Does Food Aid Affect the Agricultural Sector? The Small Economy Case: Jamaica

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Abstract

This paper looked at a small developing country, Jamaica and tried to determine whether food aid has had an effect on its agricultural sectorin particular the supply of maize by farmers, the price of maize and the imports of maize. In order to meet this objective, a simultaneous equation system of six equations was estimated. The results found that food aid had a negative and inelastic impact on maize production in Jamaica. Food aid however did not affect the price of maize or the import demand for cereals in Jamaica, contrary to major concerns about food aid to developing countries. The study also produced some interesting results such as tourist arrivals had a positive influence on GDP per capita in Jamaica and the highly elastic response of the domestic supply of maize to temperature. Thus the steady rise in temperature in Jamaica over the period 1970 to 2006 may have had a depressing effect on maize production especially with the more rapid rise in temperature since 1996. In general therefore the inelastic supply effects as well as the lack of impact on maize prices and import demand for cereals some measure of success in limiting the negative effects of food aid on the Jamaican agricultural sector.

Key words: food aid, agricultural impact of food aid in Jamaica, maize supply function

Introduction

The potential for food aid to be a disincentive to the recipient country's agricultural production has been a serious concern for both recipient countries and donor countries. Two basic arguments have dominated the literature:

- that food aid has great potential for dampening both short- run and long-run price incentives to producers; and
- that food aid in the long run weakens incentives to develop effective agricultural policy of a recipient government (Schultz 1960 and Mann 1967).

These price and policy disincentives, in turn, could lead to economic inefficiency and misallocation of resources. Hence, the objective of this paper is to determine whether it can be demonstrated that food aid has had an effect on the agricultural sector of a small developing country, Jamaican particular the supply of maize by farmers, the price of maize and the imports of maize.

Background

Jamaica like the rest of the islands of the Caribbeanis included in the UN classificationof Small Island Developing States (SIDS). SIDS were first recognized

as a distinct group of developing countries facing specific social, economic and environmental vulnerabilities at the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit, held the 3-14 June 1992 in Rio de Janeiro, Brazil (UN-OHRLLS 2011).

The Barbados Programme of Action (BPOA) adopted in 1994, further complemented by The Mauritius Strategy of Implementation (MSI) of 2005 and MSI+5 Outcome document, noted that while SIDS are faced with the same economic difficulties and confronted by development imperatives comparable to developing countries generally, SIDS have their own unusual vulnerabilities and characteristics, and thus the challenges they encounter while trying to achieve sustainable development are for the most part severe and complex (SIDSnet 2011). According to SIDSnet (2011), these vulnerabilities and characteristics include:

- Small size –This refers in the first instance to the land area of the islands but also refers to a number of areas such as excessive dependence on international trade and or tourism hence vulnerability to global developments; high population density; relatively small watersheds; limited supplies of fresh water. The small size of the populations also results in small domestic markets and limited potential for export volumes, which are generally too small to achieve economies of scale.
- Isolation – These islands and island chains are often spread over wide geographic locations which makes access to markets difficult thus resulting in high transportation costs that reduce their international competitiveness.
- Climate change and sea-level rise – the majority of SIDS are situated in coastal zones that are susceptible to the negative effects of climate change and sea level rise.
- Natural and environmental disasters – SIDS are usually located in regions that are prone to natural disasters that result in high economic, social and environmental consequences. The damage caused by these natural disasters are often made worst by excessive land degradation caused by poor land use practices.

Table 1 presents some general indicators for Jamaica and as seen in this table Jamaica has the characteristics of small land area and population, low ranking on the HDI and high levels of poverty and unemployment.

Food Aid

According to Barrette and Maxwell (2005), three (3) core characteristics distinguish food aid from other forms of foreign assistance:

- International sourcing of food – food must originate from outside of the domestic economy (that is, the food must cross a border)
- Concessional resources – food must be donated to the recipient countries at non-commercial rates
- Assistance must be in the form of food or must be for the provision of food.

The USA, though perhaps the world's leading economy, still has its own food insecure families. Thus, while the number of Americans who did not have enough to eat declined in 2011, this number still stood at a near record number of almost 49 million people. (Fessler 2011) An increase in domestic government food grants perhaps led to the modest decline. Thus, Fessler (2011) stated that new data from the USDA indicated that 17.2 million households in the USA were food insecure in 2011 and more than a third of these households had members who went hungry at some point during the year,

because they could not afford to buy enough to eat.

Despite having its own hungry people, the United States of America (USA) has been the major supplier of food aid to developing countries. Figure 1 gives the breakdown of food aid given by developed countries in 2004 and it shows that the USA gave 57% of the food aid, while the EU gave 20% as the other major food aid donor.

The USA has had multiple objectives for food aid given to developing countries. According to the USAID (2000) these include:

- To combat world hunger and malnutrition and their causes;
- To promote broad-based, equitable and sustainable development, including agricultural development;
- To expand international trade;
- To develop and expand export markets for US agricultural commodities; and
- To foster and encourage the development of private enterprise and democratic participation in developing countries.

However, Mousseau (2005) has pointed out various problems associated with food aid. These include:

- It is donor-driven and promotes the domestic interests of donor countries.
- It is used mainly as a foreign policy tool by donor countries and development of the recipient countries is not necessarily its main objective.
- International institutions providing food aid are often driven by food exporting firms.
- Cheap (highly subsidized) American grain and other foods dumped onto the local economy, affect the domestic agricultural sectors of developing countries.
- Small domestic producers in developing countries may be driven into further unprofitability, because their governments, as recipient countries are encouraged to remove protections from their farming sectors, exposing further the international uncompetitiveness of these small producers.

Figure 2 (after Mousseau 2005) presents the international aid flows and the international price of wheat from 1988-2001. Here it is seen that there was an inverse correlation between food aid donations and the price of wheat. That is, when the price of wheat was very high around 1995-1997, food aid flows were much reduced, compared to the flows in the period 1989-1993, when wheat prices were competitively lower.

Figure 3 provides the total food aid to Jamaica for the period 1970-2006. Here it is seen that food aid receipts increased markedly over the period 1986-1993, corresponding to the period of low international prices for wheat, illustrated in Figure 2. It can also be seen that food aid was reduced to negligible levels after 2004 corresponding to the increased utilization of grain in the USA for ethanol production. This increased use of grain was one of the causes of the food crisis of 2007-2008 (Headey and Fan 2010).

Analytical Framework

To meet the objective of this paper, a simultaneous equation system was estimated. This model was based on Bezuneh et al. (2003) and had the following structure (variables in natural logarithms with the hypothesized signs of the coefficients in brackets).

(1) Supply Equation:

$$l\mathrm{QS} = f_1(l\mathrm{PG}_{t-1}, l\mathrm{QS}_{t-1}, l\mathrm{FA}_t, l\mathrm{WIR}_t, l\mathrm{WIT}_t, l\mathrm{PS}_{t-1})$$

(2) Demand Equation:

$$l\mathrm{QD}_t = f_2(l\mathrm{PG}_t, l\mathrm{YD}_t, l\mathrm{PS}_t)$$

(3) Income Equation:
$lYD_t = f_3(lQS_t, lQI_t)$

(4) Commercial Import Equation:
$lQM_t = f_4(lQS_t, lPW_t, lFA_t, lPop_t)$

(5) Price Setting Equation:
$lPG_t = f_5(lQS_{t-1}, lPG_{t-1}, lPQ_{t-1}, lFA_t)$

(6) Market Clearing Identity:
$lQTD_t = l(QS_t + QM_t)$

where:

lQS_t = log of total maize production in Jamaica

lPG_t = log of the price of maize in Jamaica

lFA_t = log of total food aid imports, Jamaica

$lWIR_t$ = log of the average annual rainfall in Jamaica

$lWIT_t$ = log of the average annual temperature in Jamaica

lPS_t = log of the price of yam in Jamaica

lQD_t = log of per capita demand cereals in Jamaica

lQM_t = log of import of cereals

lYD_t = log of the GDP/capita

lQI_t = log of the arrival of tourists in Jamaica

lPW_t = log of the US price of wheat

$lPop_t$ = log of the total population of Jamaica

lPQ_t = log of Jamaica consumer price index

$lQTD_t$ = log of demand for cereals in Jamaica

t = denotes time in years

Equation (1) was a supply function for maize produced in Jamaica and this was a function of the lagged price of maize in Jamaica ($lPG_{t-1}[+]$), lagged supply of maize in Jamaica ($lQS_{t-1}[+]$), food aid to Jamaica ($lFA_t[-]$), annual rainfall ($lWIR_t[+]$), average annual temperature ($lWIT_t[\pm]$) and lagged price of yam in Jamaica as a substitute good ($lPS_{t-1}[-]$).

Equation (2) was a demand function for cereals in Jamaica, which was hypothesized to be determined by price of maize in Jamaica ($lPG_t[-]$), per capita GDP ($lYD_t[+]$) and price of yam as a substitute good ($lPS_t[+]$).

Equation (3) was an income equation explaining per capita GDP in Jamaica (lYD_t) as a function of quantity supplied of maize in Jamaica ($lQS_t[+]$), (as a proxy for agricultural output) and the tourist arrivals into Jamaica ($lQI_t[+]$) representing a major growth sector of the Jamaican economy.

Equation (4) was introduced to explain the commercial imports of cereals into Jamaica (lQM_t) which was a function of the domestic supply of maize ($lQS_t[-]$), the US price of wheat ($lPW_t[-]$), and food aid into Jamaica ($lFA_t[-]$).

Equation (5) is the price setting equation for maize in Jamaica (lPG_t). This was hypothesized to be determined by the quantity of maize produced in Jamaica ($lQS_{t-1}[-]$), a lagged dependent variable ($lPG_{t-1}[+]$), lagged consumer price index ($lPQ_{t-1}[+]$) and food aid into Jamaica ($lFA_t[-]$).

The final equation (6) was a market clearing or equilibrating equation, which set the total demand for cereals (QTD_t) equal to the total quantity of maize

produced in Jamaica (QS_t) plus the imports of cereals into Jamaica (QM_t).

Thus, in the model, food aid was hypothesized to have a negative impact on the quantity supplied of maize in Jamaica via equation (1), a negative impact of commercial imports of cereal via equation (4) and it was also hypothesized to impact negatively on the price set for maize in Jamaica.

Empirical Procedures

The Data

The data covered the period 1970-2006 excluding the years 2002 and 2003 for which data was missing for some series. QI_t data was obtained from the Jamaica Tourist Board (JTB), PQ_t was obtained from the World Bank (WB), WIR_t and WIT_t data were obtained from the Center for Climatic Research (CCR), while Pop_t and YD_t were obtained from the United Nations Statistics Division (UNSTAT). For the remaining variables the data was obtained from the Food and Agriculture Organization (FAOSTAT).

Regression Analysis

It is well know that regression of a non-stationary time series on another non-stationary time series may produce a spurious results, thus it was imperative to determine if the series were stationary (Gujarati 2003). Thus, the series were tested for stationarity using the augmented Dickey-Fuller test. Given that nine of the fourteen variables were non-stationary, it was necessary to test for cointegration in the estimated relationships. Equations 1 to 6 were estimated using Two-Stage Least Squares, with the instrumental variables being the true exogenous variables as indicated in Tables 3 to 8. To test for cointegration of these equations the Engle-Granger test was performed on the residuals of the estimated equations.

Results and Discussion

Presented in Table 1 are the results of the augmented Dickey-Fuller test for the fourteen variables used in this study. The results indicated that the variables PG, PS, QI and PQ were stationary, while the other variables were non-stationary.

Table 2 presents the results of the Engle-Granger test for cointegration which found that all the equations 1 through 6 were cointegrated indicating a long run relationship exists between the dependent variables and the independent variables, ruling out spurious regressions.

Table 3 presents the results of the estimated supply equation for maize and showed that lagged maize production, food aid and temperature were statistically significant. It was found that a 10% increase in maize production in Jamaica would lead to a 6.3% increase in maize production in the following year. A 10% increase in food aid to Jamaica would lead to a 0.5% decrease in maize production in Jamaica, while a 10% increase in temperature would result in a 44% decrease in maize production. Furthermore, rainfall was not found to be significant in determining maize production.

Presented in Table 4 are the results for the demand equation. For this equation, none of the variables were found to be statistically significant.

Table 5 presents the results of the income equation, which showed that the variable “tourist arrivals into Jamaica” was statistically significant in explaining GDP per capita. That is, a 10% increase in tourist arrivals would lead to a 7.6% increase in the GDP per capita.

Table 6 presents the results of the

"commercial import of cereal" equation and indicated that the total population variable was significant in determining the imports of cereals into Jamaica. The results suggested that a 10% increase in population would result in a 15% increase in the imports of all cereals.

Presented in Table 7 are the results of the price setting equation, which indicated that the lagged price of maize in Jamaica and the lagged consumer index were statistically significant. A 10% increase in maize production and consumer price index caused a 0.9% and 0.2% increase in the price of maize. Food aid did not significantly impact on the price of maize in Jamaica

Table 8 presents the market clearing identity.

Conclusions and Discussion

Based on the results obtained a number of conclusions can be made with respect to the food aid and the Jamaican economy. Firstly, food aid had a negative impact on the domestic supply (production) of maize in Jamaica. Increasing food aid by 10% caused the domestic supply of maize to fall by .5% suggesting that the impact of food aid though significant was inelastic. Food aid however did not affect the price of maize nor the import demand for cereals in Jamaica, contrary to major concerns about food aid to developing countries. This result along with the inelastic supply effect suggests some measure of success in limiting the negative effects of food aid on the Jamaican agricultural sector.

Tourist arrivals had a positive influence on GDP per capita in Jamaica which shows the importance of tourism to the Jamaican economy. Furthermore, population had a major influence on grain imports. Another interesting result found is the study is the highly elastic response of the domestic supply of maize to temperature. Thus the steady rise in temperature in Jamaica over the period 1970 to 2006 may have had a depressing effect on maize production especially with the more rapid rise in temperature since 1996 (Figure 4)

The issue is not whether food aid is good or bad, but how it can be used to promote human and physical capital formation in the recipient countries. Such an argument places great responsibility on the governments of recipient countries to determine and design policies so as to realize the potential benefits of food aid, without displacing domestic production. The results of this study suggest that if Jamaica were to resume receiving food aid in substantial quantities that such policies should be put in place to alleviate any negative impacts on its domestic grain producers.

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Table 1:

Indicator	(2011 estimate)
Area	10,991 sq km
Population	2,889,187
GDP - per capita (PPP)	$9,100
Human Development Index (HDI) Rank	#80 (2010 rank)
Labour force - by occupation	
Agriculture	17%
Industry	19%
Services	64%
Literacy Rate	85.9 (2008 est.)
Unemployment rate	12.70%
Population below poverty line	16.5% (2009 est.)

Source: CIA 2011 and HDI 2011
Est - estimate

Table 2: Results of the Augmented Dickey-Fuller test for Stationarity

Variable	tau	Variable	tau
QS	-1.1652	QI	4.8361*
PG	8.1254*	QM	0.8130
WIR	-0.5831	PW	-0.2212
WIT	0.4546	PQ	3.3232*
QD	0.2407	FA	-0.8066
PS	4.3935*	QTD	0.8013
YD	1.8518	POP	3.1250*
Note: Critical value: 0.05 is -1.95 * Stationary Variables			

Table 3: Results of the Engle-Granger test for Cointegration

System Residuals	tau
Equation 1	-4.5463
Equation 2	-4.0535
Equation 3	-2.7595
Equation 4	-4.7729
Equation 5	-5.4402
Equation 6	-2.1148
Note: Critical value: 0.05 is -1.95	

Table 4: Supply Equation

Equation 1
Dependent variable: Maize production in Jamaica (lQS)
Instruments: constant $lWIT$, $lWIR$, lPS, lQI, lFA, lQS_{t-1}, lPQ_{t-1}, $lPop$, lPG_{t-1}, lPW

	Coefficient	Std. Error	t-ratio	p-value	
constant	17.9971	6.5079	2.7650	0.0057	***
Price of maize in Jamaica (lPG_{t-1})	-0.2298	0.2565	-0.8960	0.3702	
Maize production in Jamaica (lQS_{t-1})	0.6396	0.1217	5.2570	0.0000	***
Food Aid (lFA)	-0.0521	0.0265	-1.9650	0.0495	**
Rainfall ($lWIR$)	-0.1219	0.2630	-0.4634	0.6431	
Temperature ($lWIT$)	-4.4241	2.0319	-2.1770	0.0295	**
Price of yams in Jamaica (lPS_{t-1})	0.2123	0.2766	0.7676	0.4427	

Mean dependent variable	8.2188	S.D. dependent variable	0.5273
Sum squared residual	1.4421	S.E. of regression	0.2311
R-squared	0.8429	Adjusted R-squared	0.8079

Table 5: Demand Equation

Equation 2
Dependent variable: (Imports +Local Production)/Population (lQD)
Instruments:constant $lWIT$, $lWIR$, lPS, lQI, lFA, lQS_{t-1}, lPQ_{t-1}, $lPop$, lPG_{t-1}, lPW

	Coefficient	Std. Error	t-ratio	p-value	
constant	-2.4917	1.0916	-2.2820	0.0225	**
Price of maize in Jamaica (lPG)	-0.1159	0.1159	-1.0000	0.3173	
GDP/capita (lYD)	0.0704	0.1769	0.3979	0.6907	
Price of yams in Jamaica (lPS)	0.1338	0.1271	1.0520	0.2927	

Mean dependent variable	1.7970	S.D. dependent variable	0.1569
Sum squared residual	0.7505	S.E. of regression	0.1582
R-squared	0.0767	Adjusted R-squared	-0.0156

Table 6: Income Equation

Equation 3

Dependent variable: GDP per capita (lYD)

Instruments: constant $lWIT$, $lWIR$, lPS, lQI, lFA, lQS_{t-1}, lPQ_{t-1}, $lPop$, lPG_{t-1}, lPW

	Coefficient	Std. Error	t-ratio	p-value	
constant	0.3675	2.1848	0.1682	0.8664	
Maize production in Jamaica (lQS)	0.2331	0.1651	1.4120	0.1581	
Tourist arrivals in Jamaica (lQI)	0.7594	0.1307	5.8080	0.0000	***

Mean dependent variable	7.5706	S.D. dependent variable	0.4437
Sum squared residual	1.8770	S.E. of regression	0.2466
R-squared	0.7110	Adjusted R-squared	0.6924

Table 7: Commercial Import Equation

Equation 4

Dependent variable: Imports of cereals (lQM)

Instruments: constant $lWIT$, $lWIR$, lPS, lQI, lFA, lQS_{t-1}, lPQ_{t-1}, $lPop$, lPG_{t-1}, lPW

	Coefficient	Std. Error	t-ratio	p-value	
constant	-8.6171	9.2451	-0.9321	0.3513	
Maize production in Jamaica (lQS)	-0.0074	0.1154	-0.0643	0.9487	
US price of wheat (lPW)	-0.0725	0.1217	-0.5956	0.5515	
Food Aid (lFA)	-0.0090	0.0183	-0.4911	0.6234	
Population ($lPop$)	1.4995	0.5916	2.5350	0.0113	**

Mean dependent variable	12.8367	S.D. dependent variable	0.2129
Sum squared residual	0.7678	S.E. of regression	0.1627
R-squared	0.4866	Adjusted R-squared	0.4158

Table 8: Price Setting Equation

Equation 5

Dependent variable: Price of maize in Jamaica (l PG)

Instruments: constant $lWIT$, $lWIR$, lPS, lQI, lFA, lQS_{t-1}, lPQ_{t-1}, $lPop$, lPG_{t-1}, lPW

	Coefficient	Std. Error	t-ratio	p-value	
constant	1.0991	1.3253	0.8294	0.4069	
Maize production in Jamaica (lQS_{t-1})	0.0951	0.0962	0.9885	0.3229	
Price of maize in Jamaica (lPG_{t-1})	0.6558	0.1502	4.3660	0.0000	***
Jamaica consumer price index (lPQ_{t-1})	0.4358	0.1785	2.4410	0.0146	**
Food Aid (lFA)	0.0296	0.0217	1.3640	0.1725	

Mean dependent variable	8.0941	S.D. dependent variable	2.2885
Sum squared residual	0.9966	S.E. of regression	0.1854
R-squared	0.9942	Adjusted R-squared	0.9934

Table 9: Market Clearing Identity

Equation 6

Dependent variable: Imports + Local production of cereals (QTD)

Instruments: constant $l\mathrm{WIT}$, $l\mathrm{WIR}$, $l\mathrm{PS}$, $l\mathrm{QI}$, $l\mathrm{FA}$, $l\mathrm{QS}_{t-1}$, $l\mathrm{PQ}_{t-1}$, $l\mathrm{Pop}$, $l\mathrm{PG}_{t-1}$, $l\mathrm{PW}$

	Coefficient	Std. Error	t-ratio	p-value	
constant	0.0000	0.0000	-2.230	0.0258	**
Maize production in Jamaica (QS)	1.0000	0.0000	6.30e+13	0.0000	***
Imports of cereals (QM)	1.0000	0.0000	1.56e+15	0.0000	***

Mean dependent variable	388021.	S.D. dependent variable	754680.9100
Sum squared residual	8.52e-19	S.E. of regression	1.66e-10
R-squared	1.0000	Adjusted R-squared	1.0000

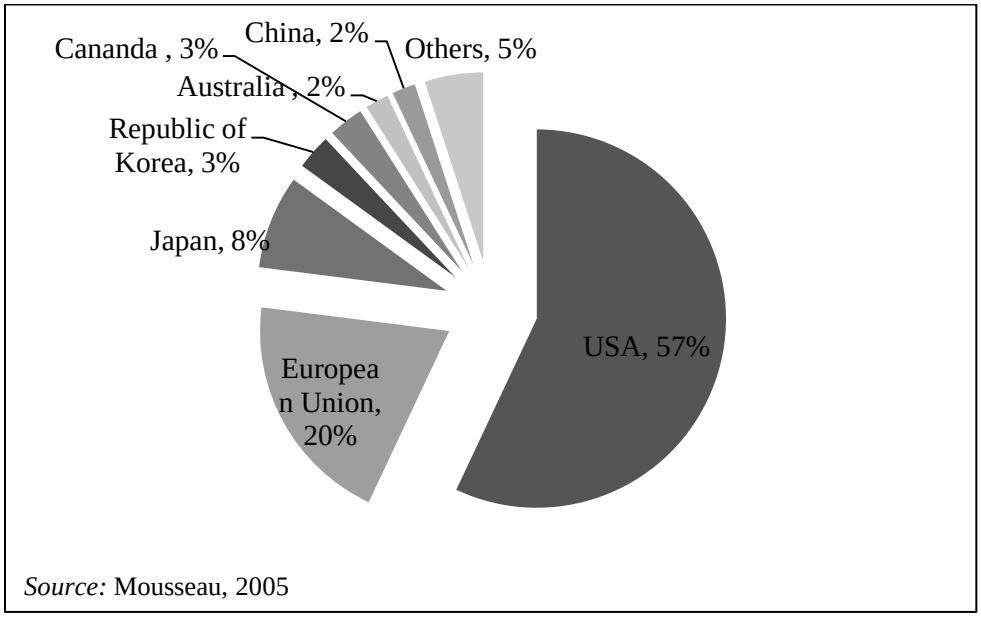

Figure 1: Food Aid Breakdown by Country, 2004

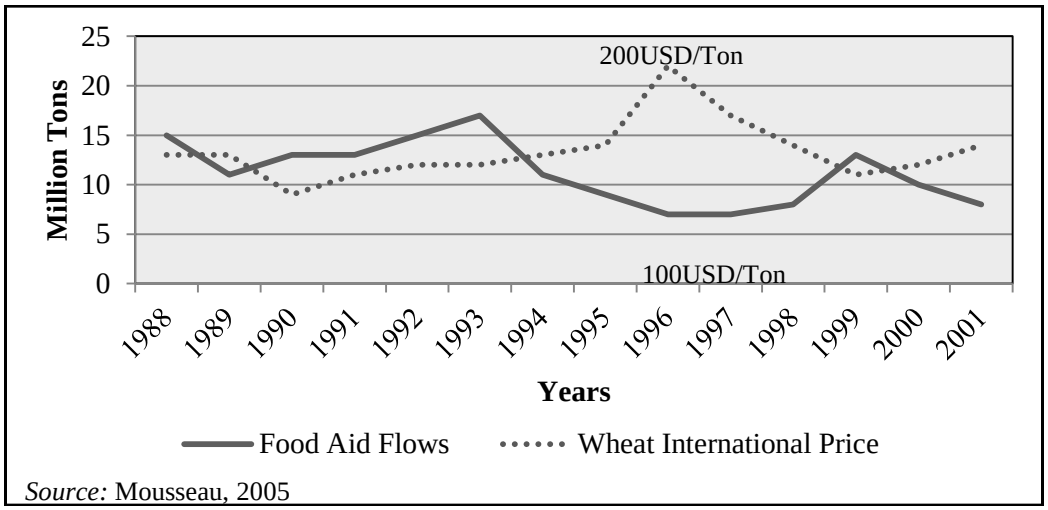

Figure 2: International Food Aid Flows Compared to the International Price of Wheat

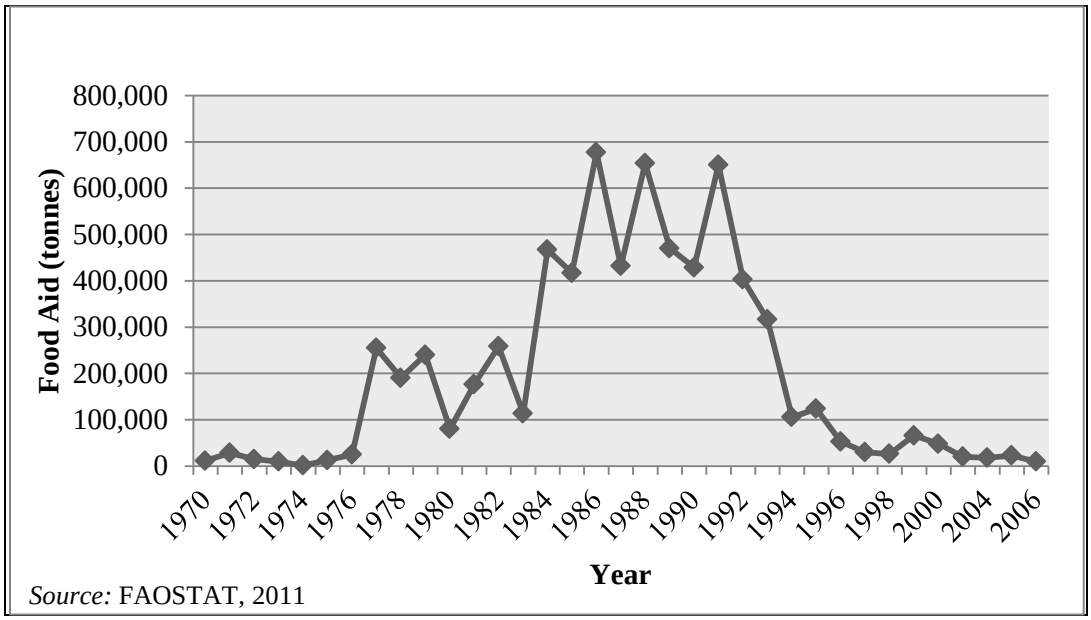

Figure 3: Total Food Aid Jamaica: 1970-2006

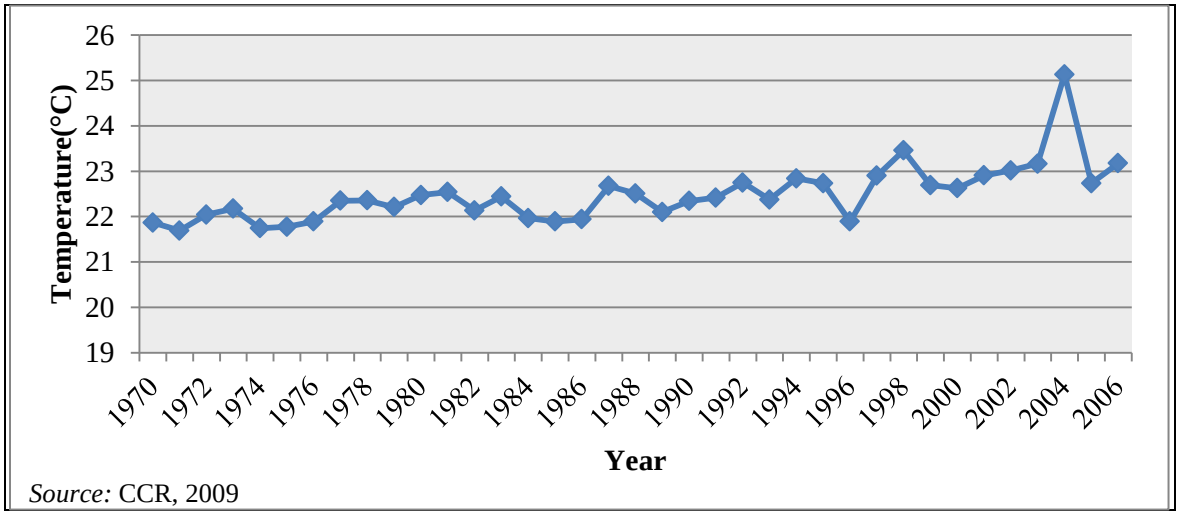

Figure 4: Average Annual Temperature in Jamaica, 1970-2006