AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Impact of Trade Liberalisation in Non-Plantation Agriculture in Sri Lanka on Economic Growth and Environmental Degradation: A Computable General Equilibrium (CGE) Analysis.

W.G.Somaratne
Anthony Chisholm
Sisira Jayasuriya
Department of Economics
School of Business
La Trobe University, Bundoora, Victoria, 3083.

Jayatilake S Bandara
School of Economics,
Griffith University, Nathan, Queensland, 4111.

January, 1997.

Paper presented to the 41st Annual Conference of Australian Agricultural and Resource Economics Society, Inc. (AARES), Pan Pacific Hotel, Broadbeach, Queensland, Australia, 20-25 January 1997. The research presented in this paper forms part of a larger research project funded by the Australian Centre for International Agricultural Research (ACIAR).

Impact of Trade Liberalisation in Non-Plantation Agriculture in Sri Lanka on Economic Growth and Environmental Degradation: A Computable General Equilibrium (CGE) Analysis.

W.G. Somaratne, Anthony Chisholm, Sisira Jayasuriya and J.S. Bandara

Abstract

During the past two decades, Sri Lanka has experienced economic growth through liberal economic policies, together with structural adjustment and other agricultural policy reforms. In Sri Lanka, new technologies and regulatory devices were used to mitigate environmental problems such as soil degradation. However, there has been concern about the impact of policy liberalisation and implementation of the GATT/Uruguay Round Agreement Agriculture (GURAA) on the environment.

This paper analyses the likely economy-wide effects of trade liberalisation in non-plantation agriculture (especially rice and other field crops) in Sri Lanka, using a computable general equilibrium (CGE) model. This model captures the environmental impacts of policy changes, particularly on-site and off-site effects of depletion of land quality.

Preliminary results shows that trade liberalisation in non-plantation agriculture is an environmentally friendly ('green') policy device which leads to both higher economic growth and reduced environmental degradation.

Key Words : Trade liberalisation, Economic growth, Environmental degradation

Acknowledgments: The authors wish to thank Dr. P.J.Gunawardana and Dr. I Fraser for their comments made on an earlier draft of the paper. However, the authors alone are responsible for the entire content of the paper.

Impact of Trade Liberalisation in Non-Plantation Agriculture in Sri Lanka on Economic Growth and Environmental Degradation: A Computable General Equilibrium (CGE) Analysis.

1. INTRODUCTION

Since 1977, successive governments in Sri Lanka have implemented a wide range of economic policy reforms. The main declared objectives of the policy reforms were to accelerate economic growth, create employment opportunities, increase capacity utilisation, stimulate savings and investments, improve the balance of payments and achieve international competitiveness (Rajapathirana, 1988; Curthberston and Athukorala, 1991; Dunham and Kelegama, 1993 & 1994; Athukorala and Jayasuriya, 1994; Far Eastern Economic Review, 1995; Gunawardana and Somaratne, 1996). The policy reforms included the removal of quantitative restrictions (QR's), reduction in import tariffs, devaluation of the currency and the introduction of export promotion measures. As a result, a high degree of openness of the Sri Lankan economy has been observed during the last two decades (Samaratunga and Jayasuriya, 1996).

Agriculture contributed about 21 percent of Gross Domestic Product (GDP), and 23 per cent of the total value of exports in 1993 and accounted for 39 percent of the employed labour force (Report of Presidential Commission on Tariffs and Trade, 1994). The non-plantation agricultural sector alone contributed 17 percent of GDP in 1993 (Central Bank of Sri Lanka, 1995). In 1963, agricultural sector's contribution to GDP was 38 percent and it accounted for 53 percent of all employment (Edirisinghe, et.al.,1992). The agricultural sector continues to be the dominant sector in the Sri Lankan economy and it also has the greatest concentration of poverty, particularly among its small scale tenant farmers, small farm owners and landless workers. Thus, any development strategy that is formulated to increase employment and alleviate poverty through economic growth in Sri Lanka, needs to concentrate on agricultural development. In the development process, sustainable agricultural development is the key to achieving an efficient pattern of resource use, reducing environmental degradation, creating of employment opportunities and alleviating poverty.

The popular belief in developing countries that trade policy liberalisation creates environmental degradation, has rarely been examined and evaluated. Most analyses of the land degradation problem show that solutions must come from within upland agriculture, through the adoption of land saving technological advancements, changing upland agricultural systems, reduced deforestation, efficient land tenure systems and effective community participation on soil

conservation measures. While these factors and issues are important, in the Sri Lankan case, so far the role of appropriate relative price changes in the protection of natural capital (i.e., soil) has been overlooked.

The objective of this paper is to examine the impact of tariff reduction in non-plantation agriculture in Sri Lanka on economic growth and changes in the level of environmental degradation in the production process and an evaluation of its on-site and off-site impacts. It further analyses the likely economy-wide impacts on tariff liberalization in non-plantation agriculture, and evaluates how effective it is as an indirect policy device for reducing externalities (land degradation) in Sri Lanka.

The paper is organised as follows. Section 2 provides an overview on existing tariff structure and its effects on the non-plantation agricultural sector. Section 3 briefly discusses the liberalization effects on economic growth in Sri Lanka within a neo-liberal policy framework. Section 4, explains the changes in land use pattern over the years and environmental degradation in the Sri Lankan agriculture. Section 5 describes the comparative static CGE model for the Sri Lankan economy and data sources for the model. Section 6 explains the CGE model closure and 35 percent tariff reduction in non-plantation agricultural sectors as an exogenous policy shock, selected for simulation policy experiments. Section 7 analyses the economywide results on simulation of tariff liberalization at macro levels and an evaluation of on-site and off-site effects including the value of savings of natural capital. Section 8 presents concluding remarks and policy implications based on simulation experiments.

2. IMPORT TARIFF STRUCTURE AND NON-PLANTATION AGRICULTURAL SECTORS

Since 1977, import tariff protection provided to Sri Lankan agriculture has been gradually reduced under liberalised trade and other agricultural reform policies, with the objective of increasing the international competitiveness of Sri Lankan agricultural products. Once the trade barriers relating to agriculture became an internationally prominent issue with the Uruguay Round Negotiations of GATT, Sri Lanka's tariff and related protectionist policies were the subject of critical analysis. In this context, QRs, import tariffs, export taxes, export subsidies and exchange controls were dismantled and other institutional and reform structures were undertaken which were conducive to economic growth in Sri Lanka. In 1977, most QRs were replaced by a six band duty system for imports ranging from 0 percent for essential consumer goods to 500 percent tariff rates on luxury

import tariff regime was introduced for most industrial and agricultural products in conjunction with a flexible exchange rate regime. Export taxes, applying particularly to the plantation sector, were also reduced. Most of the food subsidies were also removed and a targeted food stamp scheme was introduced only for the most vulnerable, lowest income earning category of people in Sri Lanka (Curthberston and Athukorala, 1991; Dunham and Kelegama, 1993; Athukorala and Jayasuriya, 1994). The 'first wave' of liberalised economic policies resulted in an enhanced rate of economic growth, thereby reducing the rate of unemployment and the rate of inflation. However, due to the civil war and associated problems prevailing in the economy, in the early 1989, the expected economic performance levels fallen sharply below expectations.

To address the economic problem, a 'second wave' of economic liberalization occurred in Sri Lanka in 1989. The government embarked upon a new stabilisation programme, which included import tariff reductions, devaluation of the Sri Lankan currency, further tax reforms, further liberalistion of commodity and financial markets (e.g. removal of the subsidy on fertiliser and removal of concessionary interest rates for agricultural credit.), privatization of government business enterprises, including state-owned plantations, and increased export promotion (Dunham and Kelegama, 1994; Athukorala, 1994; Jayasuriya, 1994; Lakshman, W.D. 1994)

Table 1: Macro-Economic Indicators in Sri Lanka (1988 - 1993)

Indicator	1988	1989	1990	1991	1992	1993
GDP Growth (%)	2.7	2.3	6.2	4.6	4.3	6.9
Budget deficit*	15.6	11.2	9.9	11.2	7.4	8.1
Inflation (%)	14.0	11.6	21.5	12.2	11.4	11.2
Current account deficit*	-5.6	-4.4	-3.2	-5.4	-4.5	-3.8
Investment*	22.5	21.5	21.9	22.6	23.5	24.0
Domestic savings*	12.0	12.2	14.3	12.7	15.3	15.5
Exports*	21.1	22.3	24.7	22.6	25.9	26.6

*** As a percentage of GDP**
Source: Dunham and Kelegama (1994)

The overall performance of the Sri Lankan economy between 1989 and 1993 is shown in table 1. It reveals that a solid macro-economic progress was recorded as measured by almost all indicators. A

items. These rates were imposed even on agricultural sectors, considering various commodity specific tariff rates. The Sri Lankan tariff structure has been periodically reviewed since 1980, and successive changes toward a lowered tariff structure have been implemented (Ratnayake, 1993; Report of Presidential Tariff Commission on Tariff and Trade, 1994).

To evaluate the structure of incentives in the agricultural sector in Sri Lanka, it is necessary to consider the nominal protection coefficients (NPC) and effective protection coefficients (EPC). As shown in Appendix table 1, the average EPC for the agricultural sector was 1.6, while that of the manufacturing sector was 1.8, during the period 1988-91. However, in 1992/93, whilst the EPC remained unchanged in agriculture, the EPC declined from 1.8 to 1.7 in the manufacturing sector. But in 1992/93, the EPC in the manufacturing sector continued to be higher than in the agricultural sector. The most highly protected sector in Sri Lankan agriculture is the non-plantation agricultural sector which includes rice and subsidiary food crops namely, onions, chillies, potatoes, vegetables, maize, manioc and pulses.

In non-plantation agriculture, rice and other subsidiary food crops are the major sub-sectors. The present rates of import tariff imposed on rice and other annual agricultural crop sectors range from 35 to 45 percent (see Appendix Table 2). The 35 percent import tariff rate on the CIF price is imposed on Rice, Sugar, Potatoes, Red onions, B'onions, Greengram, Blackgram, and Dried Chilies, while a 45 percent tariff applies only to Maize and Split lentils. The tariff structures have distorted resource allocation both between agricultural sectors and between agriculture and other sectors. Furthermore, tariff protection appears to have increased the cost of land degradation. For example, a high rate of import tariff protection was given to potatoes despite this crop being one of the most soil erosive crops in the non-plantation agriculture sector.

3. EFFECTS OF TRADE LIBERALISATION ON ECONOMIC GROWTH IN SRI LANKA

A positive interrelationship has been identified between trade liberalization, including the removal of import tariff and economic development (IMF,1992; Edwards,1993). Differing experiences of recent trade liberalization episodes in developing countries have been documented (see Choksi and Papageorigiou, 1986 and Papageorigiou et al., 1990). In 1977, the newly elected United National Party government in Sri Lanka dismantled most trade barriers and exchange controls and allowed the private sector to play a leading role as an "engine of growth" in the development process. In the trade liberalization process, the quantitative controls on imports were removed and a rationalised

high rate of inflation prevailed, due to high defence spending as a result of the on-going civil war. The rate of economic growth over the period 1990-93 was clearly substantially higher than for the period 1988-89.

4. LAND USE PATTERNS AND ENVIRONMENTAL DEGRADATION IN SRI LANKA

Deforestation, watershed destruction, loss of biological diversity, fuelwood and water shortages, soil erosion and water contamination, over grazing and over fishing, urban congestion and environmental pollution are common to fast growing Asia, stagnating African and heavily indebted Latin American countries (Panayotou, 1990). In Sri Lanka, environmental conditions, particularly land degradation and soil erosion, have become sensitive issues in recent years.

Since independence, successive governments of Sri Lanka have spent considerable sums of on producer subsidies to enhance productivity levels both in the non-plantation (annual crops) and the plantation (tree) crops sectors (see ADB, 1990 and Atukorale and Somaratne, 1994). Deforestation occurred at a very high rate during the 20th century, with natural forest cover being reduced from 80 to 22 percent of the country's land area. Expansion and intensification of agricultural and the continuing practice of swidden (shifting) cultivation, encroachment and utilisation of ecologically marginal lands for agricultural purposes, and the clearing of forest land for the establishment of human settlements have been major contributing factors to the high rate of deforestation and increased land degradation, particularly in the highland and midland regions[1] (Bandarathilake, 1995).

4.1 Changes in Land Use Pattern and Land Degradation

The land use pattern adopted in the upper watershed regions in Sri Lanka, which includes highland and midland districts is basically of two types, namely upland plantation crops (or perennial crops) and upland non-plantation crops. Upland plantation crops include tea, rubber, coconut, export agricultural crops (mixed-spice gardens) and forestry which represent 71, 48, 13, 54, and 12 per cent of Sri Lanka's total area grown of these crops, respectively (Plantation Sector, Statistical pocket Book , MPPPI, 1993).The upland non-plantation crops (vegetables, potatoes, tobacco and other field crops) and paddy accounted for 30 and 21 percent of total area grown, respectively

---

1 The highland districts are Nuwaraeliya and Badulla.
The midland districts are Kandy, Matale, Kegalle and Ratnapura.

(Department of Census and Statistics, Sri Lanka, 1993).

Table 2 shows that the land use pattern in the upper watershed regions has changed dramatically over the last five decades, from socially beneficial perennial crops like tea and forestry toward more soil erosive homestead and non-tea crops (annual crops). This trend in land use has had important on-site and off-site consequences. Soil erosion has impacts both on-site land productivity and down-stream irrigation and generation of hydro-power.

Table 2: Changes in Land Use Pattern in the Upper Water-Shed Regions in Sri Lanka

Land Use Type	1956 (%)	1978/79 (%)	1991 (%)
Tea	61	39	25
Homestead	7	17	18
Grassland	5	8	7
Forest	17	14	18
Forest Plantation	2	4	7
Non-tea crop land	7	15	20
Other	1	3	5
Total	100	100	100

Source: HR Wallingford (1995)

As shown in table 3, the rate of soil erosion for upland tree crops namely tea, rubber, forestry and mixed-spice garden crops are significantly lower than for annual crops grown in the upland region. Research by Coxhead and Shively (1994), shows that in Philippine agriculture, plantation crops generate higher social returns than annual crops due to the lower rate of land degradation associated with plantation crops.

Table 3: Soil Erosion Under Different Cropping Systems

Cover type/Land use	Rate of Soil Erosion * (tons/ha/year)
Tea Sector	
VP Tea	15
Well-Managed Seedling Tea	20
Poorly - Managed Seedling Tea	75 (35.2)#
Rubber	10
Mix Garden (Spice)	10
Chena Cultivation	75
Vegetable Gardens	100
Forest	
Dense Forest	0.3
Pine Forest	0.5
Patna	5
Degraded Forest	10
Scrubland	10 (5)#
Tobacco	70

Source: Bandarathilake, H.M (1995), Optimal Land Use in the Hill Country of Sri Lanka: Land Degradation and Forestry, MPI/ACIAR Project (Draft Report).

* Estimated soil loss is related to Nuwaraeliya district in the highland.
# Weighted Average

While the economic reform policy packages implemented in many developing countries have been generally successful, market failures (negative externalities) associated with natural resource use continued to be a major problem in developing countries (Panayotou, 1990; Cruz and Repetto, 1992; World Bank, 1992; Gupta and Miranda, 1995). Impoverished people have commonly been driven to over-exploit, fragile, and unproductive environments. The major areas of market failures in the Sri Lankan economy are land degradation in the agricultural sector (Bandara et al, 1995) and environmental pollution in manufacturing and some of the service sectors, such as transport, (Munasinghe and Cruz, 1995).

Land degradation and environmental pollution continue to be a major problem in most developing countries (Blaike, 1985; Repetto, 1989; Panayotou,1990; Zaho et.al.,1991). In Sri Lanka, high population pressure on land leads to increased use of marginal lands and high hilly slopes, mainly

for cultivation of non-plantation crops . Empirical studies show that soil erosion and degradation of agricultural lands not only decrease land productivity, but also impose costs in off-site down-stream areas. These costs include reduction of water quality in natural water ways, sedimentation of irrigation networks, reduction of hydro-power generation capacity of reservoirs and increased operation and maintenance costs of irrigation head-work, including down stream distributary and field canals (Coxhead and Shivelly, 1994; Coxhead and Jayasuriya, 1994; Bandara et al, 1995; Bandusena, 1995; Samaratunga, 1996). This situation represents a classic case of the interdependence between economic growth and the environment and is significant because of the economic growth impacts on the environment and environmental quality which in turn impacts on economic growth (European Commission, 1987; Pearce, David et.al.,1989; Goodstein, 1995; OECD, 1996).

Changing land use patterns and shifting cropping systems commonly lead to socially sub-optimal erosion rates. As explained by Chisholm and Dumsday (1987), there are many factors contributing to socially resulting sub-optimal soil erosion rates; imperfect information about levels and consequences of soil erosion associated with particular land use patterns; absence of well defined property rights; divergences between social and private time preference rates and inter-regional externalities. The existing policy induced price distortions in the presence of market failures pose a difficult problem for the analysis of the social costs and benefits of reducing soil erosion. In particular, the existence of externalities, due either to off-site effects or to imperfect information about the future impact of current practices of soil productivity, means that removal of existing policy distortions may not be socially optimal (Coxhead and Jayasuriya, 1994). Moreover, the impact of higher output prices on long-run land quality is an empirical issue. Depending particularly upon the availability and cost of conservation measures, higher output prices may increase or decrease long-run land quality (Repetto,1989; Chisholm, 1992; LaFrance, 1992; Clarke, 1992; Barret, 1991). Therefore, careful and effective policy evaluation is necessary based on a model that captures general equilibrium impacts. In this context, partial equilibrium analysis is unable to capture likely important economy-wide impacts.

With changes in economic policies, market forces, particularly changes in relative product prices, play a decisive role in selecting profitable crop combinations. Important factors influencing crop combinations are the mobility of primary inputs namely, labour and capital, in relation to changes in demand and supply of primary inputs and commodity markets. These changes are based on technology and tastes. In this context, it is clear that adverse environmental effects resulting from market failure have significant implications for policy intervention (Goodstein, 1995). Over the last few decades, structural and other preventive measures of land degradation have been developed

and applied in developing countries by means of regulations and community participatory approaches. However, the potential for changes to trade policies to reduce problems of land degradation have not been widely explored.

5. A CGE MODEL FOR THE SRI LANKAN ECONOMY

A recent phenomenon in the economic modelling arena, was the development of a class of economy-wide models, which are known as computable general equilibrium (CGE) models. CGE models are mainly employed to evaluate the likely economy-wide impacts on a wide range of policy issues in both developed and developing countries. Basically these models provide an internally consistent economy-wide framework for policy analysis, in considering internal and/or external shocks to an economy on macro and micro economic variables.

In considering the above issues, there were four CGE models recently developed by Bandara (1989), Centre for International Economics (CIE) (1992), Herat (1994) and Bandara et al., (1995) for the Sri Lankan economy to evaluate the economy-wide likely impacts of various policy issues including external shocks, 'Dutch disease' type policies, technological change, and trade related policy issues. In Bandara et al., (1995) model, the relationship between economic reform policies and issues on externalities, in particular aggregate and sectoral level of soil erosion was considered to investigate likely economy-wide impacts. This model was the first model developed for analysing environmental effects in the Sri Lankan history of economic policy analysis. All of these models are neo-classical, comparative static models, the structure of which is based on the traditional ORANI model of the Australian economy (Dixon, et.al., 1982). The CIE and Bandara et al. models are more disaggregated than Bandara's (1989) model. These two models used a recent input-output data base in taking into account of 1977 structural changes in economic liberalisation of the Sri Lankan economy.

In this analysis, the comparative-static CGE model developed by Bandara et al., (1995), which belongs to Johansen class, with linear in proportional changes of variables, is adopted as the base for analysis, with further disaggregation of the model. The advantage of the Johansen class models is the flexibility to address a range of comparative-static problems involving changes in policies, prices, factor endowments and technologies. This model assumes a one to one correspondence between industries and commodities. Although modelling of all on-site and off-site effects of land degradation is an extremely difficult task, efforts have been made to evaluate the economywide impacts of land degradation, including on-site cost of land degradation and off-site impacts on

irrigated agriculture and hydro-power generation. Accordingly, this CGE model was further disaggregated from 37 to 40 industries based on new technical information on land degradation to incorporate on-site effects of of soil erosion at a more detailed sectoral level. In this context, the tea sector was further disaggregated into highland, midland and lowland tea sectors while the other agriculture sector was disaggregated into highland, midland and lowland other agriculture and upland potatoes. The model includes 14 agricultural industries in the upland, midland and lowland regions. Each industry produces a single good by using three primary factors: land, labour and capital.

The main data base used for the model is the input-output table developed by the Department of Census and Statistics in 1989, which was further updated and improved in 1991 by the CIE, incorporating the structural changes taking place in the economy, after the second wave of economic reforms in 1989. This input-output data base captures the production accounts in the economy, the share coefficients in sales, costs and revenues in current production, investment, household consumption, foreign trade, and margin industries (marketing value-added distribution etc.) are computed to implement the relevant CGE model. In addition, the model requires various parameters, namely substitution elasticities between domestically produced and imported commodities (Armington elasticities); own, cross price and expenditure elasticities for Sri Lankan consumers; foreign demand elasticities for Sri Lankan exports; substitution elasticities between primary factors in each industry and investment parameters for each industry. In this model, the elasticity coefficients are taken from the model developed by the CIE. The CIE has used elasticity coefficients in its model drawn from existing literature on the subject and based on "best guesstimates" utilizing data for similar situations from developing countries in the Asian region.

In this model, land mobility is allowed between crop industries within upland, midland and lowland regions. The relative price changes of products resulting from changes in economic policy framework influence the land use patterns in the economy, which in turn affects rates of soil erosion. Changes in levels of soil erosion linked to changes in land use patterns in the upland and midland regions, have both on-site and off-site consequences. The main off-site impact of land degradation is the reduction of the productivity of physical structures for the storage and delivery of water for irrigation and hydro-power generation. An increase in sediment delivery rate to these water storage tanks in the lowland areas directly increases the costs in irrigated agriculture and hydro-power generation. The on-site productivity impacts from soil erosion and the off-site impacts of reduction in irrigation capacity for crops and hydro-power generation are modelled to estimate the value of depletion of natural resource capital in the Sri Lankan economy. For given quantities of sector-specific capital endowments, an increase in erosion levels in the upland and

midland sectors reduces lowland sectors' output by reducing their effective specific factor endowment. The parameter measuring the relationship between changing land use and induced soil erosion in the upland and the loss of irrigation capacity in the lowland can not be directly estimated due to a lack of secondary data. The off-site impact parameter used in the Bandara et al. (1995) study, based on the Philippine experience, for measuring off-site damage in lowland agriculture and hydro-power generation was 0.1, indicating that a 1 percent increase in acreage of upland crop sectors reduces the lowland irrigated area and hydro-power generation by 0.1 percent. In model use in the present study adopts the same value of (0.1) for the off-site impact parameter.

In the policy simulations it is expected to assess the relationship between trade liberalisation in the non-plantation agricultural sector, including tariff reductions, and on-site and off-site changes in levels of land degradation. In all simulation experiments of tariff liberalisation, a model closure is employed in which real wages and balance of trade are fixed. Accordingly, shifts in labour demand are absorbed by quantity adjustments (endogenous labour supply), and aggregate net income changes appear as changes in real household consumption. In addition, the nominal foreign exchange rate remains fixed, as a *numereire* of the model. Any movements in domestic price levels change the real exchange rate, which is defined as the ratio of an index of the border prices of tradeables to an index of domestic prices. The small country assumption is employed and world prices of imports are treated as exogenous. In this analysis, it is assumed that real wages are fixed and allowed determine endogenously the level of aggregate employment in the economy. It is possible to change the closure, if necessary, to determine the real wages endogenously, with aggregate employment in this case being the exogenous variable. The rates of soil erosion at both sectoral and for the economy as a whole is an endogenous variable in the model.

6. TRADE POLICY SHOCKS IN THE NON-PLANTATION AGRICULTURAL SECTORS

In the Sri Lankan economy, trade policy reforms in the agricultural sector that have taken place include the reduction of tariff in non-plantation agricultural sector, granting export subsidies for the plantation crops (tea, rubber, coconut, and other export agriculture), imposition of import quotas on rice, sugar and wheat-flower, and trade distorting "domestic policies" namely, re-establishment of national procurement programmes on paddy (rice), export credit subsidies on non-traditional exports, floor prices for other export agricultural (spicy) crops, and a fertiliser subsidy for paddy.

In the following analysis of trade policies, the recent import tariff reduction in the non-plantation

agricultural sector, including the other agricultural crops sector will be selected as exogenous policy shocks to evaluate their economy-wide impacts, including valuation of the on-site cost and off-site effects of changes in the rate of aggregate soil erosion. As shown in Appendix table 1, the rate of tariff imposed on non-plantation sectors was 35 percent of CIF price. In April, 1996, the government temporarily removed the 35 percent import tariff imposed on rice and other agricultural sectors, due to an unexpected drought, and allowed the private sector to import rice and other agricultural products free of tariffs, up to October 1996. In this study, the economy-wide impacts of a 35 percent sector specific import tariff reduction in upland, midland and lowland other agricultural sectors, and the upland potatoe sector, in the Sri Lankan economy are analysed.

Most natural resource accounting studies (WRI,1989; WRI, 1992; Lutz, 1994) indicate that the cost of agricultural land degradation leads to a significant reduction in the measured rate of economic growth. As estimated by Bandara et.al (1995), the aggregate annual average value of soil erosion in Sri Lanka in terms of the nutrient replacement cost was US$ 15.4 million per year. That is to say, a strong relationship between trade policies and land degradation was found. The major non-plantation crops grown were tobacco, potatoes, onions, chillies, vegetables and other field crops (OFC's), which are highly soil erosive crops. In the last two decades, these crops were given a high priority in order to attain the goals of food self sufficiency and agricultural crop diversification. As a result, while most farmers in these sectors have obtained short-term, lucrative private profits, but at the expense of land degradation. It is therefore evident that trade policy has important implications for land quality.

7. RESULTS OF POLICY SIMULATIONS

This section presents the simulation results of recent tariff reductions in non-plantation agricultural sectors in Sri Lanka, derived from CGE modelling. The analysis focuses mainly on changes in real economic growth and resource allocation, together with the changes in land use patterns and associated levels of aggregate soil erosion. The impact of tariff reductions on the on-site aggregate value of soil savings or losses (natural capital) and down-stream off-site effects are evaluated.

I. Macro-Economic Effects of Tariff Liberalisation

The macro economic impacts of recent tariff liberalisation in the non-plantation agricultural sectors in Sri Lanka are presented in Table 4. A strong relationship is shown to exist between economic growth and a reduction in land degradation as a result of tariff liberalisation. A 35 percent tariff

reduction in the non-plantation agricultural sectors increases the growth rate of real GDP by 0.03 percent. Moreover, while fostering economic growth, the induced changes in land use lead to a reduction in aggregate level of land degradation in the country of 0.04 percent per year.

Tariff liberalisation also increases the level of aggregate employment in the economy by 0.08 percent. As a consequence of tariff liberalisation in the non-plantation sectors, other manufacturing sectors receive an impetus for export-led growth and labour absorption. Moreover, tariff liberalization indirectly increases the level of other activities including margin activities.

Table 4: Macro Economic Impacts on Tariff Liberalisation in Non-Plantation Agricultural Sectors in Sri Lanka (Percentage Changes)

Endogenous Variables (Macro)	35% Tariff Reduction
A. Government Budget	
Government budget position (Rs. Million)	120.45
B. Household Consumption and Disposable Income	
Aggregate nominal household consumption	-0.2
Aggregate real household consumption	**0.04**
Nominal household disposable Income	-0.2
C. Price Indices	
GDP deflator	-0.23
Consumer price index	**-0.24**
D. Aggregate Employment	
Rate of Aggregate employment	**0.08**
E. Gross Domestic Product (GDP)	
Nominal GDP	-0.20
Real GDP	**0.03**
F. Aggregate soil erosion (tons/year)	
Total erosion	**-0.04**

Real household consumption increases by 0.04 percent with price reduction, induced by lower tariff. Price levels decline as measured by both the CPI and the GDP deflator. Further, tariff liberalisation in the non-plantation sectors leads to an increase both the value of imports and exports, but the rate of increase in the value exports is greater than the rate of increase in the value of imports resulting in an improved balance of trade in the economy.

In summary, tariff liberalisation assists to reduce on-site and off-site impacts of soil erosion, while fostering economic growth and improving most other macro economic indicators. In the near future, as one of the signatories of GATT-Uruguay round and WTO (World Trade Organisation)

negotiations, Sri Lanka is thus in a strong position to reduce import tariffs and strengthen market competition.

II. Level of Environmental Degradation (Soil Erosion) and An Evaluation of its On-Site and Off-Site Effects :

a. Changes in Rate of Land Degradation

Tariff liberalisation in non-plantation sectors encourages a shift of lands in an environmentally friendly direction in the Sri Lankan economy. It leads to a marginal increase of land in low soil erosive crops like tea (high-grown and mid-grown) and reduces land used in high soil erosive crops like other agricultural products in upland, and midland regions (see Appendix Table 5). Consequently, it substantially reduces the sectoral level of soil erosion in non-plantation sectors as well as the level of aggregate soil erosion in the economy (table 5).

Table 5: Effects of Tariff Liberalisation in the Non-Plantation Agricultural Sectors on Level of Soil Erosion

Sector	Rate of Soil Erosion (Percentage Changes)
Tea-High grown	0.13
Tea-Mid grown	0.12
Other.Agr-Highland	-0.39
Other.Agr-Midland	-0.4
Potatoes-upland	-0.39
Aggregate Soil Erosion	-0.04

Further, it is evident that tariff liberalisation in non-plantation agricultural sectors changes the land use pattern from highly soil erosive crops to low soil erosive crops, in both upland and midland regions. Even in the lowland sectors, there is an indirect shift of land from annual other agricultural crops to perennial tea crops. It is evident that, if the government continues to liberalise tariffs in non-plantation sectors, it will be an effective policy device attaining both a more efficient resource allocation and lower land degradation.

b. Aggregate Value of On-Site Land Degradation

In this analysis, the aggregate value of on-site soil erosion is evaluated on the basis of the nutrient replacement (defensive) cost, due to a lack of crop specific data on the relationship between productivity and soil erosion in Sri Lankan agriculture. The value of nutrient loss evaluation is based on the analyses done by Clark (1994) in relation to the upper Mahaweli watershed regions in Sri Lanka.

The value of aggregate soil-nutrient replacement cost in the base year (1992) is US$ 86.32 Million (Rs.3783 Million), which is shown in Appendix Table 3. This value is considered as a base value for the evaluation of cost of land degradation in the economy. In this context, as shown in table 6, in comparison with the base value, the tariff liberalisation policy in non-plantation agriculture leads to reduce aggregate on-site soil erosion cost in Sri Lanka by US$ 13.73 Million (RS. 601.5 Million). The real value of soil saved represents 0.16 per cent of total GDP (1992). If a developing country like Sri Lanka can make significant savings of natural capital indirectly by using economic policy devices rather than costly regulatory or other devices, it will lead to a more sustainable economy.

Table 6: Tariff Policy Induced Annual Aggregate Value of Soil Erosion in Sri Lanka (US$-Million)

Crop	Rate of Soil Erosion (tons/hec/year)	Base Value of Soil Erosion (US$-Million)*	%	Value of Tariff Policy Induced Soil Erosion (US$-Million)	%
Tea-High grown**	35.2	11.89	13.8	13.44	18.5
Tea-Mid grown**	35.2	13.67	15.8	15.31	21.1
Rubber	10	4.50	5.2	4.50	6.2
Coconut	20	5.13	5.9	5.13	7.1
Export Agriculture	10	1.83	2.1	1.83	2.5
Other Agr-Highland#	100	17.82	20.6	10.87	15.0
Other Agr-Midland#	100	21.90	25.4	13.14	18.1
Potatoes-Upland#	100	3.08	3.6	1.88	2.6
Forestry**	5	6.49	7.5	6.49	8.9
GRAND TOTAL		86.32	100.0	72.59	100.0
Value of Tariff Policy Induced Soil Savings Per Year; (Based on Nutrient Replacement Cost)				US$-Million	13.73
				Rs-Million (1992)	601.46
				As a Percentage of GDP (1992) :	0.16

** Weighted average of rate of soil Erosion

Total annual extent grown including both "Maha and Yala" Seasons

Source: (1) Bandarathilake, H.M. (1994)

(2) Plantation Sector Statistical Pocket Book (1994)

(3) Department of Census and Statistics, Sri Lanka (1993)

c. Off-Site Effects of Land Degradation

The importance of tariff liberalisation in the non-plantation sectors is further illustrated by the positive off-site effects in down-stream regions. The improvement in down-stream irrigated agriculture, especially in the paddy sector, and in the generation of hydro-power electricity is derived from the reduced level of soil erosion in the economy. This has been handled within the

model by means of an off-site impact parameter which measures the improvement of productivity levels in the paddy sector and hydro-power electricity sector. The paddy and the hydro-power electricity sectors in the model have increased productivity levels of 0.04 and 0.02 percent, respectively.

8. CONCLUDING REMARKS AND POLICY IMPLICATIONS

The policy analysis conducted with the CGE model for the Sri Lankan economy, has shown that tariff liberalisation in non-plantation agriculture has positive impacts on almost all the macro economic indicators. The economy-wide general equilibrium consequences of liberalised tariff policies, have also shown a close relationship between economic growth and the environment. It shows the possibilities for mitigation of agricultural environmental degradation in the production process through tariff policy liberalisation together with increased growth rates in the economy, as a 'win-win' solution. The formulation of environmentally friendly (green) development policy devices like liberalised tariffs for non-plantation agricultural sectors is vital for enhancing a high rate of long term economic growth, reducing negative externalities and attaining sustainable economy.

Tariff liberalisation for non-plantation agriculture, has an indirect ability to reduce aggregate soil erosion (i.e., save of natural capital) both with respect to its on-site impact on the economy and the positive off-site impacts for the production of paddy and for the generation of hydro-power electricity. Furthermore, it shows that if import tariffs continue in Sri Lanka, the future productivity of other micro-level industries and the growth of GDP will be lower.

It is necessary for government to play a leading role in further liberalisation of economic policies, including tariffs in order to enhance long-term economic growth. However, government will need to pay attention to externalities in the production process, particularly through policies designed to encourage users to employ conservation measures to prevent further land degradation in upland Sri Lanka. Institutional and community participatory mechanisms should be encouraged to conserve environmental and natural resources.

With a high degree of tariff protection in the non-plantation agricultural sector, it has been shown that short-term growth in this sector has been achieved at the cost of significantly reducing the on-site value of natural capital and at the same time imposing off-site damage costs on down-stream industries.

9. REFERENCES

Asian Development Bank (ADB) (1990), Report on Crop Production Incentives in Sri Lanka, Vol. II, Canberra : ACIL Australia Pty. Ltd.

Athukorala, P and Jayasuriya, S (1994), Macro Economic Policies : Crisis and Growth in Sri Lanka, 1969-90, Washington D.C : World bank.

Athukorala, P (1994), Economic Liberalisation and Industrial Restructuring in Sri Lanka, Paper Presented for the International Conference on Economic Liberalisation in South Asia, 30, Nov.-2nd Dec.1994 : Australian National University

Athukorale,R and Somaratne, W G (1994), State Support for Agriculture in Sri Lanka : An Overview, ARTI, Colombo. (Unpublished Manuscript).

Bandara, J S (1994), The Fiscal Impact of Trade Liberalisation in LDCs:The Case of Sri Lanka, Paper Presented for the International Conference on Economic Liberalisation in South Asia, 30, Nov.-2nd Dec.1994 : Australian National University.

Bandara, J.S, Coxhead,I., Chisholm, A.H., Ekanayake, A., Jayasuriya, S. (1995), Economic Reforms and the Environment in Sri Lanka, Discussion Paper, 27/95, School of Agriculture, Australia : La Trobe University

Bandara,J S (1989), A Multi Sectoral General Equilibrium Model of the Sri Lankan Economy With an Application to the Analysis of the Effects of External Shocks, PhD Thesis, La Trobe University, Melbourne

Bandarathilaka, H.M (1995), Optimal Land Use in the Hill Country of Sri Lanka: Land Degradation and Forestry, Draft Commissioned paper submitted to the Ministry of Plantation industries, Sri Lanka.

Bandusena W.M. (1995), An Economic Assessment of Off-Site Impacts of Soil Erosion: A Case Study of Sri Lanka, Paper Presented at the Environmental Economics and Policy Workshop, International Environmental Programme, Harvard Institute for International Development, July, 1995 : Harvard University.

Barret, Scott, (1991), Optimal Soil Conservation and the Reform of Agricultural Pricing Policies, Journal of Development Economics, 36 (Oct.), pp 167-87.

Blaikie, Piers (1985), The political Economy of Soil Erosion in Developing Countries, London and Newyork: Longman.

Central Bank of Sri Lanka (1995), Economic and Social Statistics of Sri Lanka, December, 1995, Colombo.

Centre for International Economics (CIE), (1992), The Composition and Level of Effective Taxes for Exporting and Import Competing Production in Sri Lanka, Canberra: Centre for International Economics.

Chisholm, A.H. (1992), Australian Agriculture: A Sustainability Story, *Australian Journal of Agricultural Economics*, 36, pp.1-29, April

Chisholm, Anthony and Robert Dumsday (1987) Land Degradation : Problems and Policies, Cambridge : Cambridge University Press.

Choksi, Armeane and Papageorgiou, Demetris (1986) Economic Liberalisation in Developing Countries, Oxford : Basil Blackwell.

Clarke, Harry (1992), The Supply of Non-Degraded Agricultural Land, Australian Journal of Agricultural Economics, 36(1), pp 31-56.

Clark, Rebecca (1994), Economic Evaluation of soil Erosion and Soil Measures: A Case Study of the Perawella area in the Upper Mahaweli Catchment, A Sri Lanka British Project, Technical Report- No. 20., environmental and Forest Conservation Division, Polgolla, Sri Lanka : Mahaweli Authority of Sri Lanka.

Coxhead, I, and Shively,G 1994), Measuring the Environmental Impacts of Economic Change: The Case of Land Degradation in Philippine Agriculture, Department of Agricultural Economics, University of Wisconsin-Madison.

Coxhead, I, and Jayasuriya, Sisira (1994), Technical Change in Agriculture and Land Degradation in Developing Countries: A General Equilibrium Analysis, Land Economics, 70(1) p. 20-37.

Cruz,W and R. Repetto, (1992),The Environmental Effects of Stabilization and Structural Adjustment Programmes : The Philippines Case, Washington D.C, : World Resource Institute.

Cuthberston, A G and Athukorala, P (1991) " Sri Lanka" in D. Papageorgiou, M. Michaely and A.M.Choksi, Eds., Liberalizing Foreign Trade : Indonesia, Pakistan and Sri Lanka: Basil Blackwell.

Department of Census and Statistics (1993), Statistical Abstract, Colombo.

Dixon, P B, B R Parmenter, J. Sutton and D.P Vincent (1991), ORANI : A Multi Sectoral Model of the Australian Economy, Amsterdam : North-Holland.

Dunham, David and Kelegama, Saman (1994), The second Wave of Liberalisation in Sri Lanka 1989-93: Reform and Governance, Paper Presented for the International Conference on Economic Liberalisation in South Asia , held on 30 th Nov.- 2nd Dec.,1994, at the Australian National University, Canberra.

Dunham, David and Kelegama, Saman (1993), Economic Liberalisation and Structural Reforms: The Experience of Sri Lanka, 1977-93, Monograph, Colombo: Institute of Policy Studies.

Edirisinghe,N. F.Abayaratne, W.G.Somaratne, I.Tudawe, and, P.Wickrmarachchi (1991), Efficiency and Policy Incentives in Rice Production in Sri Lanka, IFPRI/ARTI Project report, Colombo : ARTI.

Edwards S (1993), Openness, Trade Liberalisation and Growth in Developing Countries, Journal of Economic Literature, Vol.XXXI, No. 3, pp1358-1393.

European Commission (1987) , The Europeans and Their Environment in 1986, Brussels.

Far-Eastern Economic Review (1995), Peace and Prosperity in Sri Lanka, 23 rd February

Goodstein,Eban (1995). The Economic Roots of Environmental Decline : Property Rights or Path Dependence?, Journal of Economic Issues, Vol .XXXIX, No 4, December.

Gunawardana, P.J., and Somaratne, W.G. (1996), Economic Reforms Since 1977 and Their Impact on Domestic Agriculture in Sri Lanka, Paper Presented at the 25th Conference of Economists, Australian National University, Canberra, 23-25 September, 1996.

Gupta, Sanjeew and Miranda Kenneth (1995), Public Expenditure Policy and the Environment: A Review and Synthesis, World Development, 23(3), Elsvier Science Ltd. Great Britain, pp 515-28.

Herat, P.W.R.B.A.U. (1994), An Investigation of the Impact of Some Recent External and Internal Shocks on the Economy of Sri Lanka, Colombo,: Central Bank of Sri Lanka

International Monetary Fund (1992), Issues and Developments in International Trade Policy, Washington.D.C. : International Monetary Fund.

Jayasuriya, Sisira (1994), Sri Lanka : Balancing Stabilization and Growth, Paper presented for the International Conference on Economic Liberalzation in South Asia, held on 30th Nov.- 2nd Dec.,1994, at the Australian National University, Canberra.

LaFrance, J.T., (1992), Do Increased Commodity Prices Lead to More or Less Soil Degradation?, Australian Journal of Agricultural Economics, 36(1), pp 57-82.

Lakshman, W D (1994) Structural Adjustment Policies in Sri Lanka : Imbalances, Structural Disarticulation and Sustainability, Paper presented for the International Conference on Economic Liberalzation in South Asia, held on 30 th Nov.- 2nd Dec.,1994, at the Australian National University, Canberra.

Lutz, E (1994), National Resources Accounting, Washington D.C : World Bank.

Ministry of Plantation Industries (1994), Plantation Sector-Statistical Pocket Book, Colombo.

Munasinghe, Mohan and Wilfrido Cruz (1995), Economywide Policies and the Environment: Lessons from Experience, World Bank Environment Paper No. 10, Washington D.C.: The world Bank.

OECD (1996), Implementation Strategies for Environmental Taxes, France : Organisation for Economic Co-operation and Development.

Panayotou. Theodore (1990), The Economics of Environmental Degradation:Problems Causes And Responses, Development Discussion Paper No. 335, A CARE Project Report, Harvard University, USA : Harvard Institute for International Development.

Papageorgiou, Demetris, Choksi, Armeane and Micheal Michaely (1990) Liberalising Foreign Trade in Developing Countries : The Lessons of Experience, Washington D.C: World Bank

Pearce, David, Anil Markandya, and Edward, B Barbier, (1989), Blue Print for a Green Economy, Earthscan Publications ltd., London: The London Environmental Economics Centre.

Pearson, K.R (1988), Automating the Computation of Solutions of Large Economic Models, Economic Modelling, 15, 385-395.

Pezzey, John (1992), Sustainability : An Interdisciplinary Guide, Environmental Volumes : 1-4.

Presidential Tariff Commission (1994), Report of The Presidential Commission on Tariff and Trade, Colombo.

Rajapathirana, S (1988), Foreign Trade and Economic Development: The Case of Sri Lanka,World Development, Vol.16, No. 10, pp 1143-57.

Rathnayake.R (1993), Political Economy of Tariff Reforms in Developing Countries: Sri Lankan Experience, Working Papers in Economics, No 113, Wellington:University of Auckland.

Repetto, Robert (1989), Economic Incentives for Sustainable Production in Environmental Management and Economic Development. eds., Gunter Schramm and Jeremy J.Warford, Washington D.C. :The World Bank.

Samaratunga, R.H.S and Sisira Jayasuriya (1996), Regional Economic Integration, Trade and Investment : South Asia and OPEC, Paper Presented at the Conference of Economists, Australian National University, Canberra, 23-25 September, 1996.

Samaratunga, P.A (1996), Optimal Replacement of Long-Lived Crops Grown on Erosive Soils With an Application to The Tea Sector of Sri Lanka, PhD Thesis, School of Agriculture, La Trobe University Melbourne (Unpublished).

Somaratne, W.G and Wasanthi Wickramasinghe (1993), Efficiency in Rice Production in Sri Lanka, Paper Presented at the Symposium on Policy Issues in Agriculture,18-19 December, Colombo : Agrarian Research and Training Institute.

Wallingford HR (1995) Sedimentation Studies in the Upper Mahaweli Catchment in Sri Lanka, Report EX 3201, April . Oxon : HR Wallingford Ltd.

World Bank, (1992), International Trade and the Environment,World Bank Discussion Paper, No 159, Ed. Patrick Low, Washington D C : The World Bank.

World Resource Institute (1989), Wasting Assets : Natural Resources in the National Income Accounts. Washington D.C. : World Resource Institute.

World Resource Institute (1992), Accounts Overdue : Natural Resource Depreciation in Costa Rica, Washington DC. : World Resource Institute.

Zhao, Fengkun, Fred Hitzhusen and Wen S.Chen (1991), Impact and Implications of Price Policy and Land Degradation on Agricultural Growth in Developing Countries, Agricultural Economics, Vol. 5, Amsterdam, pp 311-324: Elsvier Publishers.

Appendix Table 1: Protection Rates for Selected Agricultural Commodities in Sri Lanka

Sector	1988-1991		1992-1993	
	NPC*	PC **	NPC	EPC
Food				
Rice	1.2	1.5	1.3	1.5
White flour/bread	1.1	1.8	1.3	1.9
Other Agriculture	2.0	2.8	2.0	2.8
Sugar	1.3	1.6	1.4	1.7
Milk	1.0	1.0	1.0	1.0
Coconut	1.4	1.6	1.2	1.4
Tea and Rubber	0.8	0.6	1.0	1.0
Sub Total	1.3	1.6	1.3	1.6
Manufacturing	1.4	1.8	1.3	1.7

* NPC : Nominal Protection Coefficient

**EPC : Effective Protection Coefficient

Source : Report of the Presidential Commission on Tariff and Trade, 1994.

Appendix Table 2: Rates of Import Tariff Imposed on Selected Non-Plantation Agricultural Sectors in Sri Lanka.

H.S. Code	Products	Alternative Rates of Duty	I.C.L. From
0701 0701.90	Potatoes Other	35% or Rs. 12.00 per kg	04.06.92
0703.10.01 0703.10.02	Red Onions B'Onions	35% or Rs. 9.00 per kg 35% or Rs. 9.00 per kg	08.05.92 30.06.94
0713.31.01 0713.39.01 0713.40.01 0713.40.09	Greengram (Moong) Blackgram (Oorid) Split Lentiles Other	35% or Rs. 10.00 per kg 35% or Rs. 10.00 per kg 45% or Rs. 12.00 per kg 35% or Rs. 12.00 per kg	Not on licence Not on licence Not on licence Not on licence
0904.20.01 0904.20.09	Dried Chillies Other	35% or Rs. 20.00 per kg 35% or Rs. 10.00 per kg	08.05.92 08.05.92
1005	Maize	45%	25.05.92
1006.10 1006.20 1006.30 1006.40	Rice in the husk (paddy or husk) Husked (brown) Rice Semi-Milled or Wholly Milled Rice, whether or ot polished or glazed Broken Rice	35% or Rs. 7.00 per kg 35% or Rs. 7.00 per kg 35% or Rs. 7.00 per kg 35% or Rs. 7.00 per kg	Not on licence Not on licence Not on licence Not on licence
1701.11 1701.12	Cane Sugar Beet Sugar	35% or Rs. 6.50 per kg 35% or Rs. 6.50 per kg	Not on licence Not on licence

Source : Report of the Presidential Commission on Tariffs and Trade, (December, 1994).

Appendix Table 3: Annual Aggregate Value of Soil Erosion in Sri Lanka (US$-Million)

Sector	Rate of Soil Erosion (tons/hec/year) (1)	Highland (Hec)	Midland (Hec.)	Total (Hec) (2)	Value of Soil Erosion (US$-Million)*
Tea-High grown**	35.2	73110	0	73110	**11.89**
Tea-Mid grown**	35.2	0	84062	84062	**13.67**
Rubber	10	0	97416	97416	**4.50**
Coconut	20	0	55529	55529	**5.13**
Export Agriculture	10	3692	35956	39648	**1.83**
Other Agr-Highland#	100	38567	0	38567	**17.82**
Other Agr-Midland#	100	0	47391	47391	**21.90**
Potatoes-Upland#	100	6663	0	6663	**3.08**
Forestry**	5	120444	160669	281113	**6.49**
GRAND TOTAL					**86.32**
Total Cost of Nutrient Replacement Per Year:				**US$-Million**	**86.32**
				Rs-Million	**3783.24**
Value of Aggregate Soil Erosion as a Percentage of GDP (1992) :					**0.98**

* [(1) * (2) * US$4.62] : Based on Clark Rebecca (1994)

** Weighted average of rate of soil Erosion

\# Total annual extent grown including both "Maha and Yala" Seasons

Source: (1) Bandaranayake, H.M (1994)
(2) Plantation Sector Statistical Pocket Book (1994)
(3) Department of Census and Statistics in Sri Lanka (1993)

Appendix Table 4: Aggregate Value of Soil Nutrients (Rs/Hec/year)

Type of Nutrient	Rate of Soil Nutrients Loss* (tons/hec/year)	Market Value of Soil Nutrients (Rs/ton)	Value (Rs/Hec/year)
Organic Carbon#	2.65525	3500	**9293.38**
Nitrogen	0.15314	23065	**3532.17**
Phosphate	0.016055	23065	**370.31**
Potash	0.038285	17100	**654.67**
Magnesium Oxide	0.013585	9050	**122.94**
Aggregate Value (Rs./69tons/hec/year)			**13973.48**
Aggregate Value (US$./69tons/hec/year)			**318.81**
Aggregate Value (Rs./ton/hec/year)			**202.51**
Aggregate Value (US$./ton/hec/year)			**4.62**

* Mid Point

Source: Clark, Rebecca (1994)

Jayaratne and Hathurusinghe (1993) - Price of Organic Carbon

Appendix Table 5: Effects of Tariff Liberalisation in Non-Plantation Agriculture on Changes in Land Use

Sector	Land Use Change (%)
Tea-High grown	0.13
Tea-Mid grown	0.12
Tea-Low grown	0.48
Other Agr.-Highland	**-0.39**
Other Agr.-Midland	**-0.40**
Other Agr.-Lowland	**-0.20**
Potatoes-Upland	**-0.39**