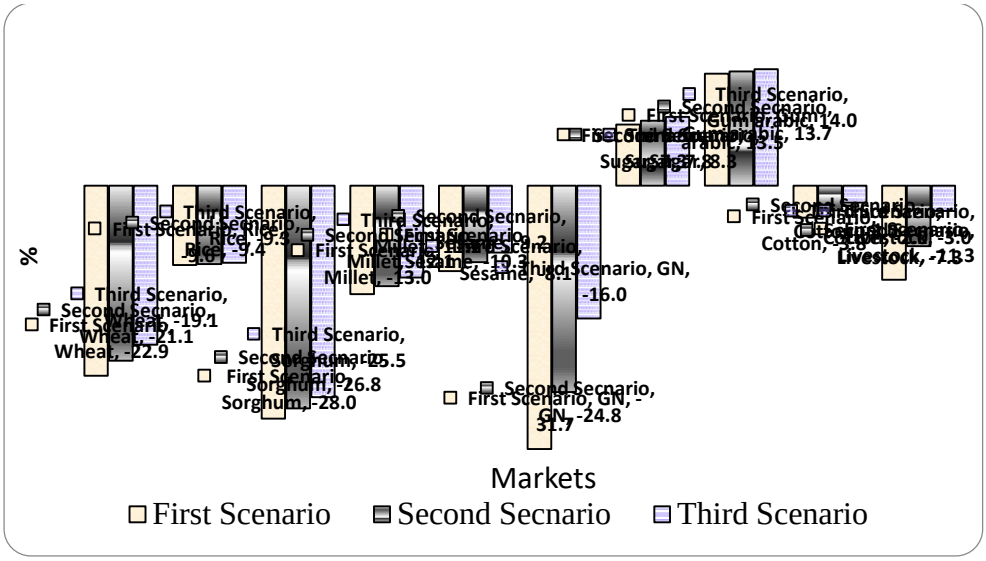
The demand effect

Figure 1 illustrates the simulation results of demand responses under the three scenarios. Policy intervention by removing tariffs and export taxes at 50% and 100% in scenario two and three respectively, mainly designed to improve consumer's food accessibility and to alleviate the effect of the high world market prices. All consumers markets tend to have higher prices except that for sugar and gum arabic.

Starting with the demand for import substitutes like cereals, it would decrease considerably in the first scenario, especially wheat (-22.9%), because of the remarkable increase of its world market price coupled with the imposed value added tax (VAT) rate of 10% reflected in a high level of consumer price. Due to the policy intervention in the second and the third scenario the negative impact on demand for wheat could be reduced to -21.1 and -19.1% , respectively. Rice demand is showing a slight decrease in the second and third scenarios because of wheat demand substitution effect. With regard to exported cereals, the demand for sorghum and millet, the major staple food, would be negatively affected by the world market price increase in the first scenario. However, this effect could be reduced by policy intervention in the second and third scenarios to -11.7% and -11%, respectively, for sorghum and to only -9.6% and - 8.7% respectively, for millet.

In the markets of oil seeds, the largest decrease in demand is observed in groundnut (-31.7%) in the first scenario. This is due to the effect of the increase in world prices and the high taxation. Both sesame and groundnut reveal a sharp decrease in consumers demand. This would be less in the second and third scenarios due to the cuts of export taxes.

The only exception is sugar and gum arabic which have lower world prices than the base scenario. Accordingly, their demand show an increase because of the lower consumer prices in the first scenario. The demand would show higher increase because of export tax cuts in the second and third scenarios.



Source: Author's own calculations

Figure 1. Changes in demand, effect of world market prices and the liberalization scenarios.

Ending with the classical export commodities (cotton and livestock), their demand follows the demand theory and they show a decrease in their demand because consumer's prices increase in all scenarios compared to the base line scenario.

The trade effects

The increasing world market food prices have a positive effect on the trade sector of the Sudanese agricultural markets. However, the abolition of export taxes would entail an increase in producer prices and, on the other hand, a decrease in consumer prices and, hence, agricultural export is a result of the joint effect of increasing supply and demand.

Table 3 demonstrates the simulation results of trade indicators for the three scenario models. With regard to export indicators, total exports of the agricultural crops covered in the model would increase considerably in response to the price increase of 2008. The growth rate of exports shows an increase of 335% of agricultural exports. The increase in total exports is attributed to the remarkable increase of exports of sorghum, millet, sesame, groundnut, cotton and livestock. Despite the abolition of taxes in the second and third scenarios, the increase of consumption outweighs the supply increase resulting in an increase in export growth rate of 294% and 241%, respectively.

Export propensity index shows that domestic farmers earn about 7% of their income from foreign trade in 2006. This ratio could increase to 24% in response to the high world prices in 2008 in the first scenario. However, because of the increase of local demand resulting from liberalization policies, this index will fall to 21% and 18% in the second and the third scenarios, respectively.

On the side of import indicators, the import penetration index is used as the basis of specific policy objectives targeting self-sufficiency. It provides an indication of the degree of vulnerability to certain types of external shocks. The index shows that 77.5% of domestic demand for wheat and rice is satisfied

by imports at the 2006 world prices, while, this ratio could decrease at the 2008 simulated prices to reach 64.5% because of the decrease of imports of wheat and rice as a consequence of the high world prices. By introducing liberalization policies, the index will reach 66.5% and 68.4% reflecting the increase in imports resulting from the low prices of import substituting crop markets. The marginal propensity to import index explains that changes in imports between the 2006 and 2008 represents about 0.025 of the GDP changes. This index would increase under the scenarios of liberalization policies to reach 0.034 and 0.044, respectively. Finally, the export/import coverage index shows that exports could cover 5.3 times of imports at the simulated 2008 prices. This strengthens the ability of the country to finance its essential food imports. However, the index reflects lower export/ import coverage in the second and third scenarios of liberalization to reach 4.5 and 3.7, respectively. This deterioration is attributed to the high increase of imports substitute's prices relative to other export crop markets in spite of the effect of liberalization policies.

Table 3. The effect of world market prices on trade indicators under the different scenarios.

Trade indicators	First scenario	Second scenario	Third scenario
Growth rate of exports (%)	336.000	294.000	241.000
Export propensity	24.000	21.000	18.000
Import penetration	77.500	66.500	68.400
Marginal propensity to import	0.025	0.034	0.044
Export /import coverage	5.300	4.500	3.700

Source: Author's own calculations

CONCLUSIONS AND POLICY IMPLICATIONS

The world high prices has a positive impact on the agricultural markets supplies. This improvement is reflected in the growth of local supplies of the import substitutes of wheat and rice. Although the essential local food crops of sorghum and millet are facing high competition from exported crops of sesame and groundnut, they exhibit a noticeable increase in their supplies. With regard to demand for agricultural crops, the rising prices incapacitate consumers' access to staple food proved by the noticeable decrease in the quantity demanded for most of the agricultural goods especially imported and locally produced cereals.With regard to the impact on trade, the agricultural crop markets are showing improvement under the high prices scenario; proved by the increase in export growth rate by 335.9%, the increase of export propensity to 24% and the ratio or export/import coverage to 5.3 compared to the base year, which strengthens the ability of the country to finance its essential food imports. Following the recommendations of the World Bank of lowering domestic prices through reducing tariffs and other taxes on key staples, the liberalization scenarios are introduced to the model. The second and the third scenarios of partial liberalization and full liberalization entail reduction of taxes by 50% and 100%, respectively. These policies are serving the consumers, since they reduce domestic prices, reflected into less deteriorated food situation in the country. The demand of major cereals markets will fall at lower levels than that with existence of these taxes. With regard to the trade sector, the liberalization policy, partial or full, has positive impacts on the exports of agricultural commodities, on both quantity and value. The trade growth rate of the agricultural commodities is still greatly improved as a result of higher domestic prices compared to the

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تأثير الزيادة العالمية لأسعار الغذاء على قطاع التجارة الزراعية الخارجية في السودان

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الخلاصة

تهدف هذه الدراسة إلى تقييم استجابة المتغيرات الاقتصادية الزراعية للأسعار العالمية المرتفعة في العالم وأثارها على التجارة الزراعية الخارجية بالإضافة إلى تقدير أثر سياسات التحرير الاقتصادي. في هذه الورقة تم استخدام نموذج الأسواق المتعددة والتوازن الجزئي كأداة رئيسة للتحليل وتحليل اثر الأسعار على أسواق المحاصيل الزراعية في السودان، حيث تعتبر نماذج التوازن الجزئية من أكثر أنواع النماذج انتشاراً في استعمالها لتقويم اثأر السياسات في قطاع الزراعة .أوضحت النتائج إن الأسعار العالمية لديها اثر ايجابي على عرض السلع الزراعية وهذا التطور ينعكس في زيادة عرض السلع المحلية والسلع الاحلاليه المستوردة على حد سواء. أوضحت النتائج انه بالنسبة للطلب على السلع الزراعية فان الأسعار العالمية المتزايدة قد حدت من إتاحة الطلب عليها وذلك يتضح جلياً في نقص الطلب على معظم السلع الزراعية المنتجة محلياً. أما من ناحية التجارة الخارجية فان الأسعار المرتفعة أدت إلى تطور كبير فيها . وبإتباع توصيات البنك الدولي بتطبيق سياسات تعمل على تخفيض الأسعار المحلية وذلك من خلال تخفيض التعرفه الجمركية و الضرائب فان سيناريوهات سياسة التعرفة طبقت على النموذج حيث أوضحت النتائج إن عرض السلع الزراعية ما زال مرتفعاً وان الطلب على سلع الحبوب سينخفض إلي مستويات اقل مما كانت عليه.