Economic Consideration and Model Development Spatial Trade for Sorghum and Millet Staple Food in Sudan

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Abstract

This study deals with spatial trade analysis to explore the possibility of in-country inter and intra-regional trade between Southern Darfur State (SDS) and other selected States in the Greater Sudan. The productions and prices of staple food grain millet and sorghum in different States of the Sudan namely, Southern Darfur, Northern Darfur, White Nile, Southern Kordufan, Northern Kordofan, Gadaref and West Darfur, were the main concern of the analysis for the study time span 1993-2007. SDS is also highly grain trade connected to the currently independent South Sudan, where the State provides South Sudan with its whole consumption requirements from sorghum and millet. Descriptive statistic and regression analysis were used throughout the course of the study. The model of analysis used was based on Koaster [1], Correlation coefficient matrix. Regression equation was used for estimating a dependent variable from independent variables to determine the level of market co-integration among the market places covered. Trade analysis indicated that production across States is not correlated which create more opportunities for intra-regional trade between Nyala market of SDS and other States of the country for both millet and sorghum provided that trade barriers are removed.

Introduction

Trade in agricultural products serves three functions First, trade can contribute to stabilizing supply when national fluctuation in production are greater than fluctuation in the region, hence, reducing the need for holding carryover stocks. Second, it may partially substitute for working stocks if the harvesting calendar differs somewhat among trading partners. Third, trade may allow country or a region within a country to specialize in production of certain crop according to comparative advantage. Thus, trade may help to increase national income and improve food security [2].

In-country regional trade cooperation can improve food security by reducing the costs of achieving food policy objectives. Also, a group of countries or regions can achieve the same degree of food security at total lower costs.

According to the economic theory of co-integration, regional markets can only contribute less to food security than worldwide integration. In case of Greater Sudan, it can generally be presumed that the potential for intra-regional trade is greater if the country as a whole is sufficient in stable food but individual regions/states are not. To expand trade in agricultural products it is important to have these three elements:

a.   Internal adjustment should be directed towards internal and external agricultural trade regimes and exchange rate policy.

b.   External adjustment should be directed towards reorientation in food policy.

c.   Food aid in the region must be considered as a disincentive for intra-regional trade.

Framework of analysis

The study deals with spatial trade analysis to explore the possibility of in-country inter and intra-regional trade between SDS and other selected States in Greater Sudan (before South Sudan Independence). The productions and prices of millet and sorghum in different States of the Sudan namely, Southern Darfur, Northern Darfur, White Nile, Southern Kordufan, Northern Kordofan, Gadaref and West Darfur, were the main States of concern of the analysis for the study time span 1993-2007 [3-12].

Descriptive statistic and regression analysis were used throughout the course of the study. The model of analysis used was based on Koaster (1985), Correlation coefficient matrix.

Regression equations were used for estimating a dependent variable from independent variables. In the case of this study time t is the dependable variable and production q and market price p is the independent variables. In functional notation this is sometimes written as:

$$t= f(q1, q2, q3, ...qn)\ (1),$$

Where t, is the time and q1, q2, q3 ...qn are the quantities of grain.

For the price the equation is written as:

$$t= f(p1, p2, p3, ... pn)\ (2),$$

Where t, is the time and p1, p2, p3... pn are the prices of grain.

Regression analysis describes the effect of one or more variables (designed as independent variables) on a single (designed as the dependent variable) by expressing the latter as a function of the former.

Correlation analysis, on the other hand, is an index for measuring the degree of association, fluctuation, estimating and testing significance between the variables. Coefficient of Variation (CV) is used to measure fluctuation in production and prices. It is noted that an index value of 100 shows that the production pattern of two States are completely alike (that is the price in one state is perfectly correlated/co-integrated with the other state) whereas zero index implies complete dissimilar price pattern.

According to the economic theory of integration, regions differ in their production and market patterns have greater potential for expanding intra-regional trade if barriers are removed. Also, regional interstate trade can only contribute to food security if regions/states are not similar in their production and trade pattern, that their correlation coefficients are not similar.

Spatial trade analysis

Trade analysis using Table 1, has showed that millet production has become far less covariant and correlation was small and insignificant between all the States and Nyala or SDS, has the chance of regional trade between all the States except for Elobeid and Elfashir. Individual States are denoted by their capital cities, Gedarif or Gedarif State, Elobeid for North Kordofan, Damzin for Blue Nile, Kosti for White Nile, Nyala for South Darfur, and Elashir or North Darfur State.

Table 1: Correlation coefficient of reported millet production among selected States of Sudan, 1993-2006

	Gedarif	Elobeid	Damazin	Kosti	Nyala	Elfashir
Gedarif	1	0.013	0.305	0.07	0.126	-0.052
Elobeid	0.013	1	0.263	0.976**	0.237	-0.014
Damazin	0.305	0.263	1	0.281	-0.478*	-0.249
Kosti	0.07	0.976**	0.281	1	0.242	-0.089
Nyala	0.126	0.237	-0.478*	0.242	1	0.459*
Elfashir	-0.052	-0.014	-0.249	-0.089	0.459*	1

Source: Computed from secondary data of the study.

**Correlation is significant at the 0.01 level (1-tailed)

*Correlation is significant at the 0.05 level (1-tailed)

Sorghum production in the States has become far less covariant; correlation was small and insignificant between Kosti and Gedarif, Damazin and Gedarif, Elfashir and Elobeid, and Damazin and Kosti. Nyala has the chance of regional trade since correlation coefficient on production was small, positive, and statistically insignificant and correlation of prices was large, positive, and highly significant with each of the other five state regional markets (Table 2).

Trade analysis has also indicated that production across States is not correlated which create more opportunities for regional trade between Nyala and other five States of the country for both millet and sorghum (Tables 1-4).

Table 2: Correlation coefficient of reported millet prices among selected States of Sudan, 1993-2006

	Gedarif	Elobeid	Damazin	Kosti	Nyala	Elfashir
Gedarif	0.699**	0.938**	0.979**	0.714**	0.781**	
Elobeid	0.699**	0.801**	0.678**	0.797**	0.916**	
Damazin	0.938**	0.801**	0.953**	0.757**	0.853**	
Kosti	0.979**	0.678**	0.935**		0.714**	0.775**
Nyala	0.714**	0.797**	0.757**	0.714**		0.840**
Elfashir	0.781**	0.916**	0.853**	0.775**	0.840**	1

Source: Computed from secondary data of the study.

**Correlation is significant at the 0.01 level (1-tailed)

*Correlation is significant at the 0.05 level (1-tailed)

Table 3: Correlation coefficient of reported sorghum production among selectedStates of Sudan, 1993-2006.

	Gedarif	Elobeid	Damazin	Kosti	Nyala	Elfashir
Gedarif		-0.323	0.37	0.561	0.134	0.137
Elobeid	-0.323		0.111	0.163	0.195	0.407
Damazin	0.37	0.111		0.431	0.189	-0.189
Kosti	0.561*	0.163	0.431		0.131	-0.086
Nyala	0.134	0.195	0.189	0.131		0.072
Elfashir	0.137	0.407	-0.189	-0.086	0.072	1

Source: Computed from secondary data of the study

**Correlation is significant at the 0.01 level (1-tailed)

*Correlation is significant at the 0.05 level (1-tailed)

Table 4: Correlation coefficient of reported sorghum prices among selected States of Sudan, 1993-2006.

	Gedarif	Elobeid	Damazin	Kosti	Nyala	Elfashir
Gedarif		0.989**	0.958**	0.984**	0.984**	0.861**
Elobeid	0.989**		0.955**	0.984**	0.806**	0.880**
Damazin	0.958**	0.955**		0.938**	0.876**	0.912**
Kosti	0.984**	0.984**	0.938**		0.809**	0.884**
Nyala	0.736**	0.806**	0.876**	0.809**		0.812**
Elfashir	0.861**	0.880**	0.912**	0.884**	0.812**	1

Source: Computed from secondary data of the study

** Correlation is significant at the 0.01 level (1-tailed)

* Correlation is significant at the 0.05 level (1-tailed)

Results and Discussion

Market association

Per capita grain production showed downward trend in all of the selected States of the country except for slight upward trend in Elobeid and Kosti. With respect to per capita grain balance, Gadarif showed the best situation followed by Damazin and Kosti. Elobeid, Nyala and Elfashir reported the worst situation from 1993 to 2006 (Table 5).

Table 5: Per capita grain balances* among selected States of Greater Sudan, 1993-2006 in tones????????

Year	Gedarif	ElObied	Damazin	Kosti	Nyala	Elfashir
1993	575	-120	111	64	-29	-108
1994	679	35	164	129	73	17
1995	359	-132	203	78	-16	-133
1996	839	-112	270	148	-16	-126
1997	617	-114	370	130	-16	-84
1998	778	-108	144	153	53	49
1999	135	-112	-49	29	-29	-86
2000	272	-118	18	-131	18	-98
2001	207	-63	274	-17	3	-97
2002	206	-87	-1	28	19	-91
2003	431	-53	98	211	-15	-90
2004	76	-119	38	-49	-73	-97
2005	319	798	221	188	-15	-99
2006	183	38	258	168	-27	-124

Source: Computed from secondary data of the study

*Per capita grain balance is the share of the person from the balance of grain production and consumption of the State.

*Per capita grain production balance is the share of the person of grain production of the State.

The prices of millet and sorghum showed upward trends in all selected State markets of the country. Although all millet prices correlation coefficients reported large, positive and highly statistically significant, production of millet showed the small, positive and insignificant correlation coefficients which indicate that there is a chance for trade between Southern Darfur and other five States. Accordingly, higher grain prices are likely to increase the importance of regional trade in stable food crops between Southern Darfur and the selected States (Figure 1).
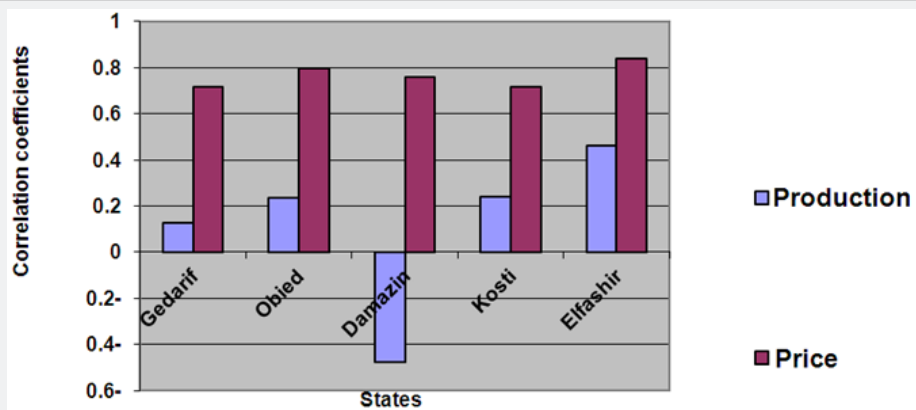

Figure 1: Southren Darfur millet market association.

With respect to sorghum prices, all the States showed upward trends, large, positive and highly statistically significant correlation coefficients but the production showed small, positive and insignificant correlation coefficients which indicate that there is a chance for trade to operate between these States and Southern Darfur (Figure 2).
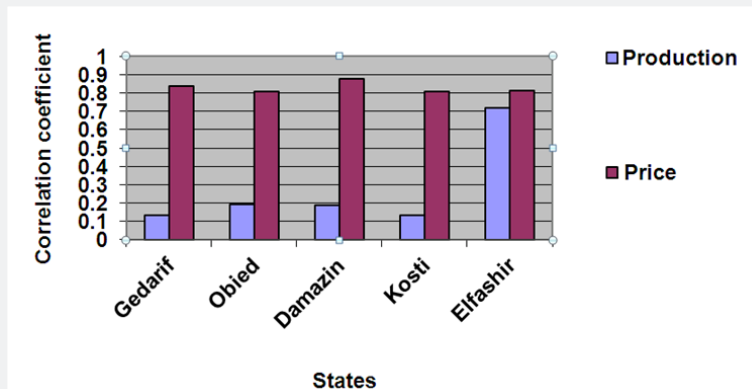

Figure 2: Southren Darfur sorghum market association.

Per capita grain production balances

The result of per capita grain production showed downward trend in all of the selected in-country States except for slight upward trend in Elobeid and Kosti. With respect to per capita grain balance, Gadarif showed the best situation followed by Damazin and Kosti. The worst situation was reported inNyala and Elfashir

The results of the analysis showed that millet and sorghum production has become far less covariant and correlation was small and insignificant and the grain prices are high which likely to increase the importance of regional trade in stable food crops between Southern Darfur and each of the other selected States.

Conclusion and Policy Implication

All the results of the analysis of per capita grain production, per capita grain balance and the production across States is not correlated, indicating a high policy option or increased opportunities for regional trade between Nyala and other States of the Greater Sudan for both millet and sorghum provided that trade barriers are removed.

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