Investigating Food Self-Sufficiency Challenges in Haiti

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Abstract

Agriculture is the primary activity for about one million (1,000,000) small farm households holding an average of 1.5 hectares under various land tenure systems. In the past two decades, agricultural production growth has stagnated and food imports have escalated. Imported rice has virtually replaced domestically produced and preferred rice. Food imports represented 23% of total imports in 2007 and have steadily increased over the years, and thus widening the trade deficit. The 1994 US embargo, neglect of the agricultural sector, food aid, policies encouraging freer trade and the promotion of import consumption have been blamed for the decline in domestic cereal and food production. However, there has not been a complete economic analysis on production and import substitution, combined with competitive advantage analysis of food production and consumption, to determine where Haiti has a comparative advantage in the production of certain crops. In this paper, we use an AIDS model to determine production, consumption, substitution and the competiveness of selected Haitian food crops in the global marketplace. There are production and consumption trade-offs in the use of various policy options. While Haiti may not be technologically competitive in all agricultural products, transaction costs and consumer preference give producers a comparative advantage in the production and consumption of certain crops. Policy makers should use this information to reallocate resources to promote the production and consumption of competitive crops grown in Haiti.

Keywords: Haiti, food imports, AIDS model, food self-sufficiency, equilibrium displacement model

Introduction

The majority of Haitian population has been facing chronic food shortages and increasing nutritional problems. Half of the population does not have access to the daily minimum ration established by FAO, 225 gram of equivalent cereal per individual, and 80% of households cannot adequately satisfy their nutritional needs (MARNDR 2010). Domestic production is contributing less and less to Haiti's total food supply and as a result Haiti has to rely on imports and food aid to meet its food deficit. Between 2003 and 2005, domestic food imports and food aid accounted for approximately 51 and 6% of total food supply in Haiti (MARNDR 2010).

Haiti high dependence on food imports has made the country vulnerable to international economic shocks, fluctuation of world food prices and natural calamities

that adversely affect food production. The sharp rise in world food prices in early 2008 hit Haiti hard. Food and input prices in Haiti increased by an average of 35% and that resulted in food shortages. The food crisis triggered riots across the country, and was responsible for the resignation of the Prime Minister (Gauthier 2008). The recent deadly earthquake in early 2010 further aggravated the situation as thousands of people were forced to migrate from the capital city to rural areas, further increasing food insecurity problems

Stagnation of Haitian food and agricultural sector is rooted in several causes, such as deforestation, soil erosion and environmental degradation, unstable political situations, poor public investments in agricultural infrastructure and production and severe competition from agricultural imports (Avery 2010). The deforestation process is at the extreme leaving a current tree coverage of less than 2%, thus fostering soil erosion that are partially responsible for floods, draughts, and landslides during climatic alteration from el Nino. Constant erosion exposes the lower soil layer to a reduction of fertility (McGuigan 2006). The political instability in Haiti makes the situation difficult for improvements in agricultural production since the government has not invested in irrigation, rural transportation, agricultural processing and storage facilities, and agricultural production services such as credit, market developments, research and extension in recent times (McGuigan 2006). In addition, political instability and poor governance at the national and regional levels have drained public funding from investment in agriculture. Finally, the trade embargo which was imposed on Haiti in the early 1990s, and the trade liberalization which began in the mid-1990s under the Structural Adjustment Program have helped to damage the agribusiness sector of Haiti, and exposed farmers to severe competition from subsidized U.S. rice exports (Oxfam 2010).

Haitian government and international donors have, in the past decade, recognized that food self-sufficiency is extremely important to Haitians, and local people should be able to produce enough food to meet their family needs. Food should be available locally and it is crucial to maintain food security as well as to foster sustainable economic growth in Haiti. Numerous isolated attempts have been made to reduce soil erosion by donor groups and NGO interventions. Attempts have been made to increase rice and corn production by increasing improved seed distribution but local food production has remained stagnant. Therefore, this study examines potential policy options to foster domestic food production in Haiti in order to increase the level of food self-sufficiency. We address the following research questions: (1) Why has the Haitian food production sector stagnated? Is food stagnation associated with trade liberalization, limited arable land, poor technology, environmental disasters, a paucity of human capital, market structure, and/or government policies? We would like to quantify the effects of various government policies and programs, such as imports, trade liberalization, and inputs subsidies on the Haitian food production sector; and finally (2) What can Haitians do in terms of tariff, import quota, price control, input subsidies to improve its food self-sufficiency and food security? The paper includes the following sections: Haitian Food Sector; Theoretical Model; Empirical Results and Discussions; and

Haitian Food Sector

The Haitian food production trend has remained constant from 1960 to 2010. Average cumulative growth rate of Haitian food production remained at about 0.4%/year during the period 1961 to 2009. Food production in Haiti includes five main crops, plantain, corn, roots and tubers, rice, and sorghum. The share of each crop

in total food production in the last 5 years (2005-2009) is 33% for plantain, 30% for corn, 16% for paddy rice, 14% for sorghum, and 7% for roots and tubers. The crop production trend is shown in Figure 1. We observe increases in production volumes of roots and tubers, rice, and plantain in 1960s and 1970s; then the trend decreased from 1997 to 2005 and then remaining constant in recent years. Sorghum and corn have increased during 1960s, but decreased sharply during 1970s, and have been fairly constant for latter years.

Area planted remained fairly constant for roots and tubers, rice, and plantain. Corn is the only crop with modest increases in area produced during the period 1961 to 2009. In contrast, sorghum production area was decreasing during the same period. However, total food crop land area changed slightly, on the average 0.4%, during the last four decades. The expansion of crop production areas is constrained by available arable land in Haiti.

For the five years of 2005 to 2009, corn occupied the largest share 54% of total crop land, followed by sorghum, 23%, rice 11%, plantain 7%, and roots and tubers 5%. Haiti has only 20% of its total flat lands on the plains, about 550,000 ha. Arable land for agriculture accounts for 29% of the country total land, however, at present about 66.7% of the country total land is cultivated Katz (2008). There is great pressure on the limited land resource for food production and firewood, which cause severe problems of deforestation, soil erosion, and environmental degradation.

Productivities in Haitian food production systems remain the same for the last four decades. This reflects the absence of investments in physical and institutional infrastructure and technology which are the main driving forces for an upward shift in the food production frontier or productivity in a country. In Haiti, plantain has the highest yield per hectare, with average yield of 6.2 ton/ha, followed by rice of 2.2 ton/ha, roots and tubers of 1.83 ton/ha, corn of 0.87 ton/ha, and sorghum of 0.83 ton/ha, see Figure 3.

Corn, sorghum, and rice are the three most important food crops in terms of production areas in Haiti. The yields of these three crops in Haiti are relatively lower than that of world levels. Haitian corn yield is 0.87 ton/ha which is much lower than the yield levels of the five largest corn producers in the world such as Mexico of 2.81 ton/ha, Brazil of 3.71 ton/ha, China of 5.35 ton/ha, Argentina of 5.61 ton/ha, and USA of 10.34 ton/ha. Haitians can think about increasing corn yield in the search of food self-sufficiency and food security. For sorghum production, Haitian sorghum yield is 0.83 ton/ha which is not so far below that of some of the largest sorghum producers in the world, e.g. 0.97 ton/ha for India, 1.53 ton/ha for Nigeria, 4 ton/ha for U.S., and 4.7 ton/ha for Argentina. Haiti also has the potential to increase its rice yield, since the yield of 2.2 ton/ha is relatively low compared to other countries, for example 3.92 ton/ha for Bangladesh, 5 ton/ha for Indonesia, or 6.59 ton/ha for China.

Haitians consume plantain, rice, corn, sorghum, wheat, and roots and tubers as the staple foods. In the past, plantain, corn, and sorghum form the three largest staple foods, which accounted for 82% of total staple food consumption in Haiti during 1960s and 1970s. However the proportion of staple foods has been changing; during the period of 2005 to 2009, rice (39%), corn (22%) and plantain (22%) accounted the largest consumption share, 83%. Rice consumption accounted for 13% of total staple food consumption during 1960s-1970s, but increased to about 40% recently. In contrast, sorghum share decreased from 22% to 9%. The consumption volumes of corn, plantain, roots and tubers, and wheat have not changed much, but rice and sorghum consumption volumes increased and decreased significantly, respectively.

Before 1970s Haiti was food self-sufficient; afterward, the country became dependent on imports and food aid to satisfy its population demand. In the period of 2005-2009, the share of imports and food aid accounted for 39% of total staple food consumption in Haiti. The reliance on foreign staple foods makes Haiti extremely vulnerable to international food price fluctuations. Among staple food imports during the period of 2004 to 2008, rice accounted for 56%, wheat 41% and corn 3%.

Haiti maintains low tariffs on food imports (average 2.9% on all food products) to keep food at low price and available to the population. Haiti imports lots of U.S. rice which is cheap because it receives subsidies from the U.S. government. The low tariff on cheap rice imports (3%) has provided disincentives to Haitian rice producers. Haitian rice, however, is preferred by Haitian consumers, but almost two times more expensive than the imported rice on the Haitian market. Therefore, normal Haitian consumers buy local rice only for special events. Food aid also has a negative effect on Haitian rice production. With food aid, farmers have less incentive to produce food because the availability of free and cheap staple foods reduces their profits from staple food production. In addition, Haiti faces a high frequency of natural calamities, e.g. floods, hurricanes, landslides, and a recent earthquake, that lead to frequent food aid donation pouring into the country from foreign governments and international organizations. The situation created high risks to staple food producers and caused farmers to develop an attitude that they can get access to free food, so that there were less incentives for farmers to produce more, or even to produce at all. In addition, Haiti pegs its exchange rate to the U.S. dollar, and maintains an overvalued local currency that favors imports. The Haiti exchange rate policy makes local food production less competitive compared to imported foods. Finally, Haitian food import market is handled by a few importers who are likely to collude in market decision-making processes and extract rent from buyers. Few importers and wholesalers have control over the market to extract profit from rice and staple food imports. Therefore, they may use their power to lobby for policies that limit the development of Haitian staple food production. All previous problems, accompanied by lack of public investments in staple food production have led to Haiti's declining food self-sufficiency and the subsequent high dependence on foreign food imports and aid. The level of food self-sufficiency has been declining rapidly in the last three decades, see Figure 4. Haiti was food self-sufficient, producing enough food for its own consumption, before 1970s, but in the most recent decade Haiti can only produce about 60% of its total staple food consumption.

Theoretical Model

Food self-sufficiency is often defined as a country's ability to meet consumption needs of staple food from own production. Food self-sufficiency is measured by the share of own-produced staple food over total staple food consumption. Barker and Hayami (1976) argued that the best way to increase food self-sufficiency is to expand physical and institutional infrastructure which are long-run and major factors that shift the production function. Countries, however, tend to adopt short-run interventions, e.g. output price support and input subsidies, to expand output along the existing production function. If food production is already at the optimal level, any intervention will cause a loss in welfare. Farmers in developing countries often employ modern inputs, e.g. fertilizer, under the optimal level due to a lack of knowledge and risk aversion. Therefore, a fertilizer subsidy could generate a positive

social profit. In contrast, an output price support policy often causes a social loss because it increases the use of all traditional inputs, e.g. land and labor, above the optimal levels. Jayne and Rukuni (1993) assessed the effects of a maize self-sufficiency pricing policy on income distribution, household food security, and government budget in Zimbabwe. They found that pricing policy, to restrain imports for the support of maize self-sufficiency, would primarily benefit a small number of wealthy farmers, and cause higher food price to consumers who mostly are low income rural farmers. Jayne and Rukuni (1993) concluded that, because of the lack of an effective income redistribution system, the output price support will inflate food costs and worsen food security of rural and urban populations compared to self-reliance policy involving imports. Hassan, Faki and Byerlee (2000) showed that food self-sufficiency is often pursued by expanding staple food production at the expense of cash crop production; and food self-sufficiency policy may induce inefficient allocation of agricultural resources if domestic food production does not conform to the country's comparative advantage. Peljor and Minot (2010) developed a simple market model for rice including supply, demand and rice imports and simulated levels of tariff and yield increases needed to achieve rice self-sufficiency in Bhutan. The authors found that rice import tariff could help the attainment of rice self-sufficiency, and therefore, benefit farmers. Nonetheless, the costs of higher rice prices to consumers exceed the gains to farmers. Rice yield improvement through irrigation and technology and rice area expansion will help achieve rice self-sufficiency without added costs to consumers; however, this strategy requires long-term interventions. Peljor and Minot (2010) also found that food self-sufficiency may be negatively correlated to food security when farmers are forced to increase households' food self-sufficiency but lack market opportunities.

In Haiti, rice and corn are the most important staple foods, and accounted for 39% and 22% of total staple food consumption during the period of 2005-2009. However, Haiti imported about 73.4% of its total rice and 10.9% of its total corn consumption needs during the period 2005-2009. Rice and corn are also the two crops that have potentials for increasing their production volumes through improvement of current low yields. Therefore, we will primarily look at rice and corn market and investigate alternative policy options that could enhance rice and corn production volumes and cereal self-sufficient levels in Haiti. We consider Haitian produced rice and imported rice as separated markets in Haiti, and Haitian rice market is presented with supply and demand functions, as below:

(1) $S_{hr} = S(P_{hr}, W_{hr})$

where S_{hr} is supply of Haitian rice, P_{hr} is Haitian rice price, and W_{hr} is an exogenous rice supply shifter. Rice supply shifter could be weather condition, input price, or technological factors. The demand for Haitian rice is:

(2) $D_{hr} = D(P_{hr}, P_{ir}, P_{hc}, P_{ic}, INC)$

where D_{hr} is demand for Haitian rice, P_{ir} is price of imported rice, P_{hc} is price of Haitian corn, and P_{ic} is price of imported corn, INC Haitian income. Haitian rice, imported rice, Haitian corn, and imported corn are all staple foods and considered weak substitutes for each other. Similar goods in a group can be complements to each other. Imported and Haitian rice are assumed to be exchanged on separate domestic markets because these two products have different tastes and are sold at different prices on the in Haitian market. Haitian rice is more expensive but preferred by all Haitian consumers. Imported rice is cheaper and more

affordable to ordinary and low income consumers. The supply function for imported rice on the Haitian market is:

(3) $S_{ir} = S(P_{ir}, W_{ir}, T_{ir})$

where, S_{ir} is supply of imported rice on the Haitian market, W_{ir} is the exogenous supply shifter of the imported rice to Haiti, T_{ir} is Haitian tariff on imported rice to Haitian market. Haiti is considered a small country and a price taker in the international rice market. Demand for imported rice in Haiti is:

(4) $D_{ir} = D(P_{hr}, P_{ir}, P_{hc}, P_{ic}, INC)$

where, D_{ir} is demand for imported rice on the Haitian market, and demand for imported rice in Haiti is a function of Haitian rice price, imported rice price, Haitian corn price, imported corn price, and Haitian income. For corn markets in Haiti, we also consider Haitian corn and imported corn are not perfect substitutes for each other and the market for Haitian corn and imported corn are weakly separable. The supply function for Haitian corn is:

(5) $S_{hc} = S(P_{hc}, W_{hc})$

where, S_{hc} is supply of Haitian corn, and it is a function of price of Haitian corn, P_{hc}, and a Haitian corn supply shifter, W_{hc}. The demand for Haitian corn is:

(6) $D_{hc} = D(P_{hr}, P_{ir}, P_{hc}, P_{ic}, INC)$

where, D_{hc} is demand for Haitian corn, and the demand for Haitian corn is a function of Haitian rice price, imported rice price, Haitian corn price, imported corn price, and Haitian income. Haiti also imports corn for its own consumption, and the supply function of imported corn to Haiti is:

(7) $S_{ic} = S(P_{ic}, W_{ic}, T_{ic})$

where S_{ic} is supply of imported corn to Haiti, W_{ic} is exogenous supply shifter of imported corn to Haiti, T_{ic} is a Haitian tariff on imported corn to Haiti. The demand function for imported corn in Haiti is:

(8) $D_{ic} = D(P_{hr}, P_{ir}, P_{hc}, P_{ic}, INC)$

where, D_{ic} is the demand for imported corn in Haiti, and it is a function of Haitian rice price, imported rice price, Haitian corn price, imported corn price, and Haitian income. We transfer the eight equations (1-8) into percentage change and obtain an equilibrium displacement model (EDM):

(1') $S_{hr}^* = \varepsilon_{hr} P_{hr}^* + \varepsilon_{xr} W_{hr}^*$

(2') $D_{hr}^* = \eta_{11} P_{hr}^* + \eta_{12} P_{ir}^* + \eta_{13} P_{hc}^* + \eta_{14} P_{ic}^* + \theta_1 INC^*$

(3') $S_{ir}^* = \varepsilon_{ir} P_{ir}^* + \varepsilon_{wr} W_{ir} + \varepsilon_{tr} T_{ir}^*$

(4') $D_{ir}^* = \eta_{21} P_{hr}^* + \eta_{22} P_{ir}^* + \eta_{23} P_{hc}^* + \eta_{24} P_{ic}^* + \theta_2 INC^*$

(5') $S_{hc}^* = \varepsilon_{hc} P_{hc}^* + \varepsilon_{xc} W_{hc}^*$

(6') $D_{hc}^* = \eta_{31} P_{hr}^* + \eta_{32} P_{ir}^* + \eta_{33} P_{hc}^* + \eta_{34} P_{ic}^* + \theta_3 INC^*$

(7') $S_{ic}^* = \varepsilon_{ic} P_{ic}^* + \varepsilon_{wc} W_{ic} + \varepsilon_{tc} T_{ic}^*$

(8') $D_{ic}^* = \eta_{41} P_{hr}^* + \eta_{42} P_{ir}^* + \eta_{43} P_{hc}^* + \eta_{44} P_{ic}^* + \theta_4 INC^*$

We let the markets, namely Haitian rice, imported rice, Haitian corn, imported corn, to be clear and have 4 equations of market equilibrium. Therefore, we have a total of 12 equations in the EDM model with 12 endogenous variables, such as $S_{hr}^*, D_{hr}^*, P_{hr}^*$, $S_{ir}^*, D_{ir}^*, P_{ir}^*$, $S_{hc}^*, D_{hc}^*, P_{hc}^*$, $S_{ic}^*, D_{ic}^*, P_{ic}^*$; and 7 exogenous variables, e.g. W_{hr}^*, W_{ir}^*, T_{ir}^*, W_{hc}^*, W_{ic}^*, T_{ic}^*, and INC^*.

The objective of this study is to investigate the cost and benefit of alternative policy options to enhance Haitian food self-sufficiency in Haiti through promotion of domestic staple food production. About 80% of rice consumption in Haiti comes from imports. This study will simulate welfare distribution of different scenarios of 50%, 75%, 100% of rice self-sufficiency in Haiti. Policy options include rice import limitation (increase T_{ir}^*), rice domestic supply promotion (increase W_{hr}^*), corn import limitation (increase T_{ic}^*), and corn domestic supply promotion (increase W_{hc}^*). The EDM model is arranged into a matrix form for simulation of the effects of

each policy option using the EDM model. The general form of the EDM model in matrix form is:

(9) $A*X = B*Z$

Where, $X' = (S_{hr}*, D_{hr}*, P_{hr}*, S_{ir}*, D_{ir}*, P_{ir}*, S_{hc}*, D_{hc}*, P_{hc}*, S_{ic}*, D_{ic}*, P_{ic}*)$ is a vector of twelve endogenous variables, and $Z' = (W_{hr}*, W_{ir}*, T_{ir}*, W_{hc}*, W_{ic}*, T_{ic}*, INC*)$ is a vector of seven exogenous variables. In order to solve for the effects of exogenous policy interventions on the four different markets of domestic rice, imported rice, domestic corn, and imported corn, we need to invert the matrix A and multiply both sides of (9) with inverted A matrix to obtain:

(10) $X = A^{-1}*B*Z$

Before the simulation of policy effects, we have to estimate parameters for each equation from (1) to (8) to obtain parameters' values for the matrix A and B.

Assumptions and data source

The baseline data are collected from the Food and Agriculture Organization (FAO), the United States Department of Agriculture (USDA), the World Bank, and Haitian Government's statistics. The descriptions of interested variables for the period 2005-2009 are presented as a baseline data and shown in Table 1.

The demand system for domestic rice, imported rice, domestic corn, imported corn can be estimated using the AIDS model to obtain own price and cross–price elasticities. The expected signs of own-price elasticities (η_{11}, η_{22}, η_{33}, η_{44})are negative, and expected signs of all cross-price elasticities η_{ij} ($i \neq j$) are all positive since staple foods are anticipated substitutes for each other. Income elasticities (θ_i) are positive. Since we inadequate data to estimate the AIDS demand system, we will use demand elasticities from the literature for the simulation process.

Shoichi Ito et al. (1989) found that income elasticities for rice in some Asian countries e.g. 0.46 for China in 1962 and decreased to 0.13 in 1985; In Indonesia income elasticities for rice range from 0.1 to 0.31; India from 0.16 to 0.12; Malaysia from 0.3 to -0.6; Japan from 0.16 to -0.7; The income elasticities for rice were decreasing over time. The income elasticities for rice are higher in countries with higher proportions of rice consumption in their total staple food consumptions, and income elasticties are smaller in higher income countries. Rice becomes an inferior good in some countries with higher income, e.g. Malaysia, and Japan. Islam (1978) found that demand elasticities of imported rice were fairly high, -6 for India, -5.3 for Philippine, - 3.3 for Korean, - 0.82 for Sri Lanka, and -0.32 for Malaysia. Income elasticities for imported rice are also larger than that of domestic rice, such as 5 for Pakistan, 2.72 for Korea, 1.18 for Philippine, 0.97 for Sri Lanka, and 0.34 for Malaysia.

Domestic rice and corn supply depend on prices, and exogenous supply shifters such as fertilizer price, cultivated land, and weather conditions. The supply of rice imports and corn imports by Haitian importers depend on their profitability, which depend on world price, import tariff, transportation and storage costs, and price of imported rice and corn sold on Haitian markets. However, due to limited data for estimation of supply functions, we use supply elasticities for rice and corn from and our assumptions on rice and corn supply functions from the literature. The supply elasticties are shown in Table 3.

Mangallas et al. (1966) found rice supply elasticity in the Philippine were 0.15 in the short-run, and from 0.02 to 1.16 in the long-run. Corn supply elasticity in the Philippine is 0.12 in the short-run and ranging from 0.42 to 1.14 in the long-run.

Empirical Results and Discussions

The simulation for the effects of exogenous variables on endogenous variable are obtained and shown in Table 4.

Tariffs on Rice Imports

Tariff is the easiest policy to implement and it has immediate effects on markets. The purpose is to reduce reliance on foreign staple food and to increase food self-sufficiency. However, a tariff will have a negative impact on consumers since an import tariff drives up price of imported rice which accounts for a large proportion of total Haitian rice consumption. The results in Table 4 show that a 10% increase in rice import tariff will drive up imported rice price by 5%, and since demand for imported rice is relatively inelastic, the drop in imported rice volume will be small, just 0.8%. Consequently, a 10% increase in tariff on rice imports will help to increase domestic rice production, but by small amounts, 0.5%. In conclusion, a tariff on rice imports has a large effect on imported rice as well as prices of domestic corn and rice, but has very small effects on increasing Haitian rice production volumes. As a result a rice import tariff will seriously affect poor consumers who depend heavily on imported rice, but an increase in rice import tariff does not help increase domestic rice production, or food self-sufficiency of rice in Haiti.

A tariff on rice import will shift the supply of imported rice to the left in the Haitian market, and will drive up the price of imported rice. As a result of substitutions among staple food, demand for local rice, corn and imported corn may increase simultaneously. The welfare effects of a 10% increase in rice import tariff are simulated for each of the four studied markets in Haiti, see Table 5.

A 10% increase in tariff causes welfare loss in the Haitian imported rice market of about $9 million a year. In contrast, a 10% increase in rice import tariff brings a gain of $6.3 million to Haitian rice producers a year. The Haitian corn markets, for both Haitian corn and imported corn, gain benefits from rice import tariff. In general, a 10% increase in rice import tariff causes a total loss to consumers of about $280,000 a year, but brings about $673,000 a year, and the total welfare effect of a tariff is still positive due to spillover effects in the corn markets.

Supports to Haitian Rice Production

Supports to Haitian rice production will help reduce domestic rice price and increase supply and demand for Haitian rice. The rice subsidy policy will have negative effects on the rest of the markets, e.g. imported rice, Haitian corn, and imported corn. The main effects are due to substitution effects between domestic rice and other staple foods in Haiti. When consumers change their habits and consume more local rice, they will move away from imported rice, corn, and imported corn. In table 4 we see that if we intervene to increase the Haitian rice supply shifter by 10%, Haitian rice supply will increase by 0.7%, a minor impact. However, a 10% increase in Haitian rice supply shifter will result in a drop of the Haitian rice price by 20%, and the imported rice price will drop by 14%. The results are consistent to the nature of inelastic demand for rice, e.g. -0.2 for Haitian rice, and -0.87 for imported rice. In Haiti, it is difficult to increase rice production areas since local rice production uses up most of the existing suitable lands for rice production. Haiti can consider the possibility of increasing the rice yield through employment of modern inputs and increase the level of rice production intensification on current rice cultivated lands.

Haitian rice supports such as input subsidies will shift the domestic Haitian rice production function output towards causing an increase in supply of Haitian rice which will drive local Haitian rice price

down and hence demand will increase in the long run. Substitution effects among different staple foods on the Haitian market will cause the demand for imported rice and imported corn to shift inwards. The welfare effects of a Haitian rice support intervention is simulated and presented in Table 6.

Haitian rice production supports bring significant positive gains to the whole economy, of about $42.5 million a year for Haitian rice market and about $23.26 million for the country as a whole. Supports on Haitian rice production have negative effects on other markets. The question is what is the cost of local rice support? We do not have data to compare the costs and benefits of a Haitian rice support. However, if the Haitian government can seek funding to invest in local rice production, it will bring positive gains to the country.

Supports to Haitian Corn Production

Haiti has great potentials to increase its corn production, since Haiti has - land areas suitable for corn production, but corn yield is relatively low. Haitian corn production increases will have negative effects on imported rice volume and price. A 10% increase in Haitian corn supply shifter will result in a 9% decrease in imported rice volume but the policy also has negative effects on local rice production. Local rice production will fall by1.4%. Here it is assumed that lower corn price will cause consumers to consume more corn and less rice.

Haitian corn production supports will shift local corn supply function outwards and increase demand for local corn because of falling price of local corn. The substitution effects will shift demand for local rice, imported rice, and imported corn inwards. Welfare effects of a 10% increase in Haitian corn supply shifter on the four markets are simulated and shown in Table 7.

Haitian corn support policy does not have positive effects on total welfare in general. Haitian corn production increases will generate positive gains to corn producers and consumers. However, substitution away from rice, domestic corn production results in welfare losses Haitian and imported rice markets. A 10% increase in Haitian corn supply will generate total losses of about 34 million a year for Haiti.

Conclusion

This study uses a multimarket model to separate the local and imported rice and corn markets, and to connect those markets in a single staple food market in Haiti. From the demand side, we look at the substitutability among staple foods in Haiti through a system of demand for staple foods. On the supply side, Haitian and imported staple foods are considered separately and Haitian producers and importers will supply staple foods to the market in a rent seeking effort. The equilibrium displacement model (EDM) is employed to link the staple food markets and to simulate effects of exogenous policy interventions on demand and supply of staple foods in Haiti. The results tell us that a rice import tariff will not help local producers, but punish local consumers. Local rice production supports will bring positive welfare effects to Haiti. A combination of rice import tariff and domestic rice production support would be the best policy option to increase the level of food self-sufficiency and total welfare in Haiti. Supports to local corn producers will not have a positive net welfare effect. The results in this study should be carefully verified and based on primary data from Haiti before it can be applied to policy decisions. Further studies should focus on estimation of demand and supply systems of staple foods in Haiti, especially to examine the substitutions of consumption and production of staple foods in Haiti.

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Table 1: Variable Descriptions, 2005 – 2009

Variable	Description	Unit	Mean	Std. Dev.
S_{hr}, D_{hr}	Domestic rice supply and demand	ton	116,650	11,586.1
P_{hr}	Domestic rice price	HTG/6 lbs	174.0	54.1
S_{ir}, D_{ir}	Imported rice supply and demand	ton	311,559.2	48,330.6
P_{ir}	Imported rice price	us$/ton	459.9	162.5
S_{hc}, D_{hc}	Domestic corn supply and demand	ton	221,100	28,280.7
P_{hc}	Domestic corn price	HTG/6 lbs	65.1	16.8
S_{ic}, D_{ic}	Imported corn supply and demand	ton	34,037.8	25,995.5
P_{ic}	Imported corn price	us$/ton	175.5	40.0
W_{hr}	Domestic rice supply shifters	-	-	-
T_{ir}	Haitian tariff on imported rice	%	3	0
W_{hc}	Domestic corn supply shifters	-	-	-
T_{ic}	Haitian tariff on imported corn	%	15	0
W_{ir}	World rice price (US rice price at fob)	us$/ton	497.6	180.8
W_{ic}	World corn price (US corn price fob)	us$/ton	154.4	47.7
INC	Haitian Income	us$/capita	572	92.4

Table 2: Rice and Corn Demand Own-price and Cross-price Elasticities

	D_{hr}*	D_{ir}*	D_{hc}*	D_{ic}*
P_{hr}*	$\eta_{11} = -0.2^{b}$	$\eta_{21} = 0.6^{c}$	$\eta_{31} = 0.2^{c}$	$\eta_{41} = 0.2^{c}$
P_{ir}*	$\eta_{12} = 0.15^{c}$	$\eta_{22} = -0.87^{a}$	$\eta_{32} = 0.1$	$\eta_{42} = 0.1^{a}$
P_{hc}*	$\eta_{13} = 0.1^{c}$	$\eta_{23} = 0.58^{a}$	$\eta_{33} = -0.37^{b}$	$\eta_{43} = 0.3^{c}$
P_{ic}*	$\eta_{14} = 0.1^{c}$	$\eta_{24} = 0.4^{c}$	$\eta_{34} = 0.3^{c}$	$\eta_{44} = -1.08^{a}$
INC*	$\theta_1 = 0.46^{b}$	$\theta_2 = 0.5^{c}$	$\theta_3 = 0.4^{c}$	$\theta_4 = 0.35^{c}$

Note: a) Dameus, Tilley, and Brorsen 2001; b) FAPRI (2011); c) Assumption.

Table 3: Supply Elasticties of Haitian and Imported Rice and Corn

Parameters	Description	Value
ε_{hr}	Haitian rice supply elasticity	0.22^{a}
ε_{xr}	Haitian rice supply shifter elasticity	0.5^{b}
ε_{ir}	Imported rice supply elasticity	0.8^{b}
ε_{wr}	Imported rice supply shifter elasticity	-0.5^{b}
ε_{tr}	Imported rice supply elasticity in respect to tariff	-0.5^{b}
ε_{hc}	Haitian corn supply elasticity	0.42^{a}
ε_{xc}	Haitian corn supply shifter elasticity	0.5^{b}
ε_{ic}	Imported corn supply elasticity	0.7^{b}
ε_{wc}	Imported corn supply shifter elasticity	-0.5^{b}
ε_{tc}	Imported corn supply elasticity in respect to tariff	-0.5^{b}

Note: a) FAPRI (2011); b) Assumption

Table 4: Simulation Results of Effects of Exogenous Policy Interventions

	T_{ir}*	T_{ic}*	W_{hr}*	W_{hc}*	P_{wr}*	P_{wc}*	INC*
S_{hr}*	0.054	0.065	0.064	-0.139	0.054	0.065	0.902
D_{hr}*	0.054	0.065	0.064	-0.139	0.054	0.065	0.902
P_{hr}*	0.244	0.297	-1.982	-0.632	0.244	0.297	4.099
S_{ir}*	-0.083	0.318	-1.088	-0.717	-0.083	0.318	2.984
D_{ir}*	-0.083	0.318	-1.088	-0.717	-0.083	0.318	2.984
P_{ir}*	0.521	0.397	-1.360	-0.897	0.521	0.397	3.731
S_{hc}*	0.067	0.114	-0.353	0.073	0.067	0.114	1.067
D_{hc}*	0.067	0.114	-0.353	0.073	0.067	0.114	1.067
P_{hc}*	0.159	0.271	-0.841	-1.018	0.159	0.271	2.540
S_{ic}*	0.058	-0.232	-0.309	-0.205	0.058	-0.232	0.965
D_{ic}*	0.058	-0.232	-0.309	-0.205	0.058	-0.232	0.965
P_{ic}*	0.084	0.382	-0.441	-0.293	0.084	0.382	1.379

Table 5: Welfare Distribution of a 10% Increase in Rice Import Tariff (Unit: $1000)

	Haitian rice	Imported rice	Haitian corn	Imported corn	Total effect
ΔPS	3,162.2	-4,332.9	1,810.6	33.7	673.6
ΔCS	3,162.2	-4,621.8	1,154.3	25.6	-279.7
ΔTS	6,324.4	-8,954.7	2,964.8	59.3	393.9

Table 6: Welfare Distribution of a 10% Increase in Haitian Rice Support (Unit: $1000)

	Haitian rice	Imported rice	Haitian corn	Imported corn	Total effect
ΔPS	28,105.0	-2,720.7	-2,315.7	-55.5	23,013.1
ΔCS	14,401.2	-9,237.9	-4,846.4	-69.3	247.6
ΔTS	42,506.2	-11,958.6	-7,162.1	-124.8	23,260.7

Table 7: Welfare Distribution of a 10% Increase in Haitian Corn Support (Unit: 1000 us$)

	Haitian rice	Imported rice	Haitian corn	Imported corn	Total effect
ΔPS	-13,164.0	-8,235.4	665.9	-175.3	-20,908.9
ΔCS	-8,261.1	-20,053.8	15,059.4	-123.4	-13,378.9
ΔTS	-21,425.2	-28,289.2	15,725.3	-298.7	-34,287.8

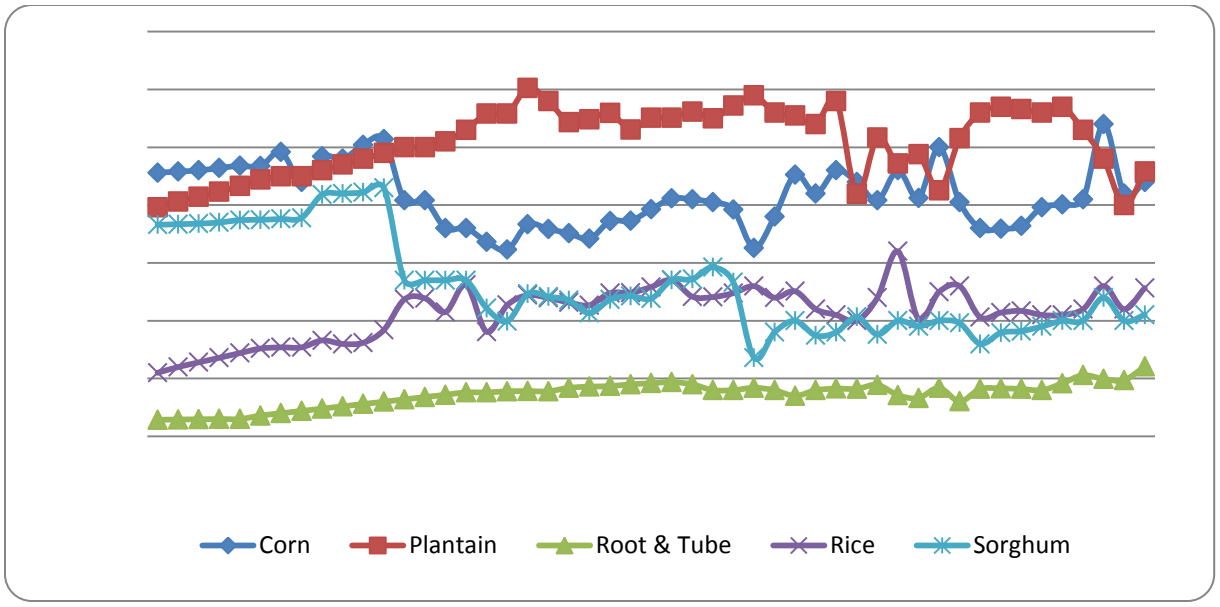

Figure 1: Trends of food production in Haiti (tons), 1961 – 2009

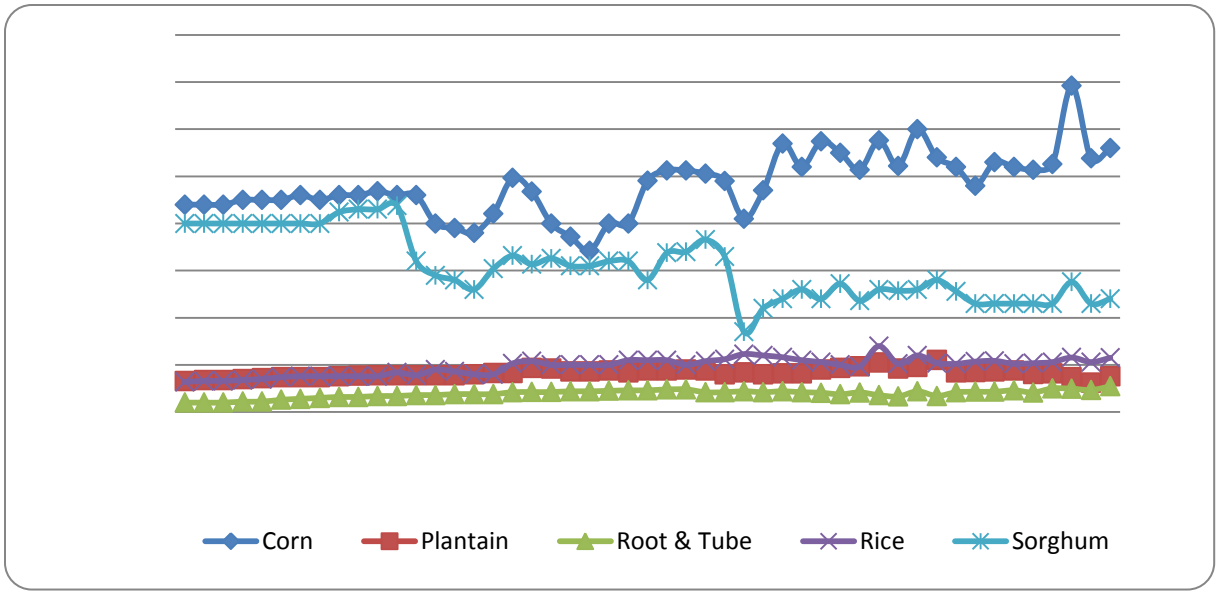

Figure 2: Trends in food production areas in Haiti (ha), 1961 – 2009

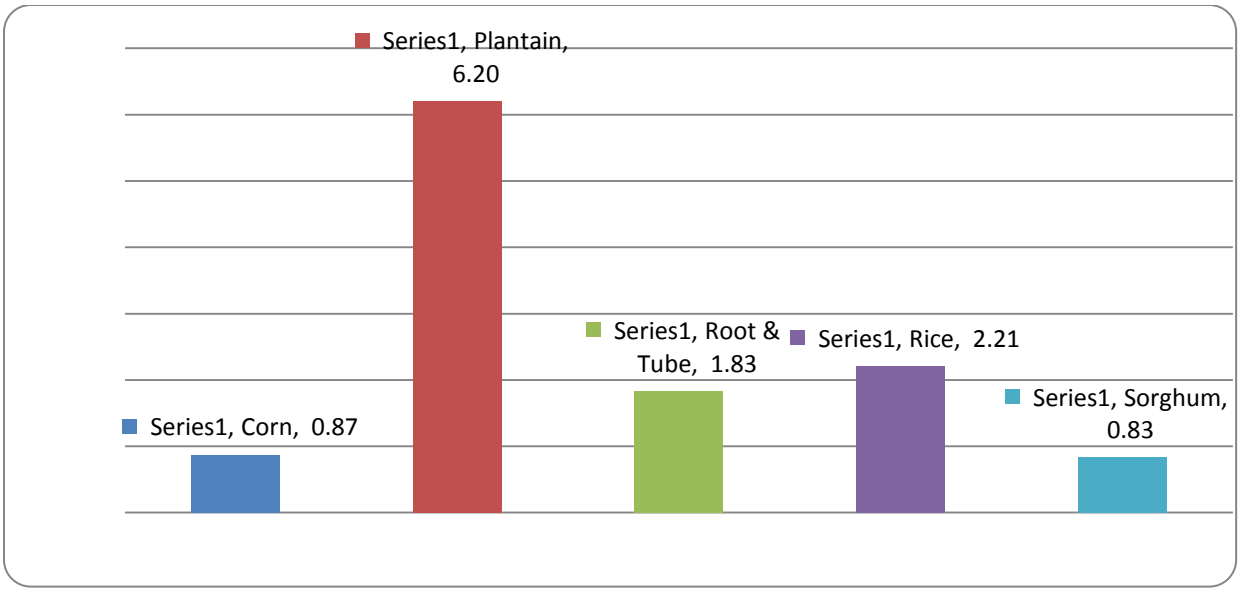

Figure 3: Average food crop yields in Haiti (ton/ha), 1961 – 2009

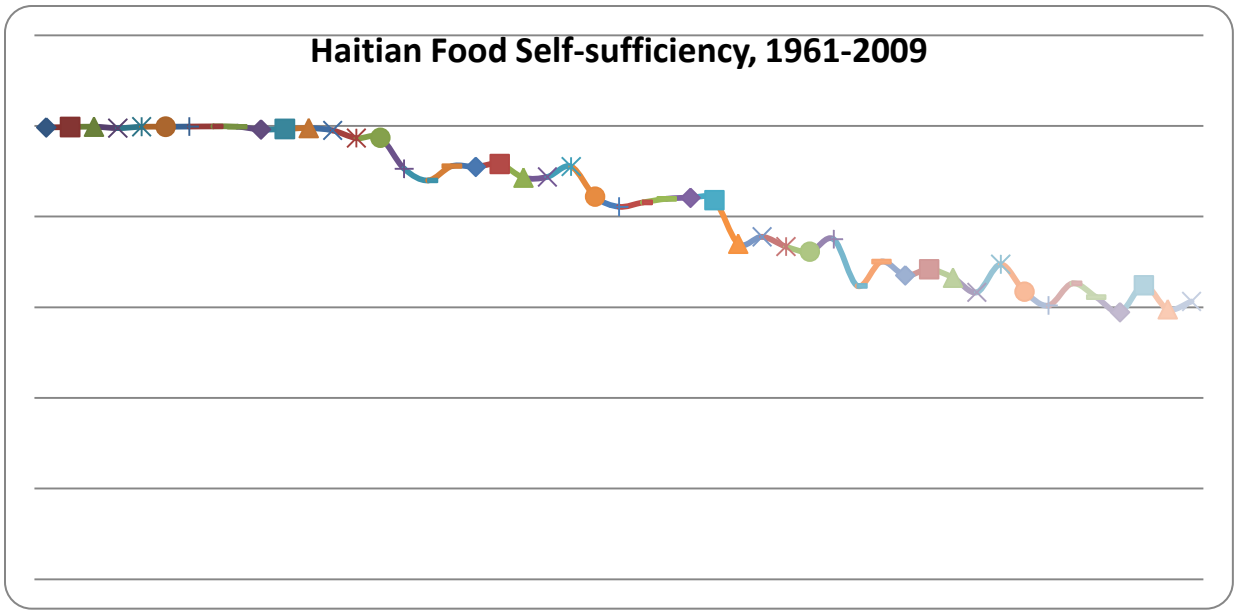

Figure 4: Haitian Food Self-sufficiency (%), 1961 – 2009