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Tariff Policy Liberalisation in Edible Oil Market and Its Implications on the Coconut Producers in Sri Lanka

S.R. Samarajeewa, J. Weerahewa[1] and H.M. Gunatilake[1]

Postgraduate Institute of Agriculture
University of Peradeniya
Peradeniya, Sri Lanka

ABSTRACT. *The objective of this paper is to assess the impact of trade liberalisation in the edible oil market on fresh coconut, coconut oil and desiccated coconut markets with special emphasis on the welfare of fresh coconut producers. To achieve this objective, a partial equilibrium market simulation model was developed for the coconut industry in Sri Lanka. The model captures the consumption linkage between coconut oil and other edible oil markets and production linkages among the three specified coconut markets. Previous econometric estimates were incorporated in the model to assess the impact of elimination of tariff on edible oil imports on the changes in producer prices and the quantities of supply in the coconut markets and the profits of the fresh coconut producers. Results revealed that trade liberalisation in the edible oil market has extended its implications on coconut product markets and leads to decrease the producer surplus of the fresh coconut market by Rs. million 13.71 per year whilst increasing the supply of desiccated coconut.*

INTRODUCTION

The world has witnessed the breaking down of barriers to trade among nations during the past few decades. Trade agreements at international level and free trade agreements at regional level have been able to reduce trade barriers across national borders. Sri Lanka is no exception in this case and tends to liberalise its trade activities by moving out of restrictive trade policies, while negotiating trade agreements with other nations. The implementation of these trade agreements has begun with the gradual elimination of tariff and other non-tariff barriers for selected imported commodities.

The trade liberalisation in the edible oil market in Sri Lanka was introduced in the early 80s by granting of tariff concessions and thereby permitting the importers to import different edible oils in large quantities. Under the current taxing regime of the government too, edible oils are allowed complimentary importation and the palm oil, soy oil and sunflower oil are the major edible oils imported to Sri Lanka during the recent past. When these edible oils are present in the market at a relatively cheaper rate, which are known to be free from cholesterol formation, the consumers may substitute such edible oils to coconut oil. Under these circumstances one can expect a reduced demand for coconut oil in the market, even though it has been consumed as the major edible oil in Sri Lanka for over centuries. This can adversely influence the domestic coconut oil milling industry, which has been badly affected due to various other reasons, such as low export demand for coconut oil and views associated with cholesterol.

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[1] Department of Agricultural Economics, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka.

The coconut industry as a whole forms related markets, where there are direct and indirect linkages in production and consumption. The fresh coconut is the most important fundamental raw material in the system, which permits the production of many kinds of coconut-based products such as coconut oil and desiccated coconut. Once the coconut oil industry has lost its competitiveness, it directly influences the fresh coconut production sector as the input demand created by the coconut oil industry declines. This is evidenced by the proportion of fresh coconut utilisation in the coconut oil milling industry during the past decades. It has utilised 32% of the total annual fresh coconut production in 1978, whilst in 1998 it has only utilised around 13% of the production. However, the total coconut production remain more or less similar in quantity (Coconut Statistics, 1978, 1998). Eventually, this leads to make changes in the balances of the coconut markets.

Conversely, the coconut growing industry comprises a large number of small-scale resource poor growers who earn their living by coconut cultivation and related activities. Therefore, many of the development programs in the domestic coconut sector have been mainly focussed on the welfare improvement of the primary producer. However, the profits gain by these development programs can be outweighed if any adverse implication occurred in any of the related coconut market is transmitted to the primary coconut producer. Therefore, it is worthwhile to investigate the repercussions of the trade policy liberalisation in the edible oil market, on the coconut producer sectors.

Policy analysis studies on the domestic coconut sector are scarce. A pioneering attempt on this aspect was made by De Silva (1985), who studied the changes in the coconut markets for several price policy instruments using graphical illustrations, based on the priory expectations of the demand and supply elasticity values. However, no welfare implications were made due to lack of econometric estimations of demand and supply functions. Samarajeewa (2002) used a partial equilibrium econometric model of three major coconut markets, to reveal the price and quantity impacts of selected market interventions on the domestic coconut sector.

This study aims to assess the impacts of the trade liberalisation in edible oil market on coconut producer sectors focussing mainly on the fresh coconut producers. The specific objectives of the study were to examine the implications of trade liberalisation on edible oils on the welfare of fresh coconut producers and to suggest policy measures to improve coconut producer's welfare further.

METHOD

Conceptual model

The main components of the coconut market equilibrium model used by Samarajeewa (2002) consist of behavioural functions of producers and consumers. They describe the key features of production and consumption patterns of three major coconut markets, *i.e.*, (i) fresh coconuts, (ii) coconut oil and (iii) desiccated coconut.

Specifically, the coconut market model for Sri Lanka is developed as follows. Coconut product supply is a function of its own price and other exogenous variables. It is given by:

$$X_i = g(P^f_i, Z_{xij}) \qquad for\ i = 1, 2, 3 \tag{1}$$

where;

X_i = the total quantity supplied of the coconut product i
P^f_i = the producer price of the product i
Z_{xij} = the vector of exogenous variable influencing the coconut product supply i (j = 1, ... , n)

The function g is an increasing function of P^f_i. For the fresh coconut market, the supply change corresponding to the price change is not instantaneous. Therefore, appropriate lag prices are considered in the empirical model.

Coconut product demand is a function of its own price, per capita income and other exogenous variables that shifts demand. Demands are decreasing functions of own prices and is given by:

$$Y_i = f(P^r_i, I, Z_{yij}) \qquad for\ i = 1, 2, 3 \tag{2}$$

where;

Y_i = the quantity demanded of the coconut product i
P^r_i = the consumer price of the product i
I = per capita consumer income
Z_{yij} = the vector of exogenous variables influencing the coconut product demand I, i (j = 1, ..., n), *i.e.*, the coconut oil demand function has captured the substitutability of palm kernel oil and soy oil for coconut oil by including their prices in the function.

For the policy simulation process, the producer price in the supply function and the consumer price in the demand function should be appropriately linked at the equilibrium of the market and is given by:

$$P^f_i = h(P^r_i) \qquad for\ i = 1, 2, 3 \tag{3}$$

The three coconut product markets are linked by production at the equilibrium of the fresh coconut market and is given by the following identity,

$$X_1 = Y_1 + X_2 + X_3 + other\ uses \tag{4}$$

where;

X_1 = the total quantity supplied in the fresh coconut market
Y_1 = the quantity of fresh coconut demand
X_2 = the quantity of coconut oil production in fresh nut equivalent
X_3 = the quantity of desiccated coconut production in fresh nut equivalent

As this study concerns on the fresh coconut producer welfare, the model is extended to estimate the producer surplus of the fresh coconut market. The producer surplus (PS), which is measured by the area above the supply curve and below the price line is given by,

$$PS = P^f_1 . X_1 - P^f_1 . X_1 \, dX_1 \qquad (5)$$

The important feature present in the coconut markets is the interactions present among the markets. The fresh coconut is the basic raw material for other two industries and thus the producer price of fresh coconuts becomes the input price for coconut oil and desiccated coconut supply. Hence, these three industries are linked by production. Other edible oils are substitutes for coconut oil. Therefore, the trade liberalisation in edible oil market has direct impacts on coconut oil market, and possibly extends its indirect implications on fresh coconut and desiccated coconut markets due to these linkages present among the coconut markets. Fig. 1 further describes the indirect implications expected to occur in the fresh coconut market due to the trade liberalisation policy in edible oil market.

The trade liberalisation in edible oil market reduces the demand for coconut oil and this in turn reduces the price of coconut oil. Consequently, there is a demand shift in the fresh coconut market. The fresh coconut market then comes to a new equilibrium, where there is lower demand, lower supply and lower producer price. The producer surplus of the fresh coconut market before the trade liberalisation in edible oil market is, "a+b+c" (Fig. 1). It reduces to area "a" after the trade liberalisation in edible oil market, and consequently the fresh coconut producer loss is equal to area "b+c" (Fig. 1).

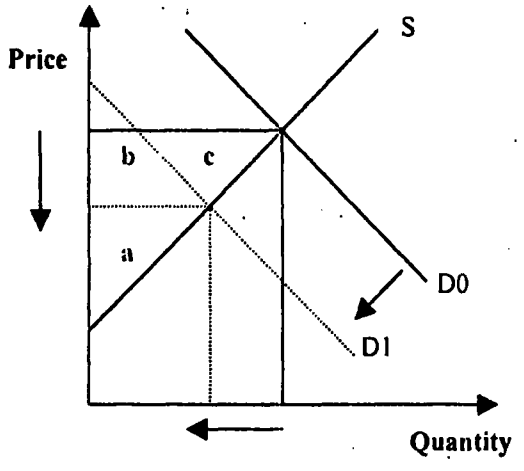

Fig. 1. Changes in the fresh coconut market due to the trade liberalisation policy in the edible oil market

Empirical model

This study emphasises on the welfare implications of fresh coconut producers due to the trade liberalisation in edible oil market. For that purpose, the elasticity estimates of the three major coconut markets, *i.e.*, fresh coconuts, coconut oil and desiccated coconuts provided by Samarajeewa (2002) are used. Based on these estimates, the coconut market model simulation with desired policy shock is conducted to achieve the specific objectives of this study. The coconut market simulation model consists of 13 endogenous variables including supply, demand, producer price and consumer prices for three coconut markets. The lists of the behavioural equations estimated for the coconut market equilibrium model are presented in the Appendix 1.

The lag response of the coconut producers, between price changes and the quantity supplied has been considered especially in the fresh coconut market and in the coconut oil markets. In addition, the model includes palm kernel oil price as an endogenous variable, to assess the implications of the tariff policy liberalisation on edible oil on the coconut markets. The import tariff rate and the world market price of palm kernel oil are considered as exogenous variables. Appendix 2 presents the econometric estimates generated by Samarajeewa (2002), using the seemingly unrelated regression procedure. The magnitudes of the elasticity values of supply and demand with respect to prices are the key factors, which determine the changes of each endogenous variable for respective policy shock in the simulation procedure. Table 1 presents the elasticity estimates based on the results of the econometric estimation, which were calculated at the mean of the sample.

Table 1. Estimated elasticity values for coconut markets used in the analysis.

Variable	Market		
	Fresh Coconut	Coconut oil	Desiccated coconut
Supply elasticity with respect to own price	0.195**	0.512**	0.048
	(5.00)	(5.16)	(0.806)
Supply elasticity with respect to input price	-0.079	-0.362**	-0.22**
	(-0.75)	(-2.36)	(-3.27)
Demand elasticity with respect to own price	-0.11**	-0.479**	-0.041
	(-2.25)	(2.51)	(-0.69)
Demand elasticity with respect to income	0.3 **	-0.054	-
	(2.39)	(0.35)	

Figures in parenthesis are the 't' statistics; ** Significant at P<0.05.
Income elasticity of desiccated coconut demand was not calculated. The income elasticity of coconut oil demand was found to be a negative value.
Source: Samarajeewa (2002).

RESULTS AND DISCUSSION

Validation of the model

Validation is necessary to understand the reliability of the model to be used in policy analysis. The commonly available measures of validation are correlation coefficient, biasedness and root mean square error (RMSE). The RMSE expressed in percentage terms, which was used to test the accuracy of the simulated performance against the actual value. It was obtained by dividing RMSE by the mean of the variable and multiplied by 100. The bias is an indication of systematic error, since it measures the extent to which the average values of simulated and actual series deviate from each other (Pindyck and Rubinfeld, 1991). The low RMSE errors are only one desirable measure of simulation fit. Similarly low bias values are preferred for fitted values, if not revision of the model must be considered. The correlation coefficients of the fitted series against the actual must be as large as possible to narrow the difference of fitted values from actual. The base model validation statistics, *i.e.*, the RMSE, bias and the correlation coefficient for coconut market simulation are presented in the Appendix 3.

In the case of coconut market model, the correlation coefficient values for six models were more than 50%, except the models for fresh coconut and coconut oil demand and coconut oil retail price. All three-supply models show a high degree of correlation of predicted values with actual values. The RMSE measure was not good for some of the variables, especially for the retail prices of fresh coconut and coconut oil markets. However, the bias measure is very low and close to zero for all the variables. Based on these statistics, the coconut market model was satisfactorily accepted for policy analysis process.

Results of the tariff policy simulation

The policy simulation exercise was performed to evaluate the impacts on the producer sectors of fresh coconut, coconut oil and desiccated coconut markets due to the trade liberalization in edible oil market. The values of endogenous variables were predicted treating import tariff on palm kernel oil was zero, over the period from 1978 to 1999. The palm kernel oil was specifically selected, since it has similar uses as coconut oil and has been imported in large quantities during the past two decades. As this study mainly concentrates on the coconut producer sectors, the predicted results of the policy shock relative to the mean base values are presented in Table 2. According to the results of the policy simulation and the producer surplus calculation, it is clear that the tariff concessions given in the edible oil market has notable implications on coconut producer sectors.

The zero tariff policy shock leads a drop in fresh coconut supplies and the producer price. It is clear that the changes occurred in the coconut oil market due to the zero tariff policy on edible oils, has indirectly influenced the fresh coconut market as well. The results revealed that the coconut oil supply reduces by about 8% due to the zero tariff policy shock (Samarajeewa, 2002). Consequently, the possible low demand for fresh coconuts, which was abandoned by the coconut oil manufacturers, may lead the fresh coconut market to come to a new equilibrium with a low supply and at a lower

producer price. The producer price for fresh coconut declines by 0.23% while the fresh coconut supply declines by about 0.6% in response to the trade liberalization in edible oil market. The quantity reduction in the supply level is slightly higher than that of the producer price, depending on the inelastic supply elasticity of fresh coconuts. Based on the annual average coconut production figure, which is around 2500 million coconuts, the reduction in fresh coconut supply is about 15 million nuts.

Table 2. Results of the zero tariff policy simulation on production, and producer prices of the coconut markets at the mean of the sample (1978-1999).

Market	Variable	Unit	Mean at the base simulation	Predicted change for zero tariff policy shock
Fresh coconut	Supply	Mill. Nuts	2456.04	2439.03 (-0.6)
	Producer price	Rs/'000 nuts	2.597	2.591 (-0.23)
Coconut oil	Supply	Metric tons	67667.3	62321.6 (-7.9)
	Producer price	Rs/MT	19.31	16.76 (-13.2)
Desiccated coconut	Supply	Metric tons	50850.7	50895.3 (+0.1)
	Producer price	Rs/MT	18.83	18.5 (-1.8)

Figures in the parenthesis are the percentage changes from the mean base value.
All the prices are deflated values by the price index.

Table 3 gives the changes in the values of the producer surplus of fresh coconut market due to the trade liberalization policy in coconut oil market. It is clear that the fresh coconut producers are loosing due to the trade liberalisation in edible oil market, which is indicated by the negative change in fresh coconut producer surplus. The loss in producer surplus accounts Rs. 13,710,000 on average for the period of 1978-1999. There are about 700,000 coconut growers in Sri Lanka and, many of them operate at small-scale level. Hence, this loss may create adverse implications for the rural poor, who depend on coconuts in the country.

Table 3. Changes in producer surplus of the fresh coconut market due to the trade liberalization in edible oil market (1978–1999).

	Producer surplus at the base (Rs. million)	Producer surplus at tariff policy liberalization on edible oils (Rs. million)	Change in the Producer surplus (Rs. million)
Fresh coconut market	7639.79	7626.08	- 13.71

The residual amount of coconuts has to be utilised alternatively in coconut oil and desiccated coconut manufacturing industries, following the domestic fresh coconut consumption. However, desiccated coconut is generally accepted as the high value product, overwhelming the values of coconut oil. Therefore, one of the objectives of the liberalization in edible oil market was to facilitate the proper functioning of the desiccated coconut industry, while catering the edible oil demand in the country. Therefore, the suppression of coconut oil supplies by the liberalization of trade on edible oils, eventually expected to benefit the desiccated coconut industry. However, the results of policy simulation indicate simply a 0.1% of supply increase in desiccated coconut market is due to this policy change.

CONCLUSIONS

This study examines the impact of trade liberalization in edible oil market on the producer sectors of three major coconut markets, with an emphasis on the welfare of fresh coconut producer sector. The study used the equilibrium model econometrically estimated by Samarajeewa (2002) with extensions for welfare measurements. A policy simulation is performed to achieve the objectives of this study, assuming a zero tariff policy shock on edible oil imports. The results of the policy simulation reveal that the trade liberalization in edible oil market has notable implications on the producer sectors of fresh coconut, coconut oil and desiccated coconut markets. The policy change leads a supply decline in fresh coconut and coconut oil markets while a marginal supply increase occurs in the desiccated coconut market.

The producer surplus analysis implies that there is a welfare loss for fresh coconut producers due to the trade liberalization policy in edible oil market. This can make a depreciation of the set objectives of the development programs such as subsidy on cultivation, credit for inputs and other institutional policy measures that has been implemented to enhance the welfare of the primary coconut producers. Therefore, the welfare gain of these different policy devices needs to be high enough to compensate the welfare loss occurred by such indirect implications of other policy instruments alien to the coconut markets, to achieve the desired objectives in the coconut producer sector. Hence, a comprehensive impact assessment of micro level policy instruments before their implementation would be a valuable step to enhance the welfare for the primary coconut producer, and to improve the efficiency gains in the coconut production process. The coconut market model may also be extended further to compute consumer welfare.

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APPENDICES

Appendix 1. Behavioural equations of the coconut market model.

Fresh Coconut Market

$X_1 = f(P^f_1, PF_{t-2}, RF_{t-1}, t)$

$Y_1 = f(P^r_1, IC, t)$

$P^f_1 = f(P^r_1)$

$X_1 = (Y_1 * Population) - cf1.X_2 - cf2.X_3 + other$

Coconut oil Market

$X_2 = f(P^f_2, P^f_1, t)$

$Y2 = f(P r_2, IC, Ppko^r, Psoy^r)$

$Ppko^r = Ppko^w (1 + tr)$

$P^f_2 = f(P^r_2)$

$X_2 = Y_2 + Stocks1$

Desiccated Coconut Market

$X_3 = f(P^f_3, P^f_1, t)$

$Y_3 = f(P^{fob}_3, t)$

$P^f_3 = f(P^{fob}_3)$

$X_3 = Y_3 + Stocks2$

Endogenous Variables

P^f_1 = Wholesale price of coconuts

P^r_1 = Retail price of fresh coconuts

P^f_2 = Producer price of coconut oil

P^r_2 = Retail price of coconut oil

P^f_3 = Producer price of desiccated coconut

P^{fob}_3 = Boarder price for desiccated coconut

$Ppko^r$ = Domestic price of Palm kernel oil

X_1 = Per capita consumption of coconuts

X_2 = Coconut oil supply

X_3 = Desiccated coconut supply

Y_1 = Total coconut production

$Y2$ = Per capita demand for coconut oil

Y_3 = Quantity DC exports from Sri Lanka

Exogenous variables

$Cf1$ = Conversion factor for coconut oil (8800 fresh nuts/ MT of coconut oil)

$Cf2$ = Conversion factor for desic. Coco. (8000 fresh nuts/ MT of des. Coco.)

IC = Per capita income

$Other$ = All other uses of fresh coconuts

PF_{t-2} = Coconut fertiliser price at time t-2

$Psoy^r$ = Domestic price of Soy oil

Ppo^w =World price of palm kernel oil

RF_{t-1} = Rainfall at time t-1

tr = Import tariff for palm kernel oil

$Stocks1$ = year end stocks of coconut oil

Stocks 2 = *Year-end stocks of desiccated Coconut*

Appendix 2. Econometric estimations of the coconut market model.

Function	Variable	Co-efficient	't' value	Goodness of fit DW value
	Producer price	191.37 **	*(5.00)*	
	Fertilizer price	-13.41	*(-0.52)*	$R^2 = 0.52$
Fresh coconut supply	Rainfall (-1)	0.311**	*(2.83)*	DW = 1.95
	Technology	11.03**	*(2.31)*	
Fresh coconut demand	Retail price	-4422.36**	*(-2.25)*	
	Per capita income	2.8**	(2.39)	$R^2 = 0.60$
	Coconut oil price	133.51	(0.57)	DW = 1.82
	Taste and preferences	-1.96**	(-3.17)	
Price linkage	Retail price	532.99**	(7.87)	$R^2 = 0.82$ DW = 2.2
	Producer price	1614.67**	*(5.16)*	
Coconut oil supply	Fresh coconut price	-10175.7**	(-2.36)	
	Technology	-2872.51**	*(-6.98)*	
Coconut oil Demand	Retail price	-45.758**	(-2.51)	
	Per capita income	-0.099	*(-0.35)*	$R^2 = 0.46$
	Palm kernel oil price	65.921**	(2.95)	DW = 0.3
	Soy oil price	7.183	*(0.38)*	
Price Linkage	Retail price	888.11**	(31.85)	$R^2 = 0.9$ DW = 2.3
Desiccated Coconut Supply	Producer price	70.25	(0.806)	$R^2 = 0.56$
	Coconut price	-4244.53**	(-3.27)	DW = 1.92
	Technology	886.08**	*(6.27)*	
Desiccated	f.o.b (Colombo) price	-54.44 *	(-1.15)	$R^2 = 0.25$
Coconut export demand	Tastes and preferences	321.54	*(0.502)*	DW = 1.8

All the estimated functions are in linear form.
The estimated parameter for the income variable of the coconut oil demand was found to be negative.

Appendix 3. Validation statistics for coconut market simulation (simulation period, 1978-1999).

Market	Endogenous Variable	Validation Statistic: Correlation coefficient (r)	RMSE (%)	Bias (%)
	Supply	0.91	4.81	3.39
Fresh coconut	Demand	0.35	6.27	3.419
	Producer price	0.55	24.04	3.97
	Retail price	0.55	76.14	5.46
	Supply	0.92	22.189	0.496
Coconut oil	Demand	0.48	31.78	4.47
	Producer price	0.67	20.78	1.14
	Retail price	0.38	61.6	5.18
	Supply	0.90	9.92	0.23
DC	Export Demand	0.69	18.71	0.23
	Producer price	0.68	23.09	0.22
	World price	0.79	21.92	0.153