Integrated Assessment of Trade Liberalization and Trade-Related Policies

A Country Study on the Export Crop Sector in Nigeria

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NOTE

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EXECUTIVE SUMMARY

Preamble

The issue of environmental management has assumed a worldwide dimension, cutting across both developed and developing nations, and necessitated by the impacts generated by diverse social and economic activities, including global trade. Developing nations are the worst hit by environmental degradation arising from the exploitation of their natural resources in their quest to earn more foreign exchange. Most of the exports are from agriculture. Those that were or are oil or mineral resource exporters have started to switch to agriculture, thereby exploiting more natural resources.

Nigeria, despite her oil resources, has put in place various trade policies aimed at changing the country from a monolithic oil dependent economy to one in which the non-oil sector can contribute substantially to the gross domestic product (GDP) and exports, among other reasons. A Structural Adjustment Programme (SAP), including trade liberalization was a major policy designed to achieve these goals.

Agriculture is a major component of Nigeria's non-oil sector, contributing on average 81 per cent in 1962-1964, 56.41 per cent in 1983-1985, 64.64 per cent in 1986-1988, and rose to 71.66 per cent in 1992-1994. The value of agricultural exports increased by about 1,500 per cent, from only ₦ 193.6 million in 1985 to an annual average of ₦ 2,575 million in 1988-1992, representing 0.82 per cent of Nigeria's total GDP in 1985 and an average of 2.89 per cent in 1988-1992. Cocoa, rubber, fish and shrimps, forestry products and cotton are the main agricultural commodities boosting Nigeria's agricultural exports. Several policies and programmes put in place by the Government also significantly contribute to this achievement.

The broad objective of the study

This study attempted to assess the degree of the impacts of trade liberalization and trade-related policies on the environment, and consider the linked social and economic effects using the cocoa sector and rubber sub-sector for the case study. The aim is to identify any positive or negative impacts of the policies of trade liberalization, with a view to coming up with policy proposals that will:

1. Enhance the positive impacts
2. Mitigate the negative impacts
3. Promote coherence and sustainability of agricultural trade policy.

Methodology

A National Stakeholders' Workshop consisting of about 55 participants took place in June 2000 to sensitize the public and launch the study. A National Steering Committee was formed to guide the focus of the study. Thereafter, a sectoral inputs workshop, guided by the National Steering Committee, was held on 17 August 2000, and came up with some procedures, methods and modalities subject to the observations in the field. Arising from the secondary data collected from the relevant State and Federal Ministries, the Cocoa Research Institute of Nigeria (CRIN), the Rubber Research Institute of Nigeria (RRIN), the Nigerian Institute of Social and Economic Research (NISER), the Central Bank of Nigeria (CBN), the Federal Office of Statistics (FOS), universities, the six main states producing cocoa (Ogun, Ondo, Cross River and Abia States) and rubber (Edo, Delta, Abia and Cross River States) were selected. After preliminary visits to these states, high, low and negligible (or none) producing local government areas (LGAs) were identified for each state and crop, where Rapid Rural Appraisal (RRA) exercises were conducted and farm household cross-sectional data were collected. Soil and water samples were collected in numerous villages, farm and factory sites for analysis on nitrate, phosphate and metal concentrations. Secondary and primary data on yield, domestic and world prices, gross margin, net income, prices of agrochemicals, levels of use of fertilizers, pesticides, herbicides etc., were collected for the periods before SAP (1986), during SAP (1992-1993) and after SAP (1999-2000) was implemented. However, the primary data were collected between August and November 2000 for soil and water analysis, while secondary data were used for the SAP period and other identified regimes, as obtained from the Federal Office of Statistics, the Central Bank of Nigeria, the relevant research institutes and universities, as well as from the private sector.

Major findings

Some of the major findings derived from the study are:

(a) Production/outputs

(i) Output and exports of cocoa and rubber in Nigeria declined between 1980 and 1985 (pre-SAP) and took an upward turn after SAP policies were introduced in 1986.

(ii) New areas were planted to cocoa before the SAP period compared to during SAP, but the rate of abandonment of cocoa farms fell sharply during SAP as farmers took care of their existing cocoa farms. There was an increasing trend for new areas planted to rubber during and after the SAP period.

(b) Inputs and services profile

(iii) The importation of fertilizers and fungicides rose sharply during the SAP period compared to the pre-SAP period but importation of fungicides declined after the SAP period.

(iv) Chemical input prices have been rising sharply, partly because of the continued depreciation of the *naira*[1] since the SAP period, but the prices of cocoa and rubber declined after the SAP period and hence lowered the demand for agrochemicals by tree crop farmers.

(v) Even though farmers indicated that agrochemicals are important for increasing output, the high prices of agrochemicals relative to those of export crops accounted for little or no demand for agrochemicals.

(c) Trade liberalization (economic, social and environmental)

(vi) Due to the low usage of chemicals by the small-scale producers (that represent over 85 per cent of Nigerian farmers), the concentrations of nitrates and phosphates in the water and soil samples were low. The potential for using harmful levels of these elements is however high, if supportive policies were put in place without adequate guidance and control in the appropriate use of different levels and types of agrochemicals.

(vii) There was an apparent lack of knowledge of the potential consequences of misuse of agrochemicals, as some farmers used them to treat toothache, stomach-ache, etc. Furthermore, when applied on trees without using protective clothing, there were reported cases of body itching, swollen hands and faces of some farmers.

(viii) Over-tapping (slaughter tapping) of rubber leading to the early destruction (death) of the rubber trees, has started to expose the soil to processes of degradation, particularly when the trees (after drying up and used for fuel wood) are not replanted to maintain a desirable ecosystem.

(ix) Dumping of cocoa pod husks serves as an inoculum for *blackpod disease*, a major disease influencing the yield of cocoa. This environmental problem could lead to a loss of yield which may be as high as 20 per cent, necessitating the use of fungicides. If the pod husks are dried and properly managed, they could serve as inputs for livestock feed, soap making and organic fertilizer.

(x) Trade liberalization and trade-related policies have led to substantial gains for many farmers and the economy. However, they potentially have negative net environmental and social impacts to the tune of ₦69.92 million in the case of rubber—mainly because of over tapping—but positive environmental impacts of ₦ 11.859 billion in the case of cocoa production.

[1] Nigerian currency.

(d) Strategic policy measures for buoyant and sustainable agricultural trade

The Government should:

(a) Put in place a Farm Advisory Services Unit specifically meant for agrochemicals, to guide the optimal use of appropriate chemicals, as well as to publicize the productive use of cocoa pod husks (when dried as raw materials for soap, livestock feed and manure)

(b) Strengthen the Environmental Agency at the Federal and State levels so as to be able to monitor agrochemicals usage at the grass-roots level as well as in (rubber) factories. This should be through capacity building programmes and provision of an enabling environment.

(c) Establish a non-bureaucratic supervisory marketing body comprising farmers' associations, researchers, etc., which will ensure that domestic export crop prices received by farmers are close to world prices, serving as an incentive for increased crop production and reasonable demand for agrochemicals for optimal use on farms. This could be done through zonal arrangement by the Federal Ministry of Commerce and the NEPC, with adequate facilities at the local level.

(d) Develop infrastructures such as roads, water supplies, health centres, schools, etc. in export crop producing areas to serve as an incentive and encouragement to farmers and minimize the negative environmental impacts of trade liberalization.

The costs for all these proposed policies have been estimated and are in relevant sections of the report. On the other hand, it is suggested at the local level that:

(a) Farmers' Associations should continually inform their members on environmental degradation behaviour of the farmers through training, workshops, seminars, etc. and educate the rubber farmers on sustainable tapping techniques in order to avoid slaughter tapping as currently practiced.

(b) Farmers should serve as information disseminators to fellow farmers on sustainable production practices as well as on prices and good quality chemicals, to eradicate the 'sharp' practices of Licensed Buying Agents as observed during the study period.

ABBREVIATIONS AND ACRONYMS

ADP	Agricultural Development Programme
ANCE	Association of Nigerian Cocoa Exporters
CAN	Cocoa Association of Nigeria
CBA	cost-benefit analysis
CBN	Central Bank of Nigeria
CDU	Cocoa Development Unit
CPAN	Cocoa Producers' Association of Nigeria
CRIN	Cocoa Research Institute of Nigeria
FAO	Food and Agriculture Organization of the United Nations
FDAS	Farm Deelopment Advisory System
FEPA	Federal Environment Protection Agency
FMARD	Federal Minitry of Agriculture and Rural Development
FME	Federal Ministry of Environment
FOS	Federal Office of Statistics
GDP	gross domestic product
IITA	International Institute of Tropical Agriculture
IPM	Integrated Pest Management
LGA	local government area
naira	Nigerian currency, ₦
NGOs	non-governmental organizations
NISER	Nigerian Institute of Social and Economic Research
NTCDU	National Tree Crop Development Unit
OECD	Organization for Economic Cooperation and Development
RPAN	Rubber Producers' Association of Nigeria
RRA	Rapid Rural Appraisal
RRIN	Rubber Research Institute
SAP	Structural Ajustment Progamme
UNAAB	University of Agriculture, Abeokuta
UNP	United Nations Development Programme
WARDA	West African Rice Development Authority
WTO	World Trade Organization

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United Nations Environment Programme

The United Nations Environment Programme (UNEP) is the overall coordinating environmental organization of the United Nations system. Its mission is to provide leadership and encourage partnerships in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations. In accordance with its mandate, UNEP works to observe, monitor and assess the state of the global environment, and improve our scientific understanding of how environmental change occurs, and in turn, how such changes can be managed by action-oriented national policies and international agreements. UNEP's capacity building work thus centers on helping countries strengthen environmental management in diverse areas including freshwater and land resource management, the conservation and sustainable use of biodiversity, marine and coastal ecosystem management, and cleaner industrial production and eco-efficiency, among many others.

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FOREWORD

The importance of agriculture in the economy of nearly all developing nations is hinged on its strategic position for the:

a) Survival of their peoples in terms of household food security and for income generation;

b) Generation of employment (from agriculturally related activities);

c) Expansion of exports and hence increased foreign exchange earnings;

d) Production of fibre to the teeming local industries and savings from imports.

In practically all Sub-Saharan African nations, these goals have led to increased exploitation of natural resources in the pursuit of poverty reduction.

For nearly all the countries in the South-South, their agricultural exports often target the North which factor influences their Trade Policies and resource utilisation patterns. In the pursuit of increased foreign exchange earnings, rejuvenating inputs of agro-chemicals are used with a view to enhancing output without due regard to their potential consequences on the environment. The hallmark of such production systems is that many nations have been caught in the web of making omelette (increased output) by, expectedly, breaking the eggs (environment). There is, therefore, the need to strike a reasonable balance between increased Trade and improved well-being on one hand and sustainable environment, on the other.

This report on Nigeria has shown the actual and potential impacts of using agro-chemicals in a bid to improving the volume and value of cocoa and rubber exports. These two export crops represented over 70% of total agricultural export values between 1993 and 1995. While cocoa and rubber production values were both influenced by Trade Liberalization, their individual environmental impacts showed a divergence. Cocoa production in Nigeria, because of its nature and its increase which was mainly due to the use of excess capacity, conferred positive environmental impacts. This scenario was different from the negative environmental impacts observed in rubber production where Trade Liberalization led to excessive tapping of rubber trees which were thereafter left dried up in many areas, leading to soil exposure and fire outbreak, with their disastrous environmental consequences.

The study, even though an ex-post liberalization policy analysis, has revealed the potential danger of Trade Liberalization on the environment if certain steps are not taken. It has also shown the need for (developing) nations to monitor and regularly evaluate the technological responses of their economic sectors to Trade incentives. It has opened up the importance of the need for sound environmental policies to be entrenched in the general Trade Policies of developing countries. The study also offers valuable insights to methodological issues in environmental impact assessment in developing countries.

Against this background, there is the need for formalised collaboration between the relevant Agencies of the Ministries of Agriculture, of Trade and of Environment towards sustainable food and fibre production and as these may, variously exert positive impact on national economy.

The study reported herein is a directional first step for which UNEP's efforts and support are commendable. With it, it is hoped that it can lead to appropriate capacity-building mechanisms.

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1. BACKGROUND TO THE PROJECT

1.1 Introduction

Trade policies in Nigeria have largely centred on how the people and the country can benefit from the markets outside Nigeria. The main thrust of Nigeria's Trade Policy is to encourage the production and distribution of goods and services to satisfy domestic and international markets for the purpose of achieving and accelerating economic growth and development. The overall objectives of the Trade Policy include:

(i) the integration of the Nigerian economy into the global market through the establishment of a liberal market economy;

(ii) the promotion and diversification of exports in both traditional and non-traditional markets;

(iii) the promotion of the transfer, acquisition and adoption of appropriate and sustainable technologies to ensure competitive export-oriented industries, among others.

Even though these policy statements are desirable, few studies have been conducted to determine the real impacts of these on the people and particularly on the environment. One thing is at least very clear, the country is not at a crossroads regarding the need to make Nigeria a non-mono-product export structure. This became much clearer in the 1980s when Nigeria's main export material, crude oil, started to record rapid decreases in prices and hence a sharp decline in total revenue, because oil contributed about 90-95 per cent to the country's total revenue.

Agriculture, which is a major non-oil export, has been baptized with a lot of specific policies and programmes over the years, aimed at making the sector more productive so as to meet its expected roles. These include the following:

(i) Marketing Board Policy (1960-1977) through which all exportable agricultural products were purchased by the Government at prices far lower than world prices, and some incentives were given to the farmers to increase their acreage and adopt some imported technologies (Okuneye, 1985). No environmental issue was taken into consideration, only the goal of improved government revenue and perhaps stability of farmers' income.

(ii) Commodity Marketing Boards were established in 1977 by the Federal Military Government to take care of specific crops such as cocoa, rubber, roots and tuber, etc. Such boards e.g. the Cocoa Marketing Board, have specific production enhancing strategies with attendant potential consequences on the environment and the people. This policy further created competition in the agricultural sector for commodity resource use and depletion.

(iii) The Federal Civilian Government, when import substitution programmes were in place, enacted the Austerity Measures or the Period of Active Trade Restrictions, 1980-1985. There was limited food importation but high intensification of exportable crop production.

(iv) The Structural Adjustment Programme period in 1986-1993, which made possible the trade liberalization that enhanced export prices, partly due to the devaluation of the Nigerian currency. This led to higher levels of output of many export crops.

These and other factors informed the need to find out if the various trade policies have had any environmental impacts and to what magnitude, using the main export crops, cocoa and rubber as case studies. The social and economic impacts were also analysed. Some measures, which should mitigate the negative impacts and further consolidate the positive impacts, are suggested.

1.2 Relevance of the sector to the national economy

Agriculture is the mainstay of the Nigerian economy even though crude oil provides the largest proportion of revenue to the country. Available data has shown the significant contribution of agriculture to Nigeria's gross domestic product (GDP), export earnings and food availability. From Table 1.1, it can be observed that between 1981 and 1985 the total GDP showed a negative growth rate estimated at –0.4 per cent but recorded a positive growth rate of 4.8 per cent per annum between 1986 and 1993. One of the key factors that contributed to this development was the recovery of the agricultural sector following the adoption of a floating exchange rate system which favoured agriculture (Shaib, *et al*, 1997b). Agriculture recorded a 4.6 per cent and 4.8 per cent growth rate for the two respective periods but fell to 3.4 per cent between 1994 and 1999. It must be stated that agriculture contributed about 64 per cent to the total GDP in 1960 and 1961, before the discovery of oil in commercial quantities in the 1970s, when it started to fall in relative importance with respect to GDP as a parameter.

In the case of exports, Table 1.2 shows that agriculture accounted for a high proportion of the non-oil exports. The contribution averaged 80.98 per cent in 1962-1964, 56.41 per cent in 1983-1985, 64.64 per cent in 1986-1988 and rose to 71.66 per cent in 1992-1994.

The value of agricultural exports increased by about 1,500 per cent, from only ₦ 193.6 million in 1985 to an annual average of ₦ 2,575 million in the period 1988-1992. With respect to total exports however, agriculture's contribution nose-dived from 71 per cent in 1962-1964, 36.1 per cent in 1968-1970, 4.4 per cent in 1986-1991, to a mere 1.5 per cent in 1995-1996. This is largely due to the dominance of crude oil that represented over 90 per cent to total exports since 1974-1976. In general, average figures for the period 1993-1995 show that cocoa, rubber, fish and shrimps and cotton were the major agricultural commodities boosting Nigeria's agricultural exports, at about 51 per cent, 22.7 per cent, 54 per cent, and 38 per cent respectively (CBN, 1997). Cocoa's share in non-oil exports earnings rose from 22.3 per cent in 1993 to 42.7 per cent in 1998. Rubber on the other hand declined from 18 per cent in 1993 to 9.45 per cent in 1998. Both crops still remain the largest non-oil exports from Nigeria. Figures 9 and 10 (Appendix 5) show that cocoa and rubber

represented 65 per cent and 10 per cent of total agricultural exports during the SAP period (1986-1993). If agriculture is compared to other non-oil exports, it will be observed that it is highly relevant, representing over 300 per cent in the 1960s, over 180 per cent in the 1970s and 1980s and over 200 per cent in the 1990s, compared to other sectors' export values.

In the case of the food supply, Nigerian agriculture provides a large proportion of the country's food needs, although Nigeria is far from being self-sufficient. Apart from the significance enumerated above, agriculture still provides employment for about 50-52 per cent of the economically active labour force. Moreover, over 75 per cent of Nigeria's estimated 110 million people live in the rural areas where agriculture takes place. According to Titilola et al., (1998), the proportion of the rural population dependent on agriculture is about 86 per cent.

TABLE 1.1

Nigeria's gross domestic product at 1984 factor cost

(₦ Billion)

Year	*Total GDP ₦ billion*	*Share of agriculture %*	*Share of crude oil %*	*Others %*
1981	70.4	34.8	14.1	51.1
1982	70.2	35.8	12.4	51.8
1983	66.4	37.7	12.8	49.5
1984	63.0	49.4	15.2	35.4
1985	68.9	40.8	15.1	44.6
1986	71.1	42.8	13.8	43.4
1987	70.7	41.6	14.4	44.0
1988	77.8	41.5	14.2	44.3
1989	83.5	40.5	13.6	45.9
1990	90.3	39.6	12.9	47.1
1991	96.6	37.8	13.2	49.0
1992	97.0	38.5	13.5	48.0
1993	100.0	37.8	12.7	49.5
1994	101.3	38.1	12.6	49.1
1995	103.5	38.6	12.6	48.8
1996	107.0	39.0	13.1	48.0
1997	110.4	39.4	12.8	47.8
1998	113.0	40.4	11.6	48.0
1999	116.0	40.4	11.1	48.5
Base growth rate				
1981-1985	–0.4%	4.6	1.4	
1986-1993	4.8	4.8	2.6	
1994-1999	2.5	3.4	2.9	

Source: Federal Office of Statistics, Lagos (various issues).

TABLE 1.2

Composition of Nigerian exports by sectors

years	*Total exports ₦ million*	*Gric. exports ₦ million*	*Proportion of oil export to total exports (%)*	*Proportion of agric. exports to total exports (%)*	*Proportion of agric. to other exports (%)*
1962-64	987.0	702.3	12.0	71.0	425.6
1965-67	1130.3	581.0	31.0	51.4	292.0
1968-70	1540.3	556.0	50.0	36.1	250.5
1971-73	3539.0	443.0	80.0	13.0	184.6
1974-76	6489.0	292.0	93.0	4.5	184.6
1977-79	7344.0	3,793.0	92.2	5.2	175.9
1980-82	9082.0	179.3	97.0	2.0	193.5
1983-85	95373.0	242.0	96.0	2.5	184.8
1986-88	20,849.5	942.1	93.0	4.5	182.9
1989-91	36,463.8	1,555.2	89.2	4.3	65.1
1992-94	210,157.3	3,437.0	97.7	1.6	252.9
1995-1996	1131,233.0	16,766.2	98.0	1.5	268.8

Sources: (I) CBN Statistical Bulletin, Vol. 5 No. 1, 1994.

(II) FOS Trade Summary (various issues)

1.3 Project objectives and outputs

The promotion of export crops by the Nigerian Government with a view to generating foreign exchange for the country and enhancing farmers' income, could have brought about some positive and negative impacts on the people as well as the environment.

For this study it is easy to identify 6 clear policy regimes, namely:

1) Before and during the Civil War: 1960-1970
2) Post War reconstitution: 1970-1973
3) Oil boom period and the period of Second National Development Plan: 1974-1979
4) The period of active restrictions i.e. Austerity Period: 1980-1985 (before SAP)
5) During the Structural Adjustment Programme (SAP) period: 1986-1993
6) After the SAP period: 1994-2000.

The specific objectives, tasks, activity profiles and outputs are contained in Table 1.3.

The methodology adopted for this study is in Appendix 8.

The broad objective of the study is to find out the degree of the impacts of export crop promotion policies on the environment and assess the linked social and economic effects on the people.

TABLE 1.3

Objectives, tasks, activity profiles and expected outputs of the study

Objective	*Tasks*	*Activity profile*	*Expected output*
A. To assess and as far as possible, quantify the environmental impact of trade liberalization and policies of export crop promotion with special emphasis on cocoa and rubber.	1. To physically assess any form of land degradation in major export crop producing areas and processing sites; 2. To estimate the size or expansion of hectarages of major export crops according to policy regimes; 3. To determine the existence of soil impoverishment and degradation, if any, consequential to export crop production. 4. To investigate if there exist water and soil pollution arising from the use of agro-chemicals.	1. (a) Find out any form of erosion in crop farms. (b) Determine any soil loss. (a) State the yearly hectarages moving averages and the means of land cultivated to export crops by types and policy regimes (b) Determine incremental changes on yearly basis and according to policy regimes. (a) From the soil samples determine soil fertility and presence or absence of highly needed soil elements. (a) Obtain soil samples (0-30cm, 30-45cm) on farmers' fields. (b) Obtain water samples from the rivers/streams/wells in the relevant villages. (c) Analyze the samples for excesses or deficiencies in certain essential elements.	1. (a) Discussion of the physical characteristics of crop farms and how to manage them. (b) Description of environmental management patterns in producing areas and the required steps for managing them. 2. (a) Project possible expanded areas, and changes in earnings of the farmers. 3. (a) Advance technical packages that will rejuvenate the soil. (b) Call attention to laws and regulations, counselling and sensitization programmes 4. (a) Report on the extent of pollution. (b) Report on any water borne diseases in the export crop zones.
B. To assess the social and economic effects of Trade Liberalization and policies as well as their resultant environmental impacts on the people.	1. Sensitization of stakeholders 2. Formation of National Steering Committee 3. Division of the economic history of Nigeria into Policy regimes 4. Assessment of production Techniques used by farmers as well as profit levels 5. Finding out the reactions of Villagers through RRA 6. Determine the commonest diseases, ways and costs of curing them 7. Popularization of findings through Stakeholders' Workshop.	1. (a) Obtain their level of awareness and reactions to the subject matter, (b) Obtain secondary data on the subject matter, from the public and private sectors (c) Know the laws, regulations etc. governing same, if any; 2. (a) Present methodology to use for the study, (b) Harvest comments on the methodology. (c) Gather secondary data;	1. (a) Stakeholders, workshop report (b) Choice of members of national steering committee. 2. (a) Final methodology (b) Strengthen the Literature Review. 3. (a) Show, if any the impact of trade policies on production, exports, use of requisites according to policy regimes (b) Conclude about the effects. 4. (a) Estimation of demand for agro-chemicals and supply of export crops.

Objective	*Tasks*	*Activity profile*	*Expected output*
		3. (a) Graphical Analysis of data to show the effect of policies, (b) Statistical analysis of data according to policy regimes; 4. (a) From household survey data, determine the price response for the demand for agrochemicals and expansion of cultivated areas, (b) Determine the costs, yield and returns of farmers; 5. (a) Using RRA method, to know the action of farmers, reactions and awareness to the implication of identified practices, (b) Identify any indigenous knowledge of villagers with respect to the chemical and cultivation patterns. 6. Determine methods of curing any associated disease and how to prevent them.	(b) Analysis of costs and returns. 5. An insight into grassroots activities and behaviours. 6. (a) Come up with types of diseases if any and ways of treating them, (b) Suggestion on how to prevent such diseases (c) State the enlightenment programmes necessary for the farmers 7. Invitation of Association leaders to stakeholders' workshop along with farmers and Govt. officials researchers and International organizations.

RRA - Rapid Rural Appraisal

1.4 National institution, team members and UNEP

1.4.1 National institution

The national institution responsible for the project is the University of Agriculture, Abeokuta (UNAAB), Nigeria. The University was de-merged from the University of Lagos in January 1988 by the Federal Government of Nigeria. It is one of the three Universities of Agriculture in Nigeria created to show the government's high priorities for agricultural development. The university has over 3,500 undergraduate and about 400 postgraduate students in various fields of agriculture. These include Agricultural Economics, Agricultural Extension and Rural Development, Food Technology, Plant Science and Crop Production, Animal Science and Livestock Production, Forestry and Wildlife, Fisheries, Environmental Management and Toxicology, Agrometeorology and Water Resource Management, Physics, Chemistry, Mathematical and Biological Sciences. The university employs an academic staff of over 255 members with 26 professors, 17 associate professors and 32 senior lecturers. Other academic staff include research fellows, lecturers I and II and assistant lecturers.

The University has organized various training workshops and seminars and carried out numerous research studies for the FAO, the ILO, etc. It has a Memorandum of Understanding (MOU) with the International Institute of Tropical Agriculture, IITA; the West African Rice Development Authority (WARDA), the National Resource Institute, England (with which it is presently carrying out a research study on a *cassava* product, *fufu*) and CIDAR, Canada. The university has a village outreach programme covering about 12 villages in 3 different states in south-western Nigeria. This has opened the university to collaboration with the private sector and non-governmental organizations (NGOs). It has a strong association with the Federal Ministry of Agriculture and Natural Resources and therefore the Minister of Agriculture is regularly informed of activities involving the university. Various State and Federal functionaries have participated in the university's programmes.

1.4.2 Team members

The Team members are from diverse disciplines in consonance with the multi-disciplinary nature of the study:

Prof. P. A. Okuneye (Agricultural/Environmental Economist)	—	Team Leader
Dr. A. B. Aromolaran (Agricultural Economist)	—	Member
Prof. M. T. Adetunji (Soil Scientist)	—	Member
Dr. T. A. Arowolo (Environmental Chemist)	—	Member
Mr. K. Adebayo (Rural Sociologist)	—	Member
Mr. I. A. Ayinde (Socio-Economist)	—	Member

1.4.3 The United Nations Environment Programme

The Economics and Trade Branch (ETB) of the Division of Technology, Industry and Economics, United Nations Environment Programme, UNEP, has the mandate to research into issues of Economics and Trade as they affect the environment. It is in line with this mandate and to participate in the capacity building of institutions in developing countries that this type of training and research study is being funded. The activities carried out so far have shown that ETB only facilitates the research work and does not influence the actions or findings. The consultative meetings held and sponsored by UNEP enhance the quality of the work through interaction among experts and sharing of experiences across countries. Nearly all the costs of the research work are met by ETB, except the administrative support provided by the National Institution, UNAAB.

2. AGRICULTURAL TRADE AND THE ENVIRONMENT: THE PRELIMINARY PICTURE

2.1 SAP and trade liberalization in Nigeria

During the severe crisis of the 1980s, Nigeria adopted a series of policies directed at preventing the collapse of the economy and targeted at short to medium term adjustment to ensure a sustainable growth of the economy. However, these short-run stabilization measures failed to counter the maladies plaguing the economy. When it became clear that short-run stabilization measures and increased regulation were not appropriate responses to the deep-seated impediments to growth, the Government adopted a comprehensive Structural Adjustment Programme (SAP) in 1986. The SAP signalled a radical departure from previous adjustment efforts as it emphasized a reliance on market forces and deregulation. It was intended to restructure the production and consumption pattern of the economy, remove price distortions, and enhance the role of the free market in resource allocation. It also aimed at reducing dependence on the oil sector and on imports, and lay the basis for sustainable non-inflationary growth through diversification of the productive base of the economy, and reduction of unproductive public investments. A major component of the SAP is the diversification of the export base away from oil and the expansion of non-oil exports, especially agricultural exports. This direction was clearly crucial in the light of the downward trend in crude oil earnings and the increasing vulnerability of the economy to fluctuations in the world demand and price of crude oil (Aromolaran, 1991).

In order to achieve the SAP objective of diversifying the export base of the economy, Nigeria adopted a liberalization policy that was anchored on a number of important macro and meso economic policy initiatives. At the macro level, a deregulated exchange rate market was a prime policy instrument while at the meso level, a liberalized trade policy regime and the development of a workable rural (agricultural) infrastructure and efficient markets were the keys to the success of the SAP.

The theoretical basis for this approach is predicated on the conventional wisdom that for sustainable macroeconomic equilibrium, an enabling policy environment must exist for macro policies to impact fully and favourably on the micro level, where producers and households are the major actors (the World Bank, 1990). The effects of changing the macroeconomic climate and the adjustment process are best transmitted to producers and households through a functional meso economy. The argument in support of these claims is that changes in the meso economy determine how producers or households react to changes in the economy.

The liberalization policy environment under Nigeria's SAP was initiated principally to support the agricultural sector in general, and agricultural exports in particular (Akinyosoye *et al.*, 1998). The objective was to set forth a market regime and an enabling environment that would allow the nation and its people access to welfare gains from agricultural

activities in view of the country's enormous natural endowments in terms of land and labour.

Specific trade liberalization measures undertaken under the SAP included the removal of bureaucratic controls on trade. According to the SAP document, the medium-term policy objective is …"to gradually eliminate the existing administrative controls on trade, in line with the progressive take-off of the second-tier foreign exchange market." The import licensing system together with exchange control on all current transactions was abolished as soon as exchange liberalization began in September 1986. In addition, commodity-marketing boards were abolished. The number of prohibited imported items was drastically reduced.

The new tariff structure introduced in 1988 provided for tariffs for a seven-year period, to enable adequate planning by both producers and customers. In order to reduce dependence on the oil sector as the principal earner of foreign exchange by promoting non-oil exports, export prohibitions were abolished for most items. In 1987, a new export finance facility was introduced by the Central Bank. The financing and rediscounting facility was to assist private exporters by providing refinancing for the export of both agricultural and non-agricultural products. Additionally, in 1987, a duty draw-back/suspension scheme was introduced to enable exporters to import raw materials and intermediate products for use in the manufacturing of export products free of import duties. Other export promotion initiatives were also introduced (Kwanashie, *et al*, 1998).

2.2 Trade and the environment

Trade could be explained as the world's engine of economic growth influencing the dynamics, national positions and economic relationships. Foreign trade has played a crucial role in the economic development of many countries since the end of the Second World War WCED, 1987). Recent development in world trade patterns which has been characterized by a faster rate of growth in manufactured goods compared with primary products other than fuels, has made some developing countries such as South Korea, Indonesia, Thailand etc., major exporters of manufactured goods. However, this experience has so far eluded some developing countries that rely on the export of primary products, a large chunk of which are agricultural products. For instance, cocoa beans, rubber and palm kernel provide more than 70 per cent of Nigeria's non-oil export earnings. For this category of countries, trade has had its unpleasant dimensions, chief of which is the prevalence of unfavourable terms of trade that is symptomatic of agricultural export commodities.

Coinciding with the period of Nigeria's adoption of the SAP, has been the growing international concern for the state of the environment, its relationship with sustainable development, and global security (WCED, 1987; Myers, 1986; Prins and Stamp, 1991; Homer-Dixon, 1994; Dryzed, 1996). The gravity of environmental problems such as resource depletion (soils, oceans and forests) has been a major source of concern. A widely held view is that the abject poverty and high population growth rate in SSA countries are partly responsible for the prevailing assault on the environment (Falk, 1996).

Until recently, Nigeria and other SSA countries did not give any major attention to environmental issues. This is because these countries considered environmental issues as a distraction from the real problem of economic development. This attitude was informed both by the belief that environmental degradation is an inevitable price of development and the perception that the initial impetus and orientation of the "green movement" in industri-

alized countries was "anti-industrial development" (Salau, 1992). This attitude was influential in shaping official policies that had anything to do with the environment. Development models adopted favoured environmental exploitation as the drive for agricultural exports put immense pressure on the environment. Structural adjustment and trade liberalization exacerbated these pressures since they were put in place primarily to break foreign exchange constraints on growth and service external debts without any consideration for their impact on the environment. However, how far has this been the case in Nigeria's export crop sector? This issue forms the crux of this study.

2.3 An overview of government policies on environment

The analysis of government policies aimed at environmental protection and natural resource utilization derives from information from the Development Plan documents (1st - 4th Plans and the Rolling Plan) and from the document on the National Policy on the Environment. Other sources of information include government pronouncements in Annual Budget Speeches and keynote addresses presented by government functionaries at various conferences, and seminars and workshops concerning environment/natural resources management, conservation and protection.

(a) First and Second National Development Plans

In the First National Development Plan (1962-1968) and the Second National Development Plan (1970-1974), there was no direct mention of environmental protection. Projects that had relevance for environmental protection were however, subsumed under the 'Agriculture' and 'Town and Country Plan'. More specifically, relevant projects under agriculture were initiated under agricultural infrastructure. The project consisted of soil conservation measures aimed at wind and water erosion. There were also anti-drought measures. Specific soil conservation measures included contour bounding, terracing, check damming and drainage system. Anti-drought measures included tree planting and afforestation projects and the establishment of shelterbelts.

Between 1962 and 1968, Nigeria's major foreign exchange earner was the agricultural sector. By 1971-1974 the petroleum sector had taken over. Throughout these periods, revenue generation considerations and the need to protect domestic industries formed the basis of the Nigeria's Trade Policy. The importance of tariffs as a major source of government revenue declined as a result of the oil boom. Trade restrictions, especially importation, were therefore relaxed. However, even though trade was relatively liberalized during this period, agricultural exports were on the decline and the sector did not benefit from the relaxed trade environment. More people left the farms for the cities in search of white-collar jobs and contracts. Thus the kind of liberalization at that time (which favoured import substitution and consumption of foreign-made goods) reduced the threat which an expanding agricultural exports sector may have had on the environment. Therefore the first and second national development plans did not have environmental protection **as a major policy thrust.**

(b) Third National Development Plan (1975-1980)

It was in the Third National Development Plan that concern for environmental protection was explicitly expressed. The broad objective of the environmental policy, as indicated in the Third Plan, was to 'protect and improve the physical environment' and prevent the deterioration in the quality of life that could come with rapid economic growth. The docu-

ment then mentioned some well-known environmental problems that plagued Nigeria. The problems included slum housing, inadequate water supply and lack of recovery and proper facilities for waste disposal. The document also made reference to what it termed "secondary" environmental problems, which emerged in the course of rapid economic development. Reference was made to the pollution of air, land, rivers, lagoons and coastal waters caused by industrial manufacturing and mining operations. To grapple with these problems, the Federal Government established the National Coordinating committee on Human Environment. The State Governments were encouraged to set up similar committees to complement the efforts of the federal agency. The Government also initiated moves to halt the wasteful flaring of natural gas, which is a by-product of petroleum production. The aim of the Government in this respect was to encourage commercial utilization of natural gas.

The Third Plan contained proposals and made budgetary allocations for dealing with the usual problems of soil conservation, desert encroachment, inadequate sewage facilities, urban slum clearance, etc. These however, had no operational strategies or budgetary allocations for the urban, rural, environmental, population and land development issues raised under 'Regional Development Policy'.

Trade restriction policies began to emerge between 1976 and 1978. The trade restriction policies were intensified in the period between 1978 and 1980.

These included such policies as:

- general ban on non-essential imports especially food imports;
- tariff increases on some items;
- new duties on certain items not hitherto taxed;
- imposition of compulsory advance deposit on some classes of imports;
- industrial raw materials which were previously under open general license were placed under specific import license;
- export bans were imposed on certain items;
- export tariff were reviewed upwards for some other items;
- centralized marketing of agricultural products was reinforced through the formation of Commodity Boards which handled specific crops.

Table 2.1 shows the trend of producer price and world price and their relativity. Again there was no specific linkage between environmental policies and trade policies during this period. The step up in environmental protection was more directly linked to the pervading thought at that time that pursuit of economic growth usually does not hurt the environment. Environmental policy statements in the plan were not based on any kind of empirical finding or policy analysis.

(c) Fourth National Development Plan (1981-1985)

Environmental protection was given greater prominence in the Fourth Plan. For the first time 'environmental planning and protection' was treated as a specific subject, though under the 'social sector'. It was clearly stated that every activity undertaken by man has an effect on the environment and that failure to take cognizance of this fact in the development

and exploitation of natural resources in Nigeria has resulted in the destruction of some irreplaceable resources and the creation of ecological imbalances.

To a large extent, the achievement in the Fourth Plan over the attempts made in the Third Plan, is the recognition of the need for a comprehensive policy or programme for 'environmental planning, assessment, regulation and enforcement'. Under environmental assessment, there was a proposal to establish an 'efficient nationwide machinery', consisting principally of monitoring stations to collect data on environmental variables and synthesize such data to provide coherent information on the status of the environment. The programme under environmental protection entailed the enactment and enforcement of appropriate legislation in all relevant areas, making mandatory the assessment of the environmental impact of all major projects before implementation. It also entailed effective coordination of inter-agency actions aimed at promoting an environmentally sound pattern of economic development.

TABLE 2.1

Ratio of real producer price and world price of cocoa (1970-1997)

Year	*Producer price (a)*	*World price (b)*	*Ratio of (a) to (b)*
1970	2750	4828	0.56959
1971	2376	3260	0.72883
1972	2302	2973	0.7743
1973	3977	4905	0.81081
1974	4285	5951	0.72005
1975	3188	3960	0.80505
1976	2578	4050	0.63654
1977	3479	7932	0.4386
1978	2985	15152	0.197
1979	3116	5421	0.5748
1980	3073	3442	0.89279
1981	2539	2517	1.00874
1982	2359	2179	1.08261
1983	2061	2423	0.8506
1984	1582	2123	0.74517
1985	1500	2308	0.64991
1986	3320	3636	0.91309
1987	6459	6861	0.94141
1988	6070	3956	1.53438
1989	2750	2628	1.04642
1990	3068	2578	1.19007
1991	3069	3563	0.86135
1992	2664	4023	0.66219
1993	3361	3344	1.00508
1994	5181	2537	2.04218
1995	4051	4943	0.81954
1996	3041	4484	0.67819
1997	3028	4617	0.65584

Source: CBN Statistical Bulletin (various issues), Lagos.

It can be said that during the Fourth Plan period and the intervening period (1986-1990) before the National Rolling Plan (1991-1993), the overriding objective of environmental policy was to put in place a countrywide environmental management system. Specific landmarks were the creation of the Federal Environmental Protection Agency (FEPA) and the National Council on the Environment in 1988, as well as the promulgation of the Federal Environmental Policy Act in 1989. FEPA was given the responsibility of implementing the provisions of the National Environmental Policy Act.

The trade restriction policies that emerged during the Third Development Plan period were further intensified in the period between 1981-1985. Once again the fact that environmental protection was given greater prominence in the Fourth National Development Plan period is not directly linkable to the issues of trade restriction which was the major trade policy agenda at this time.

(d) Structural Adjustment Programme period (1986-1993)

In the trade liberalization policy which came into being from the introduction of the SAP in 1986, regulations, controls and high restrictions which prevented massive private sector (both domestic and foreign) participation in Nigeria's export trade were abolished. In effect, the trade liberalization policy can be viewed from three perspectives, namely:

1. export promotion;
2. promotion of importation of needed inputs;
3. exchange rate liberalization.

These are briefly discussed as follows:

1) Export promotion

Arising from the fact that Nigeria was becoming a monolithic oil dependent economy, the SAP which was put in place, allowed many entrepreneurs and individuals not only the opportunity to produce, but more so to export various Nigerian goods and services. This was to allow for more foreign exchange earnings. Over the years, as shown in Table 1.2, the oil sector had been dominating the export scene. Given the volatility of this resource (petroleum) to international politics and its exhaustive nature, it became apparent and expedient for the country to have a solid supportive policy for agriculture.

This objective was clearly seen in the light of the high growth rate of values of agricultural exports and the increased proportion of agricultural exports in the non-oil sector, during the SAP period. The major elements of export promotion in the SAP document and its implementation, include the following:

- Dissolution of the government controlled Commodity Boards, which liberalized exportation of commodities;
- Allowance of domiciliary accounts;
- Overhauling of custom and excise duty schedules;
- Abolition of export prohibition;
- Establishment of tariff review board;
- Establishment of an export development fund, exports guarantee scheme and export promotion zone;

- Increased domestic production of export crops;
- Increased domestic production of tradable semi-manufactured goods from agricultural raw materials;
- Relative increase in resource allocation from non-tradable to tradable goods within the sector.

This period of trade liberalization was accompanied by a sizeable boost in the agricultural sector. For example, the declining trend in domestic production for most export crops before the introduction of the SAP in 1986 was reversed, shortly after the introduction of the trade reform policies. This was because more lands and/or more inputs were committed into the production of these crops, particularly labour inputs.

2) Promotion of importation of inputs and raw materials

The second aspect of trade liberalization policy was on the promotion or the removal of the inhibitions on the importation of various agricultural requisites and raw materials for industries. Essentially, the following issues, are covered, among others:

- Replacement of most import prohibitions with tariffs.
- Abolition of import licensing system, and removal of price control.
- Liberalization of the investment regime to allow 100 per cent foreign ownership of enterprises in virtually all sectors of the Nigerian economy.
- Increasing access to appropriate technology, external markets and other benefits associatedwith foreign investments.
- Establishment of Tariff Review Board.
- Increased importation of agricultural inputs such as fertilizers and other agrochemicals, farm implements, farm power and equipment, etc.
- Increased importation of agro-industrial inputs.

Table 2.2 shows the trend of imports over the years.

3) Exchange rate liberalization

The exchange rate adjustment, the abolition of the marketing board's monopoly and the easing of export procedures were all contributory to this success (Aromolaran, 1991). It should be stated that even though the period witnessed a better-packaged environmental policy agenda than before, the policy direction was not as a result of the felt impact of trade liberalization policy on the environment. Therefore, throughout the period 1962-1993, one would not say that environmental policy formulation had a direct link to considerations regarding the consequences of trade liberalization policy. Table 2.3 shows the exchange rate of the naira to the US dollar. These rates are quite relevant when considering the rates of growth and values of Nigerian imports and exports. Furthermore, they are relevant when interpreting the high and attractive cocoa and rubber prices during the SAP period, as contained in subsequent sections of the report.

TABLE 2.2
Nigerian import values (₦ million))

		NON-OIL		
Year	***Total Import***	***Total***	***Food***	***Raw Materials***
Aug. 1970-1974	1,158	1,109	105	605
Aug. 1975-1979	6,330	6,109	761	5,663
Aug. 1980-1984	9,758	9,552	1,602	5,209
1985	7,063	7,011	1,199	3,873
1986	5,984	5,070	802	3,511
1987	17,862	14,692	1,874	10,644
1988	21,446	17,643	1,892	13,620
1989	30,860	26,189	2,109	20,485
1990	45,718	39,645	3,475	28,939
1991	87,020	79,425	3,046	28,804
1992	145,911	125,974	12,840	89,298
1993	166,100	124,771	13,952	64,115
1994	162,789	120,439	13,837	63,650
1995	755,128	599,302	88,349	342,072
1996	562,627	400,448	75,955	236,303
1997	845,717	678,814	100,640	353,509
1998	837,419	661,565	102,165	341,667
1999	862,525	650,854	103,490	317,369
2000	962,970	764,228	113,631	383,262

Source: CBN, Annual Report and Statement of Accounts (various issues).

TABLE 2.3
Nigeria: naira (₦) cross exchange rate (official)

Year	US dollar
1975	0.616
1976	0.627
1977	0.645
1978	0.601
1979	0.596
1980	0.546
1981	0.610
1982	0.673
1983	0.724
1984	0.765
1985	0.894
1986	2.021
1987	4.018
1988	4.537
1989	7.392
1990	8.038
1991	9.910
1992	17.298
1993	22.327
1994	21.886
1995	81.023
1996	81.253
1997	91.34
1998	95.52
1999	104.83
2000	109,52
2001	113.57

Source: CBN, Annual Reports (various issues).

4) The National Policy on the Environment

The broad goal of the National Policy on the Environment, prepared by the Federal Environmental Protection Agency (FEPA), is to achieve sustainable development, 'based on proper management of the environment'. To facilitate the articulation of strategies for achieving this objective, 14 problem areas of the environment were identified. A review of the entire policy document indicates that there is no direct mention of the problems associated with the production and processing of agricultural commodities. The implication of this is that the strategies for tackling the environmental problems arising from the production and processing of the commodities can only be inferred from the broad strategies, detailed under some of the other identified problem areas.

A review of the strategies shows that some of the provisions made under five 'sectors' or 'problem areas' have relevance for agricultural production and processing. The sectors are as follows:

i. The human population;

ii. Land use and soil conservation;

iii. Forestry, wildlife and protected areas;

iv. Agricultural chemicals;

Those provisions which have implications on the possible environmental problems arising from agricultural production and processing are examined in the following.

The human population

The provision that is relevant under this heading is:

— prevention of the depletion of forests.

The prevention of the depletion of forests as it concerns export crop production appears to have two aspects. The first aspect is the clearing of whole forests to establish new export crop farms. The loss of vegetation in this regard is only temporary. It is only a matter of time when the cocoa seedlings grow into trees and the forest ecosystem is more or less re-established. Perhaps some loss may be sustained with respect to wildlife and some rare forest species but this may not constitute a major problem.

The second aspect of the depletion of forests is the defoliation of forests to construct canopies to provide shade for cocoa seeds in the nursery beds, mulch for transplanted seedlings, and cover for the decoded cocoa beans under fermentation. The use of leaves in these instances could be significant, and could be replaced by the use of other synthetic materials.

Land use and soil conservation

The following two propositions (among the 15) detailed under this heading appear to have immediate relevance for the analysis here:

— promoting optimal land use for sustained production

— developing programmes to ensure rational application of fertilizers and other soil conditioners appropriate to the improvement and sustained use of the soil.

Forestry, wildlife and protection areas

The provision under this heading that can probably be applied to cocoa production states:

— establish programmes for the efficient utilization of vegetation resources including reduction of wastes and improved technologies for product consumption.

The above provision has bearing, again, for the use of tree branches and leaves to construct canopies to provide shade for nursery seedlings, the use of leaves for mulch and as cover to facilitate fermentation of cocoa beans. As already mentioned, a significant quantity of vegetation resources are utilized in these processes thereby leading to loss of biological diversity. The cost of providing alternatives that entail using less vegetation resources should be considered as an integral part of the cost of protecting forest resources. One of the goals of the National Policy on the Environment in Nigeria is to restore, maintain and enhance the ecosystem and ecological processes. These are essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystem (FEPA, 1999).

Agricultural chemicals

Cocoa is one of the export crops for which there is a long-standing history in the use of agrochemicals in Nigeria. The provisions were made in this section to reduce the adverse effects of agrochemicals on human health and the environment. The extent to which the agencies responsible for these have been effective in discharging the function is yet to be documented. There have been newspaper reports about the importation of toxic chemicals. A few works have been done on monitoring herbicide, pesticide and agrochemical residues in the soil generally, but not trade or export crop targeted. Hence there is much to be done with respect to mounting programmes to develop environmentally sound alternatives to agrochemicals and encouraging integrated pest management practices, as these approaches to pest control appear to indicate the directions for the future.

3. INTEGRATED ASSESSMENT OF TRADE LIBERALIZATION

3.1 Environmental impacts

3.1.1 Soil analysis

Trade liberalization and trade related policies, as they affect agricultural commodities, often bring about the tendency to concentrate on the increase in economic returns through increases in production and output prices. The increase in production is often achieved through increase in land under cultivation and greater use of agricultural inputs such as fertilizers and pesticides. In Africa, this is usually done without adequate consideration of the source of inputs, regardless of their sustainability, and ignoring their effects on the environment. Such intervention into the utilization and manipulation of environmental resources often leads to uncontrolled and over-exploitation of the soil resource base which may result in unanticipated consequences. Plant nutrients and pesticides are supplied from off-farm sources, with little regard to the possible displacement of the chemicals into water resources, the atmosphere or other off-site locations.

Observations made during field trips revealed that throughout the year the soils beneath the two crops under consideration (cocoa and rubber) are under vegetative cover due to the canopy formed by the tree crops at maturity, and a deep covering of the soil surface with litter through leaf drop. Characteristically, this land is usually chosen for the growth of export crops such as cocoa and rubber. Most of the soils are well drained, fairly level and deep. However, in recent years production of these crops, especially cocoa has been extending to lands hitherto considered marginal for these crops. This situation was at its peak in the late 1980s and early 1990s due to trade liberalization policies that initially conferred higher output prices relative to input prices.

The nutrient contents of the soils under cocoa trees are summarized in Table 3.1. The organic matter content of the surface (0-30cm depth) soils ranged from medium (2.26 per cent) to high (6.07 per cent). In general, the values are within the medium range for soils when compared with natural forests and fallow lands (Table 3.3) except in Abia State, which have very high values. The total nitrogen (N) content also compares well with medium values for mineral soils except in Abia and Cross River States, which possess higher values. These values may suggest a substantial return of N through litter fall since it was observed that fertilizers are rarely used in the farms visited. The nitrate-nitrogen (NO_3^-N) values of the surface soils of cocoa (1.70 to 37.54 mg kg^{-1}) are within low to medium range levels for soils. However, in Abia State, there is evidence of NO_3^-N accumulating below 30cm soil depth. This is a potential source for contaminating ground water. Since the farmers claimed that they did not apply fertilizers, the source of the high NO_3^-N values in these soils could be traced to the 'mineralization' of the high organic matter of the cocoa soils in that state. The levels of micronutrients in the cocoa soils are typical and do not appear to constitute any potential danger. The concentration of exchangeable calcium (Ca) is relatively high while that of magnesium (Mg) is moderate. The low values of exchangeable

potassium (K) in the cocoa soils suggest that some potassium has probably been lost, possibly through leaching. The concentration of phosphorus (P) in Ogun State cocoa soils, is very high. The mean value below 30cm soil depth (123.7 mg kg^{-1}) may indicate a uncharacteristically downward movement of P which in turn may suggest low P adsorption capacity of the soils and consequently the possible loss of the element through leaching. However, in Ondo and Cross River States, the values of P are lower than the medium range for soils generally.

The nutrient contents of soils under rubber crops (Table 3.2) followed the same trend as in cocoa soils. However, the organic matter contents of the soils in Delta and Edo States are very high and they exceed the normal range for mineral soils (Table 3.3), while the values are very low in Abia and Cross River States. Observations in the field showed that arising from low output prices, the farmers have virtually abandoned the trees and the canopy through the felling of the rubber trees for firewood (fuel wood). However, previous heavy leaf litters protect the soil. It is therefore possible that serious soil degradation may set in if this trend continues. Despite the high organic matter content of the Delta and Edo soils, there is no evidence of NO_3^-N accumulation in the soil as the values are within the low to medium values for mineral soils.

The values of available P in rubber soils are high to very high except in Cross River State where the values are extremely low. The non-characteristic downward movement of P similar to that in cocoa soil in Ogun State was also observed in Edo State. The values of the micronutrients manganese (Mn), iron (Fe), zinc (Zn), and copper (Cu) are within values considered normal for mineral soils. Therefore any reduction in crop yield cannot be attributed to soil degradation.

Pesticide residue

The pesticide residue values are shown in Tables 3.4 and 3.5. In the soils, most of the parameters analysed are either not detectable or are detectable at ultra trace levels. Thus, pesticide accumulation does not exist to any appreciable extent. This is an indication of low level of pesticide use.

Conclusion

Although significant soil degradation was not observed currently in the farms visited, the incursion into marginal land and the recent indiscriminate felling of rubber trees may set in the degradative processes sooner than expected. As degradative processes proceed and intensify, soil productivity usually decreases concomitantly. Thus, if conservation and rehabilitation programmes are not soon implemented, much of the lightly degraded land will undoubtedly become severely degraded. Practices such as timely replacement of lost stands, control of the tree population for effective ground cover, the proper management of the canopy, the prevention of fire, application of integrated nutrient-management systems that utilize resistant cultivars, and application practices that emphasize proper timing and effective use of fertilizers at lower application rates should be encouraged. The key management practice would be one that encourages early canopy or ground cover. This could be achieved by planting appropriate leguminous crops in the inter rows of the trees before full canopy formation. A properly managed canopy helps to intercept rainfall, winds and sun, thereby reducing their erosive effects, improves infiltration rate by decreasing surface sealing, and also improves soil structure and increases porosity and improves the biological activities of the soil through eventual transformation into organic matter, thereby improving the nutrient holding capacity of the soil.

TABLE 3.1

Nutrient contents of soil under cocoa trees in Nigeria (mean values)

State	Soil depth (cm)	Org. carbon (%)	Org. matter (%)	Total N (%)	No_3-N (mg kg-1)	NH_4-N (mg kg^{-1})	pH H_2O	Exchangeable cations (cmol kg-1) Ca	Mg	K	Mn	Na	Avail P (mg kg^{-1})	Micronutrients (mg kg^{-1}) Mn	Fe	Zn	Cu
Ogun	0-30	1.31	2.26	0.123	1.70	29.17	6.24	14.26	1.68	0.59	0.03	0.03	91.7	54.4	66.3	13.4	2.8
	30-45	0.67	1.16	0.099	0.53	21.44	6.22	10.34	1.50	0.48	0.04	0.27	123.7	40.0	69.6	12.7	2.5
Ondo	0-30	1.72	2.97	0.186	2.71	41.84	5.81	4.21	1.07	0.18	0.27	0.18	4.8	56.1	11.5	0.8	5.7
	30-45	1.20	2.07	0.126	0.94	16.42	5.08	3.85	0.67	0.15	0.35	0.51	4.1	60.7	13.3	0.8	5.6
Abia	0-30	3-52	6.07	0.26	22.74	20.62	5.0	8.93	1.47	0.04	0.04	0.44	40.6	20.1	24.0	12.8	3.1
	30.45	1.82	3.14	0.191	49.47	16.14	5.3	11.87	1.68	0.05	0.07	0.34	24.1	30.9	25.9	0.9	1.5

Source: Analysis of Nigeria survey data, 2000.

TABLE 3.2

Nutrient contents of soil under rubber trees in Nigeria (mean values)

State	Soil depth cm)	Org. carbon (%)	Org. matter (%)	Total N (%)	No_3-N (mg kg-1)	NH_4-N (mg kg^{-1})	pH H_2O	Exchangeable cations (cmol kg-1) Ca	Mg	K	Mn	Na	Avail P (mg kg-1)	Micronutrients (mg kg^{-1}) Mn	Fe	Zn	Cu
Abia	0-30	2.13	3.67	0.140	14.42	32.56	5.30	1.14	0.25	0.07	0.01	0.14	21.6	9.0	97.8	0.0	1.3
	30-45	1.68	2.90	0.162	28.03	36.06	5.60	1.80	0.36	0.12	0.01	0.34	20.1	8.0	180.4	0.0	1.1
Delta	0-30	5.15	8.88	0.425	26.77	61.19	5.50	9.86	0.74	0.25	0.08	0.41	361.4	50.3	287.6	9.9	2.2
Edo	0-30	5-81	10.02	0.339	12.03	10.75	5.60	14.46	0.50	0.06	0.01	0.50	160.0	34.2	187.2	13.6	58.4
	30.45	3.48	6.00	0.212	9.11	39.66	5.00	12.07	0.48	0.04	0.01	0.41	184.7	28.0	170.3	9.3	3.4
Cross-	0-30	1-53	2.64	0.112	24.19	16.14	5.50	1.32	0.44	0.19	0.07	0.71	3.1	28.9	31.0	11.4	2.0
River	30-45	0.80	1.38	0.080	4.23	18.41	5.50	0.91	0.35	0.24	0.03	0,57	3.4	12.8	33.6	0.6	16.2

Source: Analysis of Nigeria survey data, 2000.

TABLE 3.3

Range of soil nutrients in Natural Forest Reserve (NFR) and fallow plots in Nigeria

	Soil depth (cm)	*Org. matter (%)*	*Total. N (%)*	*pH*	*Exchangeable cations (cmol kg-1)*			*Avail P*	*Micronutrients (mg kg^{-1})*			
				H_2O	*Ca*	*Mg*	*K*	*(mg kg^{-1})*	*Mn*	*Fe*	*Zn*	*Cu*
SNR	0-15	4.68	0.24	5.51	3.73	0.91	0.38	46.4	35.8	98.6	13.8	1.6
(Mean)	15-30	3.78	0.20	5.52	3.52	0.93	0.38	38.9	–	–	–	–
	30-45	2.39	0.13	5.29	3.61	0.93	0.36	26.6	–	–	–	–
SNR	0-15	1.96-7.56	0.17-0.33	3.79-7.62	1.48-7.18	0.36-1.45	0.21-0.58	12.9-75.2	26.4-132.4	30.2-430.8	1.78-29.7	1.0-15.5
(Range)	15-30	1.87-7.00	0.12-0.32	3.32-7.84	2.20-6.96	0.42-1.64	0.19-0.60	13.0-72-5	–	–	–	–
	30-45	0.98-4.96	0.07-0.25	3.68-7.11	1.25-6.32	0.38-1.70	0.24-0.52	9.9-50-2	–	–	–	–
Fallow	0-15	1.51	0.15	4.88	3.64	0.73	0.32	15.0	30.5	71.6	5.2	1.5
Plot	15.30	1.32	0.13	4.60	3.34	0.71	0.34	13.6	–	–	–	–
(Mean)	30-45	0.79	0.09	4.53	3.61	0.64	0.32	12.5	–	–	–	–
Fallow	0-15	1-10-1.95	0.09-0.19	4.08-5.72	1.96-4.94	0.49-0.91	0.19-0.40	10.0-18.6	16.8-62.6	20.5-120-8	0.6-45.94	0.3-6.5
Plot	15-30	1.02-1.89	0.07-0.18	3.82-5.60	1.80-4.25	0.52-0.88	0.26-0.39	10.5-18.0	–	–	–	–
(Range)	30-45	0.66-0.90	0.05-0.13	3.83-5.15	1.77-4.96	0.46-0.80	0.29-0.36	10.5-15.7	–	–	–	–

Source: Ola-Adams, B. "Biodiversity inventory of Omo Biosphere Reserve, Nigeria", 1998, pp. 86-98.

TABLE 3.4

Pesticide residue (mg g^{-1}) in soil samples from cocoa fields in Nigeria

State	*Soil depth (cm)*	*a-bhc*	*g-bhc*	*ß-bhc*	*Heptachlor*	*Aldrin*	*H.Epoxide*	*44 DDE*	*Dieldrin*	*2-4 DDD*	*Endrin*	*44-DDD*	*4-4DDT*
Ogun	0-30	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	8.4×10^{-6}	9.6×10^{-6}
	30-45	1.95×10^{-5}	nil	nil	nil	4.2×10^{-6}	nil	nil	nil	nil	nil	8.4×10^{-5}	1.82×10^{-5}
Ondo	0-30	nil	nil	nil	nil	nil	nil	nil	nil	9.20×10^{-6}	nil	nil	nil
	30-45	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	2.4×10^{-5}	2.27×10^{-5}
Abia	0-30	nil	nil	nil	nil	nil	nil	1.12×10^{-5}	nil	nil	nil	9.30×10^{-6}	nil
	30-45	nil	nil	nil	nil	nil	0.81	nil	nil	nil	nil	5.57×10^{-5}	133×10^{-4}
Cross River	0-30	nil	nil	nil	nil	nil	nil	4.76×10^{-5}	nil	nil	nil	3.67×10^{-5}	1.84×10^{-4}

Source: Analysis of Nigeria Survey data, 2000.

TABLE 3.5

Pesticide residue (mg g^{-1}) in soil samples from cocoa fields in Nigeria

State	*Soil depth (cm)*	*a-bhc*	*g-bhc*	*ß-bhc*	*Heptachlor*	*Aldrin*	*H.Epoxide*	*44 DDE*	*Dieldrin*	*2-4 DDD*	*Endrin*	*44-DDD*	*4-4DDT*
Abia	0-30	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
	30-45	nil	nil	nil	nil	$4.4x10^{-6}$	nil	nil	nil	$7.3x10^{-6}$	nil	$8.9x10^{-6}$	$1.04x10^{-5}$
Delta	0-30	nil	0.59	nil	nil	nil	1.05	nil	nil	nil	nil	$1.79x10^{-5}$	nil
Edo	0-30	$1.51x10^{-5}$	nil	nil	nil	nil	nil	nil	nil	0.24	nil	$1.01x10^{-5}$	nil
	30-45	$6.2x10^{-6}$	nil	nil	nil	$2.70x10^{-6}$	nil	nil	nil	$2.60x10^{-5}$	nil	nil	nil
Cross	0-30	nil	nil	nil	nil	nil	2.01	nil	5.18	9.61	nil	nil	nil
River	30-45	nil	nil	nil	0.35	nil	0.38	nil	nil	$7.1x10^{-6}$	nil	nil	$1.69x10^{-5}$

Source: Analysis of Nigeria Survey data, 2000.

3.1.2 Water and effluent analysis

The water and effluent analysis carried out for the various elements, compounds and total petroleum hydrocarbon, shows that the trade liberalization policy has not resulted in any metal pollution of surface waters in the study area. However, the results of water analysis show that there were trace concentrations of nitrate, phosphate and metals in the water samples obtained from the study area (see Tables 3.6 and 3.7a in Appendix 9). Consequently, the present farming systems can still accommodate the use of higher levels of agrochemicals. This confirms the information provided by the tree crop farmers at the various Rapid Rural Appraisal (RRA) meetings where they confirmed that they have not been using fertilizers and pesticides on their farms. This was mainly due to the high prices of the agrochemicals, relative to the prices of cocoa and rubber.

3.2 Economic impacts

The economic impact investigation considers the following indicators:

(a) Contribution of crops to GDP and export earnings

(b) Use of resources (agrochemicals)

(c) Levels of output produced and growth rates

(d) Levels of costs and returns

(e) Cost-benefit analysis.

These are analysed based on the secondary data gathered and the primary data generated from the interviews conducted in over 360 farm households producing cocoa and rubber. The information obtained from the RRA complimented the information from the structured questionnaires.

3.2.1 Secondary data analysis

Descriptive analysis

For the two crops, the areas of land for new planting and abandonment as well as total hectarage are presented in Table 3.6.

Graphical analysis

(*a*) *General trend analysis*

Figure 1 (Appendix 5) shows the output trend for cocoa and rubber between 1970 and 1996.

Figures 2 to 7 (Appendix 5) show the variation in annual production, area cultivated, real producer and world prices for the export crops.

TABLE 3.6

Total hectarage, new plantings and abandonment for cocoa and rubber in Nigeria (1970-1997)

Year	*rubber total hectarage ('000ha)*	*cocoa total hectarage ('000ha)*	*cocoa new planting ('000ha)*	*rubber new planting ('000ha)*	*cocoa abandonment ('000ha)*
1970		718.9			
1971		734.3			
1972		732.2	2.157		4.257
1973		743.2	4.19		2.1
1974		750.9	7.76		0.06
1975		761.4	12.181		6.019
1976		770.3	21.21		12.31
1977		777.6	11.656		4.566
1978		783.3	11.003		5.303
1979			9.683		
1980			7.351	0.113	
1981		560	8.383	0.024	
1982		552	4.93	0.132	12.94
1983		526	1.434	0.048	27.434
1984		510	0.496	0.069	16.496
1985	7.84048	493	1.806	0.065	18.806
1986	8.01253	476	0.806	0.105	17.807
1987	8.14692	476	1.054	0.09	0.868
1988	8.46235	466	2.001		11.951
1989	8.69739	462	2.087		6.083
1990	9.01915	457	1.155		6.155
1991	9.17144	454	2.209	0.222	4.421
1992	9.28023	452	0.714	0.375	3.386
1993	9.50944	450	0.968	0.383	3.243
1994	10.0365	448	0.852		2.373
1995	10.4276	447	1.211		2.856
1996		446	1.719		
1997		445	0.405		

Sources: (1) CBN Annual Report and Statement of Account (various issues).
(2) CBN Research Department occasional paper.
(3) FOS Trade Summary (various issues), Federal Office of Statistics, Lagos.
(4) NTCDA, Research Report data.

(*b*) *Policy regime analysis*

Sufficient data were not available for the period 1960-1969, (post independence and civil war period) as well as 1998-1999. So the graphical analysis was based on 5 policy regimes namely:

- 1970-1973 (post war reconstruction period: regime 2);
- 1974-1979 (second National Development Plan and oil boom period: regime 3);

- 1980-1985 (intensification of restriction policies, austerity period and Third National Development plan: regime 4);
- 1986-1993 (Structural Adjustment Policies including trade liberalization: regime 5);
- 1994–1997 (post SAP policies: regime 6).

This is with respect to objective B3 (see Table 1.3)

(*c*) *Export crop output*

Figures 11 and 12 (Appendix 5) show the trend in average annual output of cocoa and rubber, for 5 of the 6 policy periods between 1970 and 1997.

Average annual cocoa output in Nigeria fell continuously from regime 2 to regime 4, which was the lowest point. The regimes 5 and 6 witnessed an increasing trend in cocoa output. Thus the output of cocoa in Nigeria declined during the pre-SAP period and took an upward turn after SAP policies were introduced in 1986.

Rubber output was about constant in the first two policy regimes and it recorded an upward trend from the third policy regime. This was the period when the economy of Nigeria began to suffer a recession due to the glut in the international oil market. The rise, which was still very small, was however increased sharply in the SAP policy period. This shows that SAP had serious effects on rubber output in Nigeria just as on cocoa.

(*d*) *New areas planted to cocoa and rubber in Nigeria (hectares)*

Figure 15 (Appendix 5) shows that new areas planted to cocoa (based on seedlings received from the public organs) on an average annual basis rose sharply in the third policy regime (Second National Development Plan/oil boom). This was probably because of the favourable government policy at that time, which encouraged expansion of cocoa holdings by planting new hectares. This sharp increase soon gave way to a sharp decline in new plantings to cocoa during the SAP period as farmers took care of all their existing cocoa farms. These figures, however, do not represent all the cocoa trees planted in Nigeria during the reference periods. This is because a number of farming communities still plant from their old trees rather than purchase improved seedlings from the public organs. It may be observed that abandonment of trees declined while new plantings stabilized.

The major reason for this is inadequate financing. One example is the cocoa farming community in Imagbon in Remo North LGA of Ogun State (one of the RRA locations for this study), where farmers claimed that a large percentage of their new cocoa plantings utilized seedlings raised from their own farms. Authoritative sources from the National Tree Crop Development Unit (NTCDU) in Benin city, Nigeria, puts the figures as representing about 90 per cent of new cocoa plantings in Nigeria.

Data were not available on new areas planted to rubber in Nigeria for the first three policy regimes. The trend from the fourth regime was an increasing one (Figure 16 in Appendix 5). For rubber, the average annual new plantings in the post SAP period was far more than was obtained in the SAP period. The reason for this is that farmers intensively tapped (slaughtered-tapped) during the SAP period to obtain the highest return consequen-

tial to the improved prices after trade liberalization, and hence plantings took place post SAP to replace the destroyed trees. This was due mainly to government (NTCDU) encouragement by reducing the prices of seedlings, and farmers' anticipation of higher market prices. It is also noteworthy that small farmers did not embark on the new plantings, which accounted for only a marginal increase of 300 hectares.

(*e*) *Agrochemical use*

Importation of agrochemicals is used as a proxy of the supply of the product to farmers in the country, although border trading is common in Nigeria (see Figures 17, 18 and 19 in Appendix 5). The figures are thus better appreciated for their relative rather than absolute values. The supply of the three types of agrochemicals for which data were available (fungicides, insecticides, and fertilizers) showed different patterns of movement over the period under consideration. Data were not available on herbicides.

Fungicide importation, which declined sharply in the fourth policy regime, rose sharply in the fifth (SAP period) but declined sharply in the sixth policy regime (Figure 17 in Appendix 5). Evidence from the RRA exercise seems to point to higher rates of fungicide use during this period.

Insecticide importation, on the other hand, declined sharply in the SAP policy period and stabilized (Figure 18 in Appendix 5).

Fertilizer importation rose consistently over the 5 policy periods. The rise from period to period was progressively sharper (Figure 19 in Appendix 5).

Similar graphical analyses were carried out for agricultural exports / non-oil exports ratio (Figure 8 in Appendix 5), cocoa exports / agricultural exports ratio (Figure 9 in Appendix 5), and natural rubber / agricultural exports ratio (Figure 10 in Appendix 5).

Statistical analysis: test of difference of means

The statistical analysis in this section utilized five of the identified six policy regimes (as used in Section 3.2.1 under Graphical analysis). The analyses are contained in Appendices 3 and 4. They tested whether the means significantly differ across the 5 policy regimes.

These are considered with respect to:

(i) *Non-oil exports/total export ratio*—The contribution of the non-oil sector to total export earnings grew in the SAP period, Figure 7 in Appendix 5 (fifth regime relative to the fourth regime (pre-SAP). The growth however, was not statistically significant. Similarly the decline during the post SAP period relative to the SAP period, was not significant.

It can therefore be concluded that there is no significant difference between the SAP and post SAP periods, even though agriculture is one of the target sectors in which SAP is expected to have impacts. It is possible, however, that the impacts of SAP and the trade liberalization policies of that period could have been offset by other factors such as mismanagement of resources and border trading.

It is interesting to note that this ratio (average annual ratio of non-oil exports to oil exports) declined significantly between the post war reconstruction period and the pre-SAP period. The decline became insignificant in the post SAP period relative to the pre-SAP period. Thus, trade liberalization fairly stabilized the contributions of the non-oil sector to total export earnings in the post SAP period relative to the SAP period.

(ii) *Agricultural exports/non-oil export ratio*—Statistical tests of difference of means show that none of the changes in ratios across policy regimes were statistically significant at the 5 per cent level.

(iii) *Cocoa exports/agricultural export ratio*—The results in Appendices 1 and 2 show that the average annual value of cocoa exports agricultural exports ratio increased in the 1974-1979 policy period relative to the 1970-1973 period (0.49 to 0.82). It also increased, but insignificantly between the 1974-1979 and 1980-1985 (pre-SAP) period (0.82 to 0.89). SAP policies, however, resulted in a significant decline in the ratio–to 0.68 from 0.89. The decline continued in the post SAP period to about 0.42. This decline was also statistically significant. Thus, cocoa export has become a less important contributor to agricultural sector foreign exchange earning by the post SAP period. This implies that other agricultural commodities contributed more to non-oil exports after SAP than before SAP.

(iv) *Export crop output*—According to Appendix 2, the average annual cocoa output declined significantly in the 1974-1979 period relative to the 1970-1973 period. The trend is similar for the 1980-1985 period relative to the 1974-1979 period, but rose significantly in the 1986-1993 period relative to the 1980-1985 period, and insignificantly in the post SAP relative to the SAP period.

In the SAP period, the rubber sector experienced a significant increase in the average annual output, which stood at 202.5 thousand tonnes relative to 80.7 thousand tonnes for the proceeding policy period (1980-1985). The increase experienced in the post SAP period was, however, not statistically significant. The increase is from 202.5 to 245 thousand tonnes. This is a clear indication that the Structural Adjustment Programme which has trade liberalization as one of its major components impacted positively on cocoa and rubber output.

(v) *Agrochemical importation/use*—The insignificant increase and outright decreases in agrochemical importation in the respective SAP and post SAP periods may have resulted from the drastic decline in the demand for agrochemicals by farmers due to the substantial relative increases in prices of these inputs. For example, *Gammalin 20* presently sells for about ₦ 180 per litre (Rapid Rural Appraisal, September 2000) as compared with the subsidized price of ₦ 2.25 per litre before SAP. Similarly, fertilizer sold for less than ₦ 100 per bag in 1985 but now sells for ₦ 1, 500 per bag.

In Ogun State, less than 5 per cent of the farmers used pesticides and fertilizers in the 1999/2000 season, and most of those who used fertilizer used it for food crops rather than for export crops. This is a great departure from their practices during the SAP period when most farmers used the inputs. The farmers (cocoa and rubber farmers) stated that most of them would not return to the use of fertilizers unless the prices fall back to between ₦ 200 – ₦ 500 per 25kg bag.

According to cocoa farmers, one tonne of cocoa, which sold for ₦100,000 in 1994–1995, now sells for about ₦70,000 (Rapid Rural Appraisal, September 2000, Appendix 6).

Rubber prices fell from ₦44/kg in 1994-1995 to about ₦18/kg in year 2000. In spite of the sharp decline in export crop prices, chemical input prices have been increasing sharply because of the continued depreciation of the *naira*, now officially put at ₦104.5 per US dollar. (Rapid Rural Appraisal, September 2000, Appendix 7). Thus, the main reason for the decline in the demand for chemical inputs in the tree crop sector in 1999–2000 was the falling prices of export crops when compared with the rising prices of chemical inputs. Farmers stated that they still believe that the agricultural requisites are important for increasing output. It is important to note that the National Policy on Agriculture during the SAP and post SAP periods emphasized self-sufficiency in food production. Even so, the increased trading activities during the SAP period favoured some 'sharp' practices such as adulteration of both inputs and outputs in the export sector.

(vi) *New areas planted to cocoa and rubber in Nigeria (hectares)*—The second implication of the increased production of export crops in the post SAP period relative to the pre-SAP period, is the loss of biodiversity and degradation of soil through expansion of hectarage cultivated.

Table 3.6 shows that the average annual new hectarage plantings to cocoa actually declined in the SAP and post SAP period relative to the pre-SAP period, implying that farmers concentrated more on maintenance of existing farms, with new farms increasing at a lower rate during the periods under consideration.

Although an increase in the new hectarage plantings was observed for rubber, the increase during SAP relative to pre-SAP was not statistically significant.

Available secondary data seems to support the conclusion that the average annual expansions in hectarage planted to cocoa and rubber in the post SAP period were respectively lower than that of the pre-SAP period for cocoa and no different for rubber. Even though trade liberalization has led to farm expansion, this is not significant although it has led to increased labour use and care for existing and relatively new developed farms.

3.2.1 Survey data analysis

Socio-economic characteristics of respondents

Table 3.7 shows the socio-economic attributes of sampled farmers. Male farmers, representing 97.1 per cent for cocoa and 92.86 per cent for rubber predominantly produced the two crops. About 26 per cent of the cocoa farmers have non-farming activity as their main occupation. The figure is 19.44 per cent for rubber farmers. Most of the cocoa growers (63 per cent) and only 29.17 per cent of the rubber producers have no formal education. Those with more than primary education were 19.7 per cent for cocoa and 12.5 per cent for rubber. The implication of this is that most of the farmers would not be able to understand by themselves instructions in the English language on the labels of agrochemicals, except when taught at informal training programmes. This may have implications for the use or misuse of agrochemicals.

Table 3.8 presents a summary of information on cocoa farmers between 1985-1986 shortly before SAP, 1992-1993 before the end of the SAP period and 1999-2000. The

average cocoa farm size increased from 4.35 hectares in 1985-1986 to 4.50 hectares in 1992-1993 and to 4.53 hectares in 1999-2000. The total output of the average farm increased from 2.19 tonnes in 1985-1986 to 2.80 tonnes in 1999-2000. Average yield rose from 0.50 tonnes to 0.62 tonnes per hectare during the period under consideration. The farm size and levels of output therefore responded positively to trade liberalization policies. The generally low yield may have been due to the old age of the trees—22.74 years on the average in 1985-1986 and 22.20 years in 1999-2000.

In the case of rubber, Table 3.9 shows that the average land area devoted to it grew from 3.14 hectares in 1985-1986 to 6.01 hectares in 1992-1993 and 8.5 hectares in 1992–2000, although most of the farms have old vegetative trees. The yield among small-scale farmers increased from 0.69 tonnes in 1985-1986 to 1.15 tonnes in 1992-1993 but fell to 0.23 tonnes in 1999-2000 (after SAP). The reasons for this may include the age of rubber trees being on average 27.53 years in 1985-1986, 33.0 years in 1992-1993 and 38 years in 1999-2000, and most of the farms have dead trees arising from over tapping.

TABLE 3.7

Socio-economic attributes of sampled farmers

ATTRIBUTE	*RUBBER %*	*COCOA %*
SEX		
1. FEMALE	7.14	2.9
2. MALE	92.86	97.1
MEMBERSHIP OF CO-OPERATIVE SOCIETY		
1. YES	50.00	73.44
2. NO	50.00	26.56
PRIMARY OCCUPATION		
1. TREE CROP FARMING	44.44	1.64
2. FOOD CROP FARMING	5.56	9.84
3. TREE/FOOD CROP FARMING	30.56	62.30
4. NON – FARMING	19.44	26.23
EDUCATIONAL LEVEL		
1. NO FORMAL EDUCATION	29.17	63.00
2. PRIMARY SCHOOL	58.33	17.24
3. SECONDARY SCHOOL.	8.33	13.79
4. POST SECONDARY SCHOOL	4.17	5.87
FORMAL TRAINING IN COCOA PRODUCTION		
1. YES	59.09	55.74
2. NO	40.91	44.26

Source: Field survey data, 2000.

3.2.2 Use of resource inputs

The Tables 3.8 and 3.9 show that labour use per hectare on cocoa farms increased from 71.7 man days in 1985-1986 before SAP to an average of 76.40 man days per hectare in 1992-1993 at the tail end of SAP, and nose-dived to 57.0 man days per hectare in 1999-

2000. It should be stated that the wage rates increased from ₦ 50 per man day in 1985-1986 to ₦ 200 in 1999-2000. In the case of rubber, labour use only rose marginally from 40 to 40.5 in 1985-1986 and 1992-1993, and fell sharply to 9.2 man days in 1999-2000, although wage rates also rose from ₦ 50 to ₦ 200 (Table 3.9).

The analysis shows that whereas fertilizer was used in 1985-1986 (although very little for cocoa), it was marginally used in 1992-1993 and not used at all in 1999-2000 for both crops. The price of fertilizer rose from about ₦ 40 per 50kg bag in 1985-1986 to ₦1, 885 in 1999-2000. The use of fertilizer on the few large-scale rubber farms was very high (1000 kg/ha) and was continuously utilized between 1985 and 2000. For comparison, the ratio of input-output prices were used in this analysis. In general, the price of fertilizer relative to the output prices declined from 1985-1986 (0.141 for cocoa and 0.18 for rubber) to 1992-1993 (0.027 and 0.12) but rose sharply in 1999-2000 (0.413 and 1.78 respectively). This may have accounted for the drastic decline in fertilizer use for both crops.

The use of pesticides averaged 1.66 litre per hectare in 1985-1986 and fell to a mere 1.09 litre per hectare in 1999-2000 for cocoa. The price of pesticide relative to that of cocoa declined from 13.55 in 1985-1986 to 3.96 in 1992-1993 but rose to 5.85 in 1999-2000. Thus, pesticide was relatively more costly in the post SAP period than during the SAP period. Pesticides were not used in small-scale rubber farms.

TABLE 3.8

Summary information on resource use on cocoa farm

		1985/86	*1992/93*	*1999/2000*
1.	Average farm size (ha)	4.35	4.50	4.58
2.	Average yield (tonnes/ha)	0.503	0.54	0.579
3.	Output for average farm (tonnes)	2.19	2.45	2.65
4.	Price of output (₦/tonnes)	20,000	94,660.00	91,340.00
5.	Labour use (man days/ha)	71.7	76.40	57.00
6.	Labour wage rate (₦ /man day)	50.00	100.00	200.00
7.	Fertilizer use kg/ha	12.57	1.21	0.00
8.	Fertilizer price (₦ /tonne)	2820.00	2560.00	37700.00
9.	Pesticide use (litre/ha)	1.66	1.35	1.09
10.	Price of pesticide (₦ /litre)	271.00	375.00	534.00
11.	Herbicide use (litre/ha)	0.04	0.00	0.01
12.	Herbicide price (₦ /litre)	120.00	NA	1,300.00
13.	Price of pesticide/price of cocoa ratio	13.55	3960	5850
14.	Price of fertilizer relative to Cocoa	0.141	0.027	0.413
15.	Price of herbicide relative to Cocoa	6.0	N.A.	14.23
16.	Age of cocoa trees (years)	22.74	20.04	25.20

Source: Field survey, 2000.

Note:

1985/86: represents pre-SAP period
1992/93: represents SAP period
1999/2000: represents post SAP period.

TABLE 3.9

Summary information on resource use on rubber farm

		1985/86	*1992/93*	*1999/2000*
1.	Average farm size (ha) (small-scale farms)	3.14	6.01	8.48
2.	Average farm size (estate rubber) (ha)	3500.00	4000.00	5000.00
3.	Average yield (tonne/ha (estate farms)	0.57	0.54	0.55
4.	Average yield (tonne/ha) small scale farmers	0.69	1.15	0.23
5.	Price of rubber (₦ /tonne) (estate farms)	50000.00	150000.00	85000.00
6.	Labour use on estate farm (man days/ha)	170.00	140.00	90.00
7.	Labour use on small scale rubber farm (md/ha)	40	40.5	9.2
8.	Labour wage rate (₦ /md)	50.00	100.00	200.00
9.	Fertilizer use on estate farm kg/ha	1000.00	1000.00	1000.00
10.	Fertilizer use on small scale rubber farms kg	191.00	83.30	NIL
11.	Fertilizer price (₦ /50kg) for small scale farms	141.00	128.00	1885.00
12.	Fertilizer price (₦ /50kg) for estate farms	130.00	120.00	1350.00
13.	Pesticide use (litre/ha) (small scale farm)	NIL	NIL	NIL
14.	Price of pesticide (₦ /litre) (insecticide)	271.00	373.00	534.00
15.	Herbicide use (litre/ha)	NIL	NIL	NIL
16.	Herbicide price (₦ /litre)	120.00	NA	1300.00
17.	Price of pesticide/price of rubber	17.37	17.46	25.22
18.	Price of fertilizer relative to rubber	0.18	0.12	1.78
19.	Price of herbicide relative to rubber	7.69	NA	61.4
20.	Age of rubber (years)	27.53	33.00	38.00
21.	Price of rubber for small scale farms	5,600	21,430	20,170

Source: Field survey, 2000.

Output response analysis

This analysis was carried out to determine the degree of influence that prices and farm size exert on cocoa output using cross-sectional data. Table 3.10 shows that cocoa output was responsive to changes in area cultivated and the amount of pesticide use. The elasticity coefficient for the response of cocoa output to farm size increases was 0.66 in 1985-1986 (pre-SAP period), 0.51 in 1992-1993 (SAP period) and 0.56 in 1999-2000 (post SAP period). These were all significant at the 1 per cent probability level. Thus data shows that output was more responsive to farm size in the pre-SAP relative to the SAP period. This can be explained by the fact that most cocoa trees are ageing and the newly planted ones are yet to attain optimal yield levels. This is in addition to the decline in the use of agro-chemicals due to high relative prices.

The output price elasticity coefficient estimate was not significant at the 5 per cent level for all three periods. Thus cocoa output did not respond significantly to price changes. Secondly, the result implies that liberalization did not alter the existing situation of low responsiveness of cocoa output to price increases. This may be the result of some structural rigidity such as ageing cocoa trees and lack of funds for hectarage expansion.

TABLE 3.10

Regression results for cocoa output response

VARIABLE DESCRIPTION	*CODE NAME*	*COEFFICIENT*	*T VALUE*	*P>/T/*
1985/86				
Nominal price of cocoa	Lncmprl	0.055	–0.378	0.709
Cocoa farm size	Lncfmszl	0.666	2.411	0.025
Age of cocoa	Ccagel	0.352	1.175	0.252
Pesticide use	Lnccpst1	0.466	2.543	0.019
Constant	Cons	–1.934	–1.188	0.248
R-squared	R^2	0.63		
Adjusted R-squared	R^{-2}	0.56		
F-statistics	F	9.28		0.000
1992/93				
Nominal price of cocoa	Lncnmpr2	0.241	1.032	0.313
Cocoa farm size	Lncfmsz2	0.510	1.647	0.113
Age of cocoa	Lncage2	–0.309	–1.397	0.175
Pesticide use	Lnccpst2	0.77	4.550	0.000
Constant	Cons	–2.73	–1.411	0.171
R-squared	R^2	0.65		
Adjusted R- squared	R^{-2}	0.60		
F-statistics		11.31		
1999/2000				
Nominal price of cocoa	Lncnmpr3	.0.182	0.608	0.550
Cocoa farm size	Lncfmsz3	0.566	2.103	0.0490
Age of cocoa	Lncage3	–0.294	–0.838	0.412

Source: Computed from field data, 2000.

The table also shows that the level of pesticide use is a major determinant of cocoa output in Nigeria. This result was consistent over the three periods under consideration. It is however important to note that the responsiveness of output to pesticide use increased considerably in the period after trade liberalization relative to the period before. According to the table, the elasticity coefficient of cocoa output response to pesticide use is 0.46 for the pre-liberalization period. This rose to 0.77 and 0.85 in the SAP and post-SAP periods. The implication of this is that liberalization is associated with considerable improvement in output response to pesticide use, as expected.

Pesticide demand analysis

The results in Table 3.11 show that the most important factor in the determination of pesticide demand in cocoa production in the pre-liberalization era are cocoa farm size and age of cocoa trees. These variables are positively related to pesticide demand and were statistically significant. The elasticity coefficients are about unity. That is, 0.96 for farm size and 1.09 for age of cocoa. During this period, cocoa and pesticide prices did not play much role in pesticide demand. Even though the estimated coefficients of both variables carried the right signs, their influences were not statistically significant.

In the post-liberalization period (SAP and post SAP periods), the price of pesticide became a significant factor in the determination of pesticide use in addition to farm size. The pesticide price elasticity coefficient was –0.54 in 1999/2000 season. Thus while pesticide price was not a major factor influencing demand for pesticide in the pre-liberalization period, the situation changed in the post-liberalization period. Price of pesticide therefore became a major determinant of the level of pesticide use.

TABLE 3.11

Regression results for pesticide demand in cocoa production

VARIABLE DESCRIPTION	*CODE NAME*	*COEFFICIENT*	*T VALUE*	*P>/t/*
1985/86				
Nominal price of cocoa	Lncnmprl	0.110	0.494	0.628
Cocoa farm size	Lncfmszl	0.964	2.267	0.038
Age of cocoa	Ccagel	1.086	2.981	0.009
Nominal price of pesticide	Lnptnmp1	–0.199	–1.169	0.259
Constant	Cons	–2.821	–1.147	0.268
R-squared	R^2	0.483		
Adjusted R-squared	R^{-2}	0.353		
F-statistics	F	3.73		2.025
1992/93				
Nominal price of cocoa	Lncnmpr2			
Cocoa farm size	Lncfmsz2	0.849	2.695	0.016
Age of cocoa	Ccage2			
Nominal price of pesticide	Lnptnmp2	0.232	0.825	0.421
Constant	Cons	–0.460	–0.265	0.794
R-squared	R^2	0.362		
Adjusted R-squared	R^{-2}	0.282		
F-statistics		4.54		0.0275
1992/93				
Nominal price of cocoa	Lncnmpr3			
Cocoa farm size	Lncfmsz3	0.358	1.079	0.290
Age of cocoa	Ccage3			
Nominal price of pesticide	Lnptnmp3	–0.541	-3.428	0.002
Constant	Cons	4.701	5.039	0.000
R-squared	R^2	0.30		
Adjusted R-squared	R^{-2}	0.25		
F-statistics		5.88		0.0076

Source: Computed from field data, 2000.

* The regression was done stepwise.

The results of the two equations estimated, point to the fact that the prices of agro-chemicals played a significant role in the low output response in the export crop sector to trade liberalization in Nigeria. Thus it can be said that the effects of trade liberalization on the environment through the export crop sector could have been greater if input prices had not increased relative to output prices.

Analysis of costs and returns

The gross margin analysis was carried out bearing in mind that the fixed cost items used by tree crop farmers were mainly cutlasses, whose depreciated values are very low relative to the variable cost items. Tables 3.12 and 3.13 show the summary of the gross margins per hectare for average cocoa and rubber farms for the three periods under consideration. The results show that the profitability ratio for the SAP period was higher (5.67 and 5.09 for cocoa and rubber) than the pre-SAP and post SAP periods, which were 1.46/4.32 and 3.41/1.65 respectively for cocoa and rubber. The fall during the post SAP period signalled the fact that the benefits during the SAP period were not sustained thereafter. Generally, profitability was more in cocoa farms than in rubber farms especially in the post SAP period. This is largely due to the sharp decline in rubber prices in the post SAP period.

TABLE 3.12

Estimation of gross margin for the average cocoa farm per hectare

	1985/86	***1992/93***	***1999/2000***
Average farm size (ha)	4.35	4.50	4.58
REVENUE			
Output (tonnes/ha)	0.503	0.544	0.579
Price (₦/tonnes)	20,000	94,660.00	91,340.00
Total Revenue	10,060	51,495.04	52,885.86
VARIABLE COST			
Pesticide	449.86	506.25	582.10
Fertilizer	35.45	3.10	0.00
Herbicide	48.0	0.00	13.00
Labour (man-days)	3,550.00	7,640.00	11,400
Total variable Cost	4,083.00	8,149.4	11,995
Gross marginal/ha	5,976.6	43,346.00	40,890.8
Profitability ratio (GM/TC)	1.46	5.67	3.41

Source: Computed from field survey data, 2000.

TABLE 3.13

Estimation of gross margin for the average rubber farm per (1 ha)

	1985/86	*1992/93*	*1999/2000*
Average farm size (ha)	3.14	6.01	8.48
REVENUE			
Output (tonnes/ha)	0.69	1.15	0.23
Price (₦ /tonnes)	15.600	21.430	21.170
Total Revenue	10.764	24,645	4.869
VARIABLE COST			
Fertilizer	–	–	–
Herbicide	–	–	–
Labour (man-days)	2.000	4,050	1.840
Pesticide	–	–	–
Total Variable Cost	2.000	4.050	1.840
Gross Marginal/ha	8.764	20.595	2.029
Profitability ratio (GM/TC)	4.32	5.09	1.65

Source: Computed from field survey data, 2000.

Cost-benefit analysis

The cost-benefit analysis (CBA) for the crops (cocoa and rubber) is carried out with respect to the financial i.e. the individual consideration and the public consideration. To this end, the bank lending rate of 35 per cent and the government bond rate of 10 per cent are considered as appropriate for a proxy of the discount rates.

One hectare constituted the unit of interpretation for the analysis. The average ages of the farms are 22 years for cocoa and 35 years for rubber, while the economic life of each crop is estimated to be 30 years and 33 years respectively. It was stated earlier that the fixed cost items are not significant. The tools of financial analysis were applied as follows:

(1) Net present value (NPV)

$$\sum_{t=1}^{n} \frac{Bt-Ct}{(1+r)^1} where$$

where: Bt is the cash inflow; Ct is the expenditure outflow in each year and t = 1, 2 .n years and r is the discount rate.

(2) Benefit-cost ratio

$$B/C = \frac{\sum_{t=1}^{n} \frac{Bt}{(1+r)^1}}{\sum_{t=1}^{n} \frac{Ct}{(1+r)^1}}$$

(3) Internal rate of return (IRR), r* is defined as:

$$\sum_{t=1}^{n} \frac{Bt}{(1+r^*)} = 0$$

where: Bt, Ct, t and r are as stated earlier and B/C is Benefit – Cost ratio

The figures utilized were obtained from the pooled data of representative farms as well as data contained in the questionnaire and the RRA reports. Tables 3.14 and 3.15 contain the analysis for cocoa and rubber at 35 per cent discount rate and Tables 3.16 and 3.17 shows a 10 per cent rate. The first 10 years represented pre-SAP, while 11^{th}-18^{th} years were the SAP period for cocoa and rubber.

A sensitive analysis was conducted with two scenarios: (a) A 20 per cent possible fall in revenue arising from over estimated output and/or price (b) A 30 per cent possible rise in cost. These are presented in Appendices 10 - 14. These conditions meet the suggestions as contained in Georgiou *et al.,* (1997), Abaza (1993), Pearce and Moran (1994) and Ruttan (1992). It is observed that at 35 per cent discount rate, the net present values (NPV) and benefit-cost (CBA) ratios are lower than those of a 10 per cent discount rate for both cocoa and rubber. This implies that at the rate the Government sells bonds (10 per cent), the economy would benefit more in the production of cocoa and rubber than the rates the banks operate. An attempt was also made to investigate the impact of uncontrolled (slaughter) tapping by some rubber farmers. The data are contained in Tables 3.18 and 3.19. They show that the farmers want early returns but in an unsustainable manner for rubber economy. The short-run approach of these farmers shows that even though the action does not support the sustainable management of natural resources, they gain more by so doing.

The summary of the results of the sensitivity analysis is presented in Tables 3.20 and 3.21. These show that if cost should increase by 30 per cent, both cocoa and rubber production will not be profitable at the 35 per cent discount rate, except when rubber is 'slaughter' tapped. Even at a 20 per cent possible fall in revenue, normal rubber tapping is unprofitable.

There is therefore a divergence between the sustainable management of natural resources and the rubber farmers' desire to enrich themselves in the short-run and medium-term scenarios, as against the scenario of long-term gain which would benefit the society.

TABLE 3.14

Cost-benefit analysis for cocoa (per ha) at 35% discount rate

AGE (YRS)	*YIELD (TONNE)*	*PRICE ₦*	*REV. ₦*	*COST ₦*	*DF 35%*	*D. COST ₦*	*D. REV ₦*
1.	–		–	2,600	0.7407	1925.8	–
2.	–		–	800	0.5887	471.0	–
3.	–		–	450	0.4064	182.9	
4.	0.125	15000	1875	2725	0.3011	820.5	564.6
5.	0.250	15000	3750	1600	0.2230	356.8	836.3
6.	0.250	15000	3750	1850	0.1652	305.6	619.5
7.	0.250	15000	3750	2850	0.1224	348.8	459.0
8.	0.375	15000	5625	3450	0.0906	312.6	509.6
9.	0.375	15000	5625	4850	0.0671	325.4	377.4
10.	0.500	20000	1000	4993	0.0497	248.2	497.0
11.	0.500	30000	15000	5145	0.0368	189.3	552.0
12.	0.500	40000	20000	10,500	0.0273	286.7	546.0
13.	0.550	50000	27500	11,797	0.0202	238.3	555.5
14.	0.600	60000	36,000	12,100	0.0150	181.5	540.0
15.	0.600	60000	36,000	12,900	0.0111	143.2	399.6
16.	0.650	100,000	65,000	17,150	0.0082	140.6	533.0
17.	0.650	200,000	130,000	20,150	0.0061	122.9	793.0
18.	0.650	180,000	117,000	24,150	0.0045	108.7	526.5
19. (1994)	0.650	190,000	123,500	79,150	0.0033	96.2	407.6
20.	0.650	190,000	65,000	27,150	0.0025	67.9	162.5
21.	0.625	200,000	125,000	28,200	0.0018	50.8	225.0
22. (1997)	0.600	220,000	132,000	31,200	0.0014	43.7	184.8
23.	0.600	120,000	72,000	30,200	0.0010	30.2	72.0
24.	0.550	100,000	55,000	32,200	0.0007	22.5	38.5
25. (2000)	0.550	100,000	55,000	29,200	0.0006	17.5	33.0
26.	0.500	110,000	55,000	29,500	0.0004	11.8	22.0
27.	0.500	120,000	60,000	30,500	0.0003	9.2	18.0
28.	0.500	120,000	60,000	31,500	0.0002	6.3	12.0
29.	0.450	120,000	54,000	32,000	0.00016	5.3	8.6
30.	0.400	120,000	48,000	33,000	0.00012	4.0	5.8
					S	7074.2	9498.8

NPV = ₦2,424.60 B/C = a/b = $\frac{9498.8}{7074.2}$ = 1.343

Source: Results from analysis of survey data, 2000.

TABLE 3.15

Cost-benefit analysis for rubber (per ha) at 35% discount rate

AGE (YRS)	YIELD Kg/ha	PRICE ₦	REV. ₦	COST ₦	INC. REV	DF 35%	DC ₦	DR ₦	DIR I.R
1	–	–	–	2000	–2000	0.741	1482	–	–1482
2	–	–	–	113.45	–113.45	0.549	62.28	–	–62.28
3	–	–	–	113.45	–113.45	0.406	46.06	–	46.06
4	–	–	–	114.50	–114.50	0.301	34.46	–	–34.46
5	–	–	–	113.00	–113.00	0.223	25.20	–	–25.20
6	–	–	–	112.81	–112.81	0.165	18.61	–	–18.61
7	–	–	–	109.59	–109.59	0.122	13.37	–	–13.37
8	400	5	2000	4545	–2545	0.091	413.60	182	–231.60
9	600	5	3000	4545	–1545	0.067	304.52	201	–103.52
10	900	5	4500	4545	–45	0.050	227.25	225	–2.25
11	1200	6	7200	4545	2655	0.037	168.17	266.40	98.24
12	1300	8	10400	4545	5855	0.027	122.72	280.80	158.09
13	1800	10	18000	9090	8910	0.020	181.80	360.00	178.20
14	1700	10	17000	9090	7910	0.015	136.35	225	118.65
15	1550	12	18600	9090	9510	0.011	99.99	204.60	104.61
16	1420	40	56800	9090	47710	0.008	72.72	454.40	381.68
17	1300	45	58500	9090	49410	0.006	54.54	351.00	296.46
18	2000	50	100000	18180	81820	0.005	90.90	500.00	409.10
19	1800	45	81000	18180	62820	0.003	54.54	243.00	188.46
20	1650	30	49500	18180	31320	0.002	36.36	99.00	62.64
21	1500	21	31500	18180	13320	0.002	36.36	63.00	26.64
22	1350	6	8100	18180	–10080	0.001	18.18	8.1	–10.08
23	2000	6	12000	27270	–15270	0.001	27.27	12	–15.27
24	1800	8	14400	27270	–12870	0.0007	19.09	14.4	–12.87
25	1650	10	16500	27270	–1077	0.0006	16.36	16.5	–10.77
26	1500	10	15000	27270	–12270	0.0004	10.91	6.00	–4.91
27	1350	12	16200	27270	–11070	0.0003	8.18	4.86	–3.32
28	1600	40	64000	36360	27640	0.0002	7.27	12.80	5.53
29	1550	45	69750	36360	33390	0.0002	7.27	13.95	6.68
30	1450	50	72500	36360	36140	0.0001	3.64	7.25	3.61
31	1400	45	63000	36360	26640	0.0001	3.64	6.30	2.66
32	1500	30	45000	36360	8640	0.0000	380361	3757.36	–46.25
33	1500	21	31500	36360	–4860	0.0000			

B/C = 0.988
NPV = ₦ –46.25
IRR = 34.98
Source: Results from analysis of survey data, 2000.

TABLE 3.16

Cost-benefit analysis for cocoa (per ha) at 10% discount rate

AGE (YRS)	*YIELD (TONNE)*	*PRICE ₦*	*REV. ₦*	*COST ₦*	*DF 10%*	*D. COST ₦*	*D. REV ₦*
1.	–		–	2,600	0.9091	–2363.7	–
2.	–		–	800	0.8264	–661.1	–
3.	–		–	450	0.7513	338.1	–
4. (1980)			1875	2725	0.6830	1861.2	1280.6
5.			3750	1600	0.6209	993.4	2328.4
6.			3750	1850	0.5645	1044.3	2116.9
7.			3750	2850	0.5132	1462.6	1924.5
8.			5625	3450	0.4665	1609.4	2624.1
9.			5625	4850	0.4241	2056.9	2385.6
10.			10,000	4993	0.3855	1924.8	3855.0
11. (1986)			15,000	5145	0.3505	1803.3	5257.5
12.			20,000	10,500	0.3186	3345.3	6372.0
13.			27,500	11,797	0.2897	3417.6	7966.8
14.			36,000	12,100	0.2633	3185.9	9478.8
15.			36,000	12,900	0.2394	3088.3	8618.4
16.			65,000	17,150	0.2176	3731.8	14144.0
17.			130,000	20,150	0.1978	3985.7	25714.0
18.			117,000	24,150	0.1799	4344.6	21048.3
19. (1994)			123,500	29,150	0.1635	4766.0	20192.3
20.			65,000	27,150	0.1486	4034.5	9659.0
21.			125,000	28,200	0.1351	3809.8	16887.5
22. (1997)			132,000	31,200	0.1228	3831.4	16209.6
23.			72,000	30,200	0.1117	3373.3	8042.4
24.			55,000	32,200	0.1015	3268.3	5582.5
25. (2000)			55,000	29,200	0.0923	2695.2	5076.5
26.			55,000	29,500	0.0839	2475.1	4614.5
27.			60,000	30,500	0.0763	2327.2	4578.0
28.			60,000	31,500	0.0693	2183.0	4158.0
29.			54,000	33,000	0.0630	2079.0	3402.0
30.			48,000	33,000	0.0573	1890.9	2750.4
					S	77951.7(b)	216267.6(a)

NPV = N138,315.9 B/C = a/b = $\frac{216267.6}{77,951.7}$ = 2.774

Source: Results from analysis of survey data, 2000.

TABLE 3.17

Cost-benefit analysis for cocoa (per ha) at 10% discount rate

AGE (YRS)	*YIELDK g/ha*	*PRICE ₦*	*REV. ₦*	*COST ₦*	*INC. REV*	*DF 10%*	*DC ₦*	*DR ₦*	*DIR ₦*
1	–	–	–	2000	–2000	0.909	–	1818	–1818
2	–	–	–	113.45	–113.45	0.826	–	93.71	–113.45
3	–	–	–	113.45	–113.45	0.751	–	85.20	–113.45
4	–	–	–	114.50	–114.50	0.683	–	78.20	–114.50
5	–	–	–	113.00	–113.00	0.621	–	70.17	–113.00
6	–	–	–	112.81	–112.81	0.565	–	63.74	–112.81
7	–	–	–	109.59	–109.59	0.513	–	56.22	–109.59
8	400	5	2000	4545	–2545	0.467	934.00	2122.52	–1188.52
9	600	5	3000	4545	–1545	0.424	1272.00	1927.08	–655.08
10	900	5	4500	4545	–45	0.386	1737.00	1754.37	–17.37
11	1200	6	7200	4545	2655	0.351	2527.20	1595.30	–931.91
12	1300	8	10400	4545	5855	0.319	3317.60	1449.86	1867.75
13	1800	10	18000	9090	8910	0.290	522.00	2636.10	2583.90
14	1700	10	17000	9090	7910	0.263	2080.33	2390.67	2080.33
15	1550	12	18600	9090	9510	0.239	4445.40	2172.51	2272.89
16	1420	40	56800	9090	47710	0.218	12382.40	1981.62	10400.78
17	1300	45	58500	9090	49410	0.198	11583.00	1799.82	9783.18
18	2000	50	100000	18180	81820	0.180	18000.00	3272.40	14727.60
19	1800	45	81000	18180	62820	0.164	13284.00	2981.52	10302.48
20	1650	30	49500	18180	31320	0.149	7375.50	2708.82	4666.68
21	1500	21	31500	18180	13320	0.135	4252.50	2454.30	1798.20
22	1350	6	8100	18180	–10080	0.083	672.30	1508.94	–836.64
23	2000	6	12000	27270	–15270	0.112	1344.00	3054.24	–1710.24
24	1800	8	14400	27270	–12870	0.102	1468.80	2781.54	–1312.74
25	1650	10	16500	27270	–10770	0.092	1518.00	2508.84	–990.84
26	1500	10	15000	27270	–12270	0.084	1260.00	2290.68	–1030.68
27	1350	12	16200	36360	–11070	0.076	1231.20	2763.36	–841.32
28	1600	40	64000	36360	27640	0.069	4416.00	2508.84	2103.57
29	1550	45	69750	36360	33390	0.063	4394.25	2290.68	1907.16
30	1450	50	72500	36360	36140	0.057	41325.00	2072.52	2059.98
31	1400	45	63000	36360	26640	0.052	3276.00	1890.72	1385.28
32	1500	30	45000	36360	8640	0.470	2115.00	1708.92	406.08
33	1500	21	31500	36360	–4860	0.043	1354.50	1563.48	–208.98
							110895.48	60454.89	50440.59

B-C = 1.83
NPV = ₦50440.59
IRR = 34.98%

Source: Results from analysis of survey data, 2000.

TABLE 3.18

Cost-benefit analysis for rubber (slaughter tapping) per hectare at 35% discount rate

AGE YRS	*YIELD KG/HA*	*PRICE ₦*	*REV. ₦*	*COST ₦*	*INC. REV. ₦*	*DF 35 %*	*DR3 %*	*DC35 %*	*DIR3 %*
1	–	–	–	2000	–2000	0.7407	–	1481	–1481.4
2	–	–	–	113.45	–113.45	0.5887	–	66.788	–66.788
3	–	–	–	113.45	–113.45	0.4064	–	46.106	–46.106
4	–	–	–	11450	–114.50	0.3011	–	34.476	–34.476
5	–	–	–	113.00	–113.00	0.2230	–	25.199	–25.199
6	–	–	–	112.81	–112.81	0.1652	–	18.636	–18.636
7	–	–	–	109.59	–109.59	0.1224	–	13.4138	–13.4138
8	600	6	3600	4545	–94.5	0.0906	326.16	411.777	–85.617
9	750	6	4500	5681.25	–1181.25	0.0671	201.95	381.211	–79.262
10	900	6	5400	5681.25	–281.25	0.0497	268.38	282.358	–13.9781
11	135	8	1080	5681.25	–4601.25	0.0368	39.744	209.07	–169.362
12	1800	10	18000	5681.25	12318.75	0.0275	491.4	555.098	336.302
13	1950	10	19500	5681.25	13818.75	0.0202	393.9	114.76	279.139
14	2700	12	32400	11362.50	21037.5	0.0150	486	170.4375	315.563
15	2550	12	30600	11362.50	19237.5	0.0111	339.66	126.124	213.5363
16	2325	40	93000	11362.50	81637.5	0.0082	762.66	93.173	669.4275
17	2130	45	95850	11362.50	84487.5	0.0061	584.685	69.311	515.3738
18	1950	50	97500	22725.00	74775	0.0045	438.75	102.263	336.4875
19	3000	45	135000	22725.00	112275	0.0033	445.5	74.9925	370.5075
20	2750	30	82500	22725.00	59775	0.0025	206.25	56.8125	149.1375
21	2475	21	51975	22725.00	29250	0.0018	93.555	40.905	52.65

B/C == 1.25

NPV = ₦1,0492.52

Source: Results from analysis of survey data, 2000.

TABLE 3.19

Cost-benefit analysis for rubber (slaughter tapping) per hectare at 10% discount rate

AGE YRS	*YIELD KG/HA*	*PRICE ₦*	*REV. ₦*	*COST ₦*	*INC. REV. ₦*	*DF 10%*	*DR 0%*	*DC10 %*	*DIR10 %*
1	–	–	–	2000	-2000	0.9091	–	1818.2	–1818.2
2	–	–	–	113.45	–113.45	0.8264	–	93.755	–93.755
3	–	–	–	113.45	–113.45	0.7513	–	85.235	–85.235
4	-–	–	–	114.50	–114.50	0.6830	–	78.2035	–78.2035
5	–	–	–	113.00	–113.00	0.6209	–	70.1617	–70.1617
6	–	–	–	112.81	–112.81	0.5645	–	63.6812	–63.6812
7	–	–	–	109.59	–109.59	0.5132	–	56.2416	–56.2416
8	600	6	3600	4545	–94.5	0.4665	167904	2120.2423	–440.843
9	750	6	4500	5681.25	–1181.25	0.4241	1908.45	2409.4181	–500.968
10	900	6	5400	5681.25	–281.25	0.3855	2081.7	2190.1219	–108.4221
11	135	8	1080	5681.25	–4601.25	0.3505	378.54	1991.2781	–1612.738
12	1800	10	18000	5681.25	12318.75	0.3186	5734.8	1810.046	3924.754
13	1950	10	19500	5681.25	13818.75	0.2897	5649.15	1645.858	4003.292
14	2700	12	32400	11362.50	21037.5	0.2633	8530.92	2991.746	5539.174
15	2550	12	30600	11362.50	19237.5	0.2394	7325.64	2720.183	47218.66
16	2325	40	93000	11362.50	81637.5	0.2176	20236.8	2472.48	17764.32
17	2130	45	95850	11362.50	84487.5	0.1978	18959.13	2247.503	16711.628
18	1950	50	97500	22725.00	74775	0.1799	17540.25	4088.2275	13452.02
19	3000	45	135000	22725.00	112275	0.1635	22072.5	37200.338	18356.963
20	2750	30	82500	22725.00	59775	0.1486	12036.61	3376.935	8659.665
21	2475	21	51975	22725.00	29250	0.1351	7021.822	3070.1475	3951.675
							3830.86	72600	134653.70

B/C = 1.71

NPV = ₦51, 230.06

Source: Results from analysis of survey data, 2000.

TABLE 3.20

Cost-benefit analysis: summary of findings

CROP	*NET PRESENT VALUE*		*BENEFIT COST RATIO*		*IRR (%)*
	35%	10%	35%	10%	
1. Cocoa	9,498.80	216,267.6	1.343	2.774	49.18
2a. Rubber (Normal tapping)	–46.25	50,440.59	0.988	1.83	34.98
2b. Rubber (Slaughter tapping)	1,049.52	51,230.06	1.25	1.71	41.29

Source : Results from analysis of survey data, 2000.

TABLE 3.21

Sensitivity analysis: summary of findings

CROP	*20% FALL IN REVENUE*				*30% INCREASE IN COST*			
	35% DF		10% DF				10% DF	
	NPV ₦	B-C	NPV ₦	B-C	NPV ₦	B-C	NPV ₦	B-C
1. Cocoa	525.00	1.07	95.062	2.22	–2560.04	0.79	114,930.89	2.13
2. Rubber (Normal tapping)	–37.00	0.79	40,352.47	40,352.47	–1141,17	–0,77	19,862.69	1.16
3. Rubber (Slaughter tapping)	176.36	1.04	32502.88	1.45	12.454	1.002	80,677.43	2.58

Source : Results from analysis of survey data, 2000.

3.3 Social impacts

This section investigated the social impacts of trade liberalization in the export crop producing areas of Nigeria. The major parameters considered are:

(a) Gender distribution of export crop farmers

(b) Health situation

(c) Level of literacy and awareness of farmers

(d) Other social implications.

About 360 farming households were interviewed, as stated in section 3.2. The RRA reports presented in Appendix 7, and the primary data, account largely for the basis of the social impact assessment.

Gender analysis

The gender issue is one of the major socio-economic variables in environmental impact assessment. This is considered with respect to what benefits accrued to female farmers arising from trade liberalization. Out of the 360 farmers interviewed 5.02 per cent were female. This shows that trade liberalization policy impacts on export crops benefited largely male farmers since only 2.9 per cent and 7.14 per cent women engaged in cocoa and rubber production respectively. Cocoa and rubber are permanent crops that are not ordinarily cultivated except by male members of the family. This is due mainly to the land tenure systems in the southern parts of the country. The land tenure system only confers authority to own a piece of land to the male children. Neither female children nor wives can inherit land in many parts of southern Nigeria. This invariably inhibits permanent (tree) crop production by these vulnerable groups.

Health situation

The use of agrochemicals by some farmers, particularly insecticides and fungicides, were reported in some villages to have led to:

(a) itching of the skin

(b) painful sensation in the eyes

(c) swollen hands after the application of the agrochemicals.

When these diseases were rampant, loss of man-days could be up to a cumulative 15-20 man-days in a community and up to 100-140 man-days from an LGA.

A pitiable situation was reported in Cross River State where two schoolboys mistakenly drank agrochemicals and later died. In general, the antidote given to most victims of the side effects in the form of itching, swollen hands, etc., are palm oil, palm kernel oil or coconut water. At the medical centres, in the few places where they exist, calamine lotion and pain relieving tablets are often administered to such patients. The cost implications may be difficult to quantify but it can be estimated that about half a bottle (0.15 litre) of palm oil could be used as a proxy for curing such ailment.

Level of literacy and awareness of the farmers

The survey data shows that most of the cocoa farmers are illiterate (63 per cent) even though 56 per cent have received formal training in cocoa production through the agricultural extension services. In the case of rubber producers, most of them had a primary educational qualification and about 59 per cent of the farmers were trained in various technical aspects of rubber production.

It should however be stated that none of the farmers had training in trade and marketing principles. However, they are versed in traditional practices and the farmers were able to compare their costs and returns as well as being aware of the implications of purchasing levels of resource inputs when the output prices are low.

Other social implications

It was observed during the farm visits and RRA trips that export crop farmers enjoyed relative affluence compared with other villagers. Their houses were roofed with iron sheets and some of them cemented and painted. In some villages, the cocoa farmers owned cars (some were Peugeot 505 and 504 cars) and had their own drivers. They, however, complained that, their high levels of resources could not be maintained after the SAP period because of the low output prices. Some of them have started to diversify into other economic activities with the hope that there would be a turn-around for cocoa and rubber in the near future.

However, despite the benefits the Government derives from the cocoa producing villages, there was no sign of improved social infrastructures such as good roads, health facilities and pipe-borne water in nearly all the communities visited. In other words, the cocoa and rubber producing areas did not have any comparative advantage over non-export crop producing areas in terms of infrastructure.

4. VALUATION OF TRADE LIBERALIZATION

4.1 Economic valuation

Economists have long recognized the centrality of trade to economic growth and development (Emery, 1968; Kravis, 1970). It is widely acknowledged, for example, that development requires modern technological inputs often embodied in imported capital goods. However, exports, particularly agricultural exports, remain crucial to the precipitation and perpetuation of growth. In this regard, expanded agricultural exports can accelerate growth through:

i. learning effects from the development of new products, technologies and information sources;

ii. opportunities to achieve scale economies that could not be realized in Nigeria's relatively small domestic market;

iii. benefits from increased linkages between agricultural exports, industry and other sectors of the economy (Sekkat and Varondakis, 1998).

The analysis of the costs and benefits adopted in this study sought to determine if there is an alternative way of achieving a project's objectives that would offer a higher return. This has been done by comparing the costs and benefits of the 'projects' (cocoa and rubber).

Given the intensive (slaughter) tapping procedures used by many rubber farmers, the society faces a drastic loss of biodiversity as the farms become dry after 20-21 years of latex production. The incidence of slaughter tapping arose from four major precursors. These are:

1. Rental and payment of fixed commission on rubber farms. This predisposes the tenant to tap as much as can be tapped within the rental period.

2. The tree owners are old and weak. They can no longer tap the trees and so have to rely on less experienced and often carefree and careless younger people to do the job.

3. The children of the original rubber farmers are not rubber farmers in their own rights. So they do not have the same sentimental attachments to the plantations as their parents. In this case, they do not often take any precautionary measures to stop the cases of slaughter tapping.

4. The trees are old and their yields have fallen. The tenant tappers therefore do their utmost to get the highest returns from the old trees.

The actual hectarage of cocoa plantations is not known, but estimates indicate that it is presently over 600,000 hectares with about 500,000 farmers (Adegeye, 2000). However, Usman (2000), quoted the Federal Ministry of Agriculture that assesses 819,000 hectares of land were planted to cocoa in Ondo State alone. It can therefore be assumed that about 1,000,000 hectares of cocoa exists in Nigeria. In the case of rubber, Aigbodion and Akinlabi (2000) reported that 236,000 hectares of land were cultivated to rubber in Nigeria.

The total earnings (gross margin) can be estimated to be *₦ 40,890 x 1,000,000 = ₦ 40.89 billion*, which can be assumed to be the financial benefits from cocoa. Rubber contributes *₦ 2, 029 x 236,000 = ₦ 0.478 billion.* The total is *₦ 41.37 billion*. If the possible increases in output arising from improved management and environmentally suitable practices are sustainable, as is being promoted by the institutes, these returns would increase in the near future.

4.2 Environmental valuation

The environmental valuation is in terms of major areas of environmental degradation or sustainability, which is based on the production logic of the crops cocoa and rubber. They are as follows:

A. COCOA

1. The abandoned farms;
2. The incidence of blackpod disease arising from the dumping of the cocoa pod husks on the farm;
3. The economic use of the dried cocoa pod husks.

B. RUBBER

1. The cost of weeding and replanting of the slaughter tapped rubber trees;
2. The economic loss resulting from fire incidence;
3. Savings made from the non-usage of pesticides;
4. Revenue derivable from the sale of dried rubber trees as fuel wood consequential to slaughter tapping.

COCOA: These three considerations formed the basis for which the cost-benefit analyses have been carried out. They are presented in tables 4.1 to 4.3. The information utilized in deriving the values used in tables 4.1 to 4.3 is presented in the box below.

Similarly, the three periods under consideration namely pre-SAP, SAP and post SAP periods have also been analysed and are presented in table 4.4

Table 4.1 indicates that the discounted revenue that is lost by the country from abandoned cocoa farms is ₦ 212.92 million. This amount would have been generated if all available cocoa plantations were put to full production by the cocoa farmers, thus increasing agricultural trade. Available research estimates by CRIN show that the yield in abandoned farms ranges between 100 and 250kg per hectare. In this analysis, 200kg have been adopted as the average yield per hectare.

In the same vein, cocoa blackpod disease is known to reduce cocoa output of neighbouring farms by 20 per cent. Moreover, nearly all cocoa farms in the country are affected by this disease. This is because most cocoa farmers do not appreciate the major causes of the disease and some consider the yield loss arising from this disease as insignificant. Furthermore, the appropriate (un-adulterated) fungicides to treat this disease are not available at affordable prices. Table 4.2 indicates that the cocoa farmers would have generated a net revenue of ₦ 19, 825.80 million if their cocoa farm is free from the disease.

It therefore implies that the revenue loss to farmers from the incidence of blackpod disease is ₦ 3,965.16 million (20 per cent of the total net revenue). Moreover, the dried cocoa husks dumped on the farm are the inoculum source for blackpod disease. The dried husks are used as raw material for the production of the traditional "soap" highly valued for domestic purposes, for livestock feed and for organic fertilizer in Nigeria. These dried husks are largely abandoned on the farm to rot whereas they could be sold if dried properly, to generate additional revenue. Table 4.3 presents the amount that would have been generated from the sale of dried cocoa husks over the years. It shows that Nigeria had lost ₦ 4,213.08 million that could have been gained from the sale of dried cocoa husks.

DRY POD PRODUCTION

Available research estimates from CRIN show that 120 fresh pods are produced per tree. An average farm, at the present level of management in the field produces 880 trees per hectare.

Therefore, fresh pods produced per hectare = 880 x 120 = 105,600 pods/ha.

For an averagely managed farm, 450kg of dried cocoa beans are produced per hectare. However, an average farm has 880 cocoa trees. Therefore, 880 trees would produce 450kg dried cocoa beans. Hence, a tree produces 450 / 880 = 0.51kg dried cocoa beans.

In addition, according to CRIN research work, from 0.794kg of dried beans, a weight of 1kg of cocoa husks is obtainable.

Therefore, 0.51kg dried beans will produce 0.51 / 0.794 = 0.644kg dried pod husks.

That is, 0.644kg dried husks would be produced per tree.

For 880 trees (1ha), 0.644 x 880 dried husks would be produced per hectare.

A kg of dry husk is sold at ₦ 5.00.

Therefore, 566.75kg of husk, obtainable in one hectare gives ₦ 2, 833.75.

This forms the basis of the value of dried husks that could be sold, if properly dried and managed.

The husks are used for the production of traditional soap, organic fertilizer and livestock feed. The dried cocoa husks are normally purchased on site.

TABLE 4.1

Revenue from the abandonment of cocoa farms 1982-1997

Year	*Ha. of cocoa abandoned*	*Production (tonnes)*	*Prices / tonne (₦)*	*Revenue (₦'m)*	*DF 35%*	*Discounted revenue (₦'m)*
1982	12,940	2,588.00	15,000	38.82	0.7407	28.76
1983	27,434	5,486.80	15,000	83.30	0.5887	48.45
1984	16,496	3,299.20	15,000	49.49	0.4064	20.11
1985	18,806	37,761.20	20,000	75.22	0.3011	22.65
1986	17,807	3,561.40	30,000	106.84	0.2230	23.83
9187	0.868	173.60	40,000	95.61	0.1652	15.80
1988	11,951	2,390.20	50,000	119.51	0.1224	14.63
1989	6,083	1,216.60	60,000	73.00	0.0906	6.61
1990	6,155	1,231.00	60,000	73.86	0.0671	4.96
1991	4,421	884.20	100,000	88.42	0.0497	4.40
1992	3,386	677.20	200,000	134.44	0.0368	4.95
1993	3,243	648.60	180,000	116.75	0.0273	3.19
1994	3,373	474.60	190,000	90.17	0.0202	1.82
1995	2,856	571.20	190,000	108.53	0.0150	1.63
1996	2,900	580.00	200,000	116.00	0.0111	1.29
1997	3,000	600.00	200,000	120.00	0.0082	9.84
						212.92

NPV = ₦212.92 million

Source: Computed from data collected during Field Survey, 2000.

Note: It is assumed that the cost incurred will only be family labour (for harvesting), which has been disregarded given its relative insignificance.

TABLE 4.2

Discounted revenue from cocoa production without the attack of blackpod disease

Year	*Ha. of cocoa ('000)*	*National production (tonnes/ha)*	*Potential output* (x 1.2) tonnes*	*Prices / tonne*	*Revenue N'm*	*DF 35%*	*Discounted revenue N'm*	*Cost/ha** (N)*	*Cost of production*	*Cost/ha** (N)*
1981	560	252,000	302,400	15,000	4536.00	0.7407	3,359.82	6,745	3.78	2.80
1982	552	248,400	298,080	15,000	4471.20	0.5887	2,632.20	7,104	3.92	2.30
1983	526	236,700	284,040	15,000	4260.60	0.4064	1,731.51	7,312	3.85	1.56
1984	510	229,500	275,400	15,000	4131.00	0.3011	1,243.84	7,567	3.86	1.16
1985	493	221,850	226,220	20,000	4524.40	0.2230	1,008.94	7,858	3.87	0.86
1986	476	214,200	257,040	30,000	7711.20	0.1652	1,273.89	7,877	3.74	0.62
9187	476	214,200	257,040	40,000	10281.60	0.1224	1,258.46	9,997	4.75	0.58
1988	466	209,700	251,640	50,000	12582.00	0.0906	1,139.93	10,957	5.01	0.45
1989	462	207,900	249,480	60,000	14968.80	0.0671	1,004.41	11,425	5.27	0.35
1990	457	205,650	246,780	60,000	14806.80	0.0497	735.90	12,065	5.51	0.27
1991	454	204,300	245,160	100000	24516.00	0.0368	902.19	12,884	5.85	0.22
1992	452	230,400	244,080	20,000	48816.00	0.0273	1,205.76	14,002	6.33	0.17
1993	450	202,500	243,000	180000	43740.00	0.0202	883.55	14,638	6.59	0.13
1994	448	201,600	241,920	19,000	45964.80	0.0150	689.47	18,699	6.38	0.13
1995	47	201,150	241,380	19,000	4586.22	0.0111	50.91	18,893	0,89	0.01
1996	446	200,700	240,840	200000	48168.00	0.082	394.98	20,142	8.98	0.74
1997	445	200,250	240,300	22,000	52866.00	0.0061	322.48	21,403	9.52	0.06
							19,838.34			12.43

NPV = N 19,838.34 million

Source: Computed from data collected during Field Survey, 2000.

Note: * An optimum index of 1.2 has been used to give the potential yield (production) if the appropriate technological practices had been followed.

** Costs arising from the potential use of fertilizer, insecticides and fungicides as recommended, had been added to the usual farmers cost of production.

20% of the NPV is the discounted loss in revenue arising from blackpod disease.

TABLE 4.3

Amount that would have been generated from the sale of dried cocoa husks

Year	*Total hectarage of cocoa ('000 ha)*	*Quantity of dried husks Tonnes*	*Expected revenue from dry husks (N'm)*	*DISC factor 35%*	*DISC revenue (₦'m)*
1981	560	317,380.00	1,586.90	0.7407	1,175.42
1982	522	295,843.50	1,479.20	0.5887	870.81
1983	526	298,110.50	1,490.55	0.4064	605.76
1984	510	289,042.50	1,445.21	0.3011	435.15
1985	493	279,407.75	1,397.04	0.2230	311.54
1986	476	269,773.00	1,348.87	0.1652	222.83
1987	476	267,773.00	1,348.87	0.1224	165.10
1988	466	264,105.50	1,320.53	0.0906	119.64
1989	462	261,838.50	1,309.19	0.0671	87.85
1990	457	259,004.75	1,295.02	0.0497	64.36
1991	454	257,304.50	1,286.52	0.0368	47.34
1992	452	256,171.00	1,280.86	0.0237	30.36
1993	450	255,037.50	1,275.19	0.0202	25.76
1994	448	253,904.00	1,269.52	0.0150	19.04
1995	447	253,337.25	1,266.69	0.0111	14.06
1996	446	252,770.50	1,263.85	0.0082	10.36
1997	445	252,203.75	1,261.02	0.0061	7.69
					4,213.08

Source: Computed from data collected during Field Survey, 2000.

Revenue lost (present value) from the wastage of dry cocoa husks = N 4,213. 08 million. The labour cost for drying the husks is insignificant as they could be dried side by side with the cocoa beans.

Table 4.4 indicates the revenue generated from cocoa production under different management practices. In the pre-SAP era, the net revenue generated from the production of cocoa under local management was ₦ 5,976.60 per hectare relative to the SAP era which was much higher (₦ 43, 346.00). This decreased again to ₦ 40, 890.80 per hectare after SAP. The same trend follows for abandoned cocoa farms and cocoa farms without blackpod disease attacks. Generally, the production of cocoa without blackpod disease has the highest derivable net revenue relative to other management practices. The amount generated from the sale of dried husks (₦ 1,305.00) signifies the additional revenue that would have been generated if cocoa farmers dried and sold the husks.

TABLE 4.4

Revenue generated (per ha) for cocoa under different management practices

Parameters	*1985/86 (Pre-SAP)*			*1992/93 (SAP)*			*1999/2000 (Post SAP)*		
	Gross revenue	*Total variable cost (₦)*	*Net revenue (₦)*	*Gross revenue (₦)*	*Total variable cost (₦)*	*Net revenue (₦)*	*Gross revenue (₦)*	*Total variable cost (₦)*	*Net revenue (₦)*
Cocoa production (under local management practice)	4,874.00m (10,060.00)	1,978.00m (4083.00)	2,895.00m (5976.60)	23,222.0m (51,495)	3,675.4m (8,149,4)	19,549.04m (43,346.0)	25,623m (52,886)	5,812m (11,995.0)	19,811.40m (40,890.80)
Cocoa production (abandoned farms)	24,895.60m (3,140.83)	6,472,80m (816.60)	18,422.8m (2,324.2)	190,040m (20,228)	31,673.4m (3,371.3)	158,366.6m (16,856.8)	* (19,082)	* (3.180.40)	* (15,901.98)
Cocoa without the attack of blackpod disease	6,117.80m (12,240.92)	3,811.95m (7,867.80)	2,305.81m (4759.20)	46,278.0m (51,306)	12,916.6m (14,320)	33,361.36m (36,986)	109.608b (109,608)	39,413b (39,413)	70.195b (70,195)
Amount generated from the sale of dry husks.	665.22m (1,373)	–	665,22m (1,373)	576.38m (1,278)	–	576.38m (1,278)	* (1,305)	*	* (1,305)

Source: Field survey, 2000.

Note: Figures in parenthesis are those for one hectare.

* Total hectarage not available.

RUBBER: The environmental costs and benefits of rubber production are presented in tables 4.5 to 4.8.

Costs

Table 4.5 shows the environmental cost arising from slaughter tapping (responsible for the destruction of rubber plantations) as evident from the cost incurred from the replanting of rubber plantation. The table indicates that an average of ₦ 5,314.00 and ₦15,038.73 would have been spent during the pre-SAP and SAP (1985-1986 and 1992-1993) periods respectively; while ₦ 33,260.00 per hectare would be spent to establish a new rubber plantation to replace that lost due to slaughter tapping.

TABLE 4.5

Cost for the re-establishment of a rubber plantation (per hectare)

Items	*1999/2000 Value (₦)*	*1992/93 Value (₦)*	*1985/86 Value (₦)*
1. Cost of bulldozing bulldozing (clearing of trees) tr	10,000.00	5,000.00	1,200.00
2. Stumping of fell trees	8,000.00	4,000.00	2,000.00
3. Ploughing of land	3,000.00	1,600.00	250.00
4. Cost of seedling and establishment	6,000.00	3,600.00	1,200.00
5. Fertilization	5,300.00	465.73	393.00
6. Pesticides use	960.00	373.00	271.00
TOTAL	**33,260.00**	**15,038.73**	**5,314.00**

Source: Field Survey, 2000/2001.
The cost of the re-establishment of a rubber plantation that can be incurred by the nation based on the two regimes is also presented in table 4.6.

TABLE 4.6

Cost incurred from the re-establishment of rubber plantation as a result of slaughter tapping according to the different regimes

	Cost incurred from the re-establishment of rubber plantation (₦'million)
1992/93	56.52
1999/2000	140.96

Source: Field survey, 2000.

It should be stated that the incidence of slaughter tapping was almost non-existent in 1985-1986. The table (4.6) shows that the cost that can be incurred for the re-establishment of a rubber plantation is nominally higher for the post SAP period. This is because the rate of abandonment of rubber plantations was higher during this time, given the low price per unit of rubber and the high cost of agrochemicals. The cost of the re-establishment of rubber plantations is taken to be the same with the cost arising from slaughter tapping.

Benefits

With respect to environmental benefit, the revenue derived from the sale of dead rubber trees obtained from cleared, slaughter tapped rubber farms was used as a proxy. The amount therefore generated from the sale of the dead rubber trees per hectare of rubber plantation is ₦16,000.00 as explained in the box below.

SALE OF DRIED RUBBER TREES PRODUCED AS A RESULT OF SLAUGHTER TAPPING (PER HECTARE)

The estimated number of rubber trees at optimum population is 1,200.

At 30 dried trees per pick-up load, this gives 40 loads of pick-up per hectare.

A load of fuel wood per pick-up vehicle is sold at ₦ 400.00.

Therefore, estimated revenue for the sale of dried rubber trees as fuel wood is ₦ 16,000.00 per hectare.

If only 40 per cent of the total hectarage was on the average slaughter tapped during and after the SAP periods, the table below shows the revenue derivable from the sale of fuel wood.

TABLE 4.7

Revenue derived from sale of rubber fuel wood by regime

Regime	*40% of Total hectarage*	*Revenue (₦'million)*
1992/93	3,758	60.12
1999/2000	4,238	67.80

Source: Field survey, 2000.

The highest revenue derivable from the sale of dried rubber trees was recorded for the post SAP period.

TABLE 4.8

Revenue derivable from rubber slaughter tapping in Nigeria by regime

Regime	*40% of Total hectarage*	*Revenue (₦'million)*	*Increase from slaughter tapping (₦' million)*
1992/93	3,758	77.39	19.35
1999/2000	4,238	8.6	2.15

Source: Field survey, 2000.

The economic benefit derivable from slaughter tapping of rubber plantations as indicated in Table 4.8 is higher during the SAP period (₦ 19.35 million) mainly because of the lower rubber price after SAP.

General outlook on the environmental costs and benefits for rubber and cocoa in Nigeria

The overall environmental costs and benefits derived from the production of cocoa and rubber are presented in Table 4.9 below. The table indicates that ₦ 20.0385 billion was obtained as an environmental benefit to the production of cocoa in Nigeria, while the environmental cost was ₦ 8.1788 billion. This gives a total net environmental benefit of ₦ 11.86 billion to Nigeria. This implies that cocoa production over the years has imposed some environmental benefits to the country.

In the case of rubber, the environmental benefit obtained from the sales of fuel wood and slaughter tapping between 1985 and 2000 totalled ₦ 71.84 million. On the other hand, the environmental cost for the re-establishment of destroyed rubber plantation was ₦ 141.76 million. This indicates that the environmental cost from rubber cultivation is higher than the environmental benefit to the tune of ₦ 69.92 million.

If the issue of possible fire incidence arising from the exposure of dried rubber trees could be estimated, the net environmental cost would have been higher. This possibility was difficult to estimate, as the cost will depend on the severity of the fire incidence.

In effect, the export crop sectors as represented by cocoa and rubber did not show net environmental cost in Nigeria during the period under investigation due largely to the production practices of cocoa farmers.

TABLE 4.9

Environmental costs and benefits derived from cocoa and rubber production in Nigeria

ENVIRONMENTAL COSTS		***ENVIRONMENTAL BENEFITS***	
COCOA:	(₦'m)		(₦'m)
1. Discounted loss in revenue arising from blackpod disease	3,965.16 m	1. Revenue from abandoned farms	212.92
2. Cost of treating blackpod disease	0.595	1. Yield arising from taking care of farms and preventing land encroachment (without blackpod disease)	19,825.58
3. Amount lost from non-use of dried husks	4,213.08		
TOTAL	**8,178.84**		**20,038.5**
NET ENVIRONMENTAL BENEFIT		**₦ 11,859.66 MILLION**	

ENVIRONMENTAL COSTS		*ENVIRONMENTAL BENEFITS*	
RUBBER:	(₦'m)		(₦'m)
1. Discounted cost of re-establishment of rubber plantation as at year 2000:		1. Revenue from slaughter tapping:	212.92
		a) SAP	N 0.46m
a. SAP	1.36m	c) post-SAP	N 2.15m
b. post SAP	140.40m	2. Sale of dried rubber trees as fuelwood:	
		a) SAP	N 1.43m
		c) post SAP	N 67.80m
TOTAL	**141.76m**	**TOTAL**	**71.84M**
NET ENVIRONMENT LOSS		**₦ 69.92 MILLION**	
NET ENVIRONMENTAL BENEFIT		**₦ 11,789.74 MILLION**	

Source: Computations from field survey, 2000.

4.3 Social valuation

This concerns social life in terms of the living standards and the psychology of the people. The damage done through the use of agrochemicals to cure the diseases they are not meant for, could deposit in the body system cancerous ailments apart from direct death, as observed in Cross River State. Out of the 22 million export crop producers, 10 per cent could be said to suffer from these ailments i.e. 2.2 million using oil palm costing ₦ 60/bottle. As they used up to half a bottle of palm oil, this works out at ₦ 30 x 2.2m = ₦ 6.6 million.

The main areas of cost implication could be the proxies of not: (i) training the people and (ii) providing community health services. The other cost is the income disparity among the villagers and the gender discrimination that the trade liberalization portends. However, given the improved status of the people, which arguably has not destabilized or inflicted costs on other villagers (more or less an optimality situation), the social costs may have been neutralized by the social benefits.

5. POLICY PACKAGE

5.1 Main impacts identified

5.1.1 Environmental impacts

The main positive impacts identified are:

(a) The cultivation of cocoa and rubber, unlike arable crop farming, has led to the prevention of erosion on farms and the formation of a good ecosystem given the canopy formation pattern and dropped leaves from the trees.

(b) The low level of soil nutrient depletion as a result of nutrient re-cycling by the roots of the crops.

The negative environmental impacts are:

(a) The destruction of biodiversity arising from expansion of farm lands.

(b) The increased incursion into marginal lands may set in degradation processes leading to decreases in soil productivity.

(c) As a sequel to low output prices, farmers have virtually abandoned their rubber trees and the canopy has broken down due to the felling of over tapped trees. It is just a matter of time before serious soil degradation starts to set in.

(d) The total petroleum hydrocarbon of the samples obtained in rubber processing factories was of high concentration and dangerous to the community.

5.1.2 Economic impacts

The positive economic impacts are:

(a) Trade liberalization had led to the improved contribution of agriculture to Nigeria's gross domestic product (GDP).

(b) Trade liberalization offers opportunities for unskilled and semi-skilled people to work on the cocoa and rubber farms as well as rubber processing factories.

(c) The rate of abandonment of old cocoa trees has reduced, thereby leading to a more productive use of natural resources.

(d) Crop farmers obtained higher incomes arising from trade liberalization which conferred higher output prices during the SAP period.

The negative economic impacts are as follows:

(a) Trade liberalization has brought about higher disparities in income among farmers in the same communities.

(b) It has led to an unsustainable use pattern of natural resources, as over tapping of rubber was engaged in, as well as the fact that marginal lands were being cultivated.

5.1.3 Social impacts

The positive social impact is:

Improvements in the standard of living of export crop farmers—some of them own luxury cars such as the Peugeot 505 and 504, and build houses with concrete and roofed with iron sheets.

The negative social impacts are:

(a) Prevalence of minor diseases such as body itching, painful sensation in the eyes, and swollen hands arising from the use of agrochemicals.

(b) Misuse of agrochemicals for the treatment of toothache and stomach-ache by farmers' households.

(c) The tree crop promotion only supports the male farmers and discriminates against women as the land tenure systems in the southern areas of Nigeria do not allow women to inherit lands and rarely can they purchase farmlands without the permission of their husbands.

5.1.4 Institutional/regulatory impacts

Trade liberalization has led to the following positive impact:

It has removed the bureaucracy in the marketing of export crops, as farmers can sell their products to any buyers.

The negative impacts are:

(a) There is no monitoring or regulatory device for buyers of exportable produce from the farmers, leading to sub-standard grading of products and reduction of the values of commodities.

(b) The buyers, in an attempt to attract the farmers gave out agrochemicals that in most cases have been adulterated and ineffective on the farm.

(c) If the prices of agrochemicals had not been relatively too high, their use would have led to serious environmental degradation arising from lack of regulatory agencies at the grassroots level, to advise on the appropriate levels and use that will be environmentally friendly.

5.2 Proposed policies to mitigate negative impacts and enhance positive impacts

The results of this study reveal that trade liberalization has not significantly polluted the environment. It must be realized that this appears to be so, simply because the response of farmers to the incentives created by the liberalization policies was more in terms of rehabilitation of existing farms, using more labour inputs, rather than large expansions of cultivated area. If the response had been accompanied by a large expansion in plantation, this action would clearly have had a negative impact on the environment. This emphasizes the need for macroeconomic policies to create in-built or greater mechanisms to ameliorate or quickly arrest unwanted effects.

The study also shows that the minimal use of agrochemicals by farmers was not only because of the escalating prices of these inputs caused by the dwindling exchange rates, but also because of farmers' reliance on age-old agronomic practices and farming system approache that tend to enhance the management of the ecosystem. Most of the agrochemicals are imported.

While it is ideal to suggest that the environment must be kept intact and undisturbed, man's survival needs will not make this possible. What should be encouraged is the prevention of permanent damage to the environment that will make natural resources unavailable to future generations. Hence, macroeconomic policy initiatives that have significant implications for natural resource utilization must incorporate strategies to curtail unintended consequences on the environment. Some of these policies are suggested as follows:

i. The Federal Ministry of Environment (FME), in collaboration with the Federal Ministry of Agriculture and Rural Development (FMARD) should be empowered to put in place a control mechanism to advise on and monitor the rate of expansion of export crop farms, giving incentives to the replanting of old trees so as to be able to dissuade farmers from unprofitable and environmentally degradable practices. In this way, an enforcement and compliance mechanism with some economic incentives and deterrent measures should be evolved to ensure optimality in the use of agrochemicals. These could include awards of prizes for environmentally friendly practices on a yearly basis.

   Moreover, it is also necessary that theCocoa Development Unit (CDU) of the various Federal and State Ministries of Agriculture and the National Tree Crop Development Agency (NTCDA) should respectively encourage cocoa and rubber farmers to continue with the local practices of partial clearing (forest thinning) such that some trees are left to protect the soil and provide shade until the transplanted seedlings are well established. The partial clearing of forestland is also advocated during the establishment of new cocoa or rubber plantations. This is expected to bring about little structural damage to the soil and the environment.

ii. There should be an effluent charge on pollutants arising from the activities of rubber processing industries and any others, to minimize or eradicate the untreated petroleum hydrocarbon generated by their factories. An appropriate charge should be evolved by the Federal Ministry of Environment indicating the minimum amounts each State Environmental Protection Agency (SEPA) should charge for each type of pollution detected. The Federal Government should empower them with the requisite legislation as well as avail them financial and technical support to enable them to effectively monitor and carry out

the required functions. These bodies should adopt and effectively implement the standard for the minimum acceptable limit of effluent discharge, as contained in FEPA's guidelines, which should vary with the type of effluents or other pollutants and the danger they portend to the environment. This is expected to gear up the manufacturing industries to develop technically superior production methods that could reduce effluent toxicity to the environment to the barest minimum.

iii. The Federal Ministry of Environment and that of Agriculture and Rural Development should intensify the standardization, control, regulation and monitoring of the importation of various agrochemicals, in spite of the liberalization policy which emphasizes less restrictive trade control measures. Imposition of tariffs on selected products would help to control undesirable imports.

iv. There is the need to further encourage research institutes especially the Cocoa Research Institute of Nigeria (CRIN), the Rubber Research Institute (RRIN) and universities to develop cocoa varieties that are resistant to some of the major diseases for which pesticides are used. Moreover, appropriate Integrated Pest Management (IPM) control methods for cocoa and rubber as currently developed by CRIN and RRIN should be further extended to farmers. This will reduce the environmental problems that may be associated with possible increases in hectarage expansion for these crops in future. Furthermore, high yielding varieties through vegetative propagation using tissue culture technology should be developed to increase productivity and income of farmers, which will limit increases of crop hectarage so that pressure on the environment will be reduced. In addition, the abandoned cocoa farms should be encouraged for rehabilitation through appropriate loans to the farmers. This will play the dual role of higher output and the elimination of the spread of diseases to neighbouring farms.

v. The Federal and State Ministries of Health should ensure the availability of more health services to the rural areas where cocoa and rubber are produced, to assist in the treatment of ailments that might result from the exposure to agrochemicals, and the need to adopt safe methods of pesticide application. Publicity and education programmes on how to use the chemicals should be mounted while the pamphlets on these should be written in English and Vernacular. The Ministry of Agriculture should offer some incentives to farmers by selling the protective clothing at reduced prices.

vi. There is also the need for the Federal Ministry of Information, the Agro-Services Corporation and the Agricultural Development Programme (ADP) in various states to revise and improve on the long-standing methods of disseminating agricultural information to farmers. This could be done using tracts and pamphlets printed in Vernacular, as well as pictorial presentations since most farmers are illiterate. In addition, the use of radio, which is more affordable and has wider coverage and accessibility to the farmers, should be fully exploited.

vii. The Federal Ministry of Agriculture and Rural Development and the various ADPs should be charged with the responsibility of complementing the efforts of the CDU and the NTCDA, by strengthening the extension outreach of ADPs

to include the dissemination of information on cocoa and rubber to the farmers, with a view to promoting agricultural growth in these areas without jeopardizing the environment.

viii. There is the need to revert to the establishment of a supervisory marketing agency that can monitor the sale and promote the production of cocoa and rubber in an environmentally friendly manner, and oversee the supply and use of only appropriate and unadulterated agrochemicals. This body should be 'quasi-government', with a substantial representation from cocoa and rubber producers' associations, researchers and the financial institutions. This body could be floated by the Cocoa Producers'Association of Nigeria (CPAN), the Cocoa Association of Nigeria (CAN), the Rubber Producers' Association of Nigeria (RPAN) and the Association of Nigerian Cocoa Exporters (ANCE), in conjunction with appropriate NGOs involved in agriculture and marketing. Their activities should be monitored by the Federal Ministries of Industries, Commerce as well as Agriculture and Rural Development.

ix. A Farm Development Advisory System (FDAS) should be evolved to advise non-producers of cocoa and rubber, on appropriate environmentally friendly and profitable enterprise combinations of new/other exportable crops. This could raise their incomes and minimize the income disparities observed between cocoa and rubber producers on the one hand, and those in the community who could not produce (e.g. females), on the other hand. The State and Federal Ministries of Agriculture and Rural Development as well as the State ADPs should be charged with these responsibilities.

x. The CRIN and the National Chambers of Commerce, Industry, Mines and Agriculture (the apex body of the organized private sector) should engage in publicizing the importance and usefulness of cocoa pod husk and encourage the full commercialization of its use by the private sector (formal and informal businesses) in livestock feeds, soap making and organic fertilizer. This can be done through the production of pamphlets, posters, jingles on the radio and television (in English and Vernaculars) as well as publications in magazines, newspapers etc.; seminars and workshops could also be periodically organized in various areas.

xi. There is the need for capacity building programmes on environmental issues, to be organized by the Federal Ministry of Environment in conjunction with the University of Agriculture, Abeokuta. This programme should target the officials of the State Environment Programme Agencies, the State Agricultural Development Programmes, the Cocoa Development Unit, the National Tree Crop Development Agency, CRIN and RRIN. This should be funded yearly by UNEP and the Federal Ministry of Environment.

xii. The Federal Ministry of Commerce and the Nigerian Export Promotion Council should put in place a zonal arrangement in export crop (cocoa, rubber, etc.) producing areas. Such an arrangement should crystallize into a non-bureaucratic Commodity Marketing Board, to educate producers and traders on factors that influence international export crop competitiveness, such as high quality products, organic farming, optimal use of inputs, profit boosting strategies and environmentally friendly production practices.

xiii. The Federal Government should set aside about 2.5 per cent of the tariffs collected on each export crop for the development of the specific crop in terms of research (e.g. disease resistant and high yielding varieties), on data generation and on training. The Federal Ministry of Agriculture, the University of Agriculture and the respective research institutes should be in charge of this funding scheme. There is the need for a more vigorous Currency Stabilization Reform to serve as incentives for farmers in terms of profitable inputs and output prices. The Central Bank of Nigeria needs to intensify its effort in this regard.

5.3 Plan of action

(i) Organization of a National Steering/Stakeholders' workshop to present the report and enlighten the public on the findings of the study.

(ii) To forward the recommendations of the workshop to the National Assembly for consideration and possible adoption.

(iii) Sensitization of policy makers on the merits of the report.

(iv) To publish the report for circulation to stakeholders and international organizations, including the International Cocoa Organization, UNDP, the WTO, etc.

(v) To organize training workshops/seminars on environmental economics to enhance the capacity building of researchers/lecturers, extension agents and leaders of Farmers Associations.

(vi) To attend various related seminars and workshops on trade, agriculture and the environment at the national and international levels.

5.4 Costs of implementing the proposed policies

The level of organization and the cost implications of the above-mentioned policies are as follows:

I. *Enforcement and compliance mechanisms by the Federal Ministries of Environment and Agriculture*

The administrative structure that will take care of the monitoring and control mechanisms, as well as incentives to farmers, will involve more recruitment and mobility of staff. To this end, at least one vehicle and three additional staff will be needed per state. Ten states are the main producers of cocoa and rubber in Nigeria. Hence, 10 vehicles and 30 graduates in relevant fields will need to be employed.

At ₦ 2.5 million per vehicle and ₦ 300,000 per annum as salary and allowances for each of the 30 graduates to be recruited, giving an initial sum of **₦ 9 million**. If ₦ 2 million is budgeted for administrative and another ₦ 2.5 million for training expenses yearly, the annual cost would be **₦ 13.5 million**. For a five-year period, the estimated cost is **₦ 25 million for capital and ₦ 67.5 million for recurrent expenditure**. The Ministries will need to provide office accommodation for these newly recruited staff.

II and III

The implementation of these policies will not cost much as they only entail commitment and the incentive of the officials carrying them out. A capacity building programme should be mounted for these officials on, among others: (a) pollution tests, (b) costing, (c) charging, (d) monitoring and evaluation methodologies. A yearly one-week training programme for three officials per state, should be sufficient. The cost will cover accommodation, honoraria for local and foreign resource persons, lecture materials, air fares and local transportation, food etc. An annual estimate of *₦15.0 million* should be enough for the training of 78 officials (i.e. 2 staff for each of the 36 states) and 6 from the Federal Ministries of Environment and Agriculture). This gives a total of **₦ 75 million** for a five-year period. This capacity building programme could be anchored at the University of Agriculture, Abeokuta.

IV. *Technology development*

The CRIN, the RRIN and the Universities of Agriculture should be encouraged, through increased research funding to develop appropriate technologies. Given the mandate of these institutions, the staff should be further exposed through training abroad, on Integrated Pest Management (IPM), etc., while the necessary research equipment and reagents should be donated by international organizations on regular basis. The exact costs of all this may be difficult to quantify given that it is a continuous process, but a minimum of *₦15 million* per year will be required. This will give a sum of **₦ 75 million** for a five-year period. This should precipitate into a Cocoa-Rubber Research Development Fund under the Federal Ministry of Agriculture.

V-VII. *Publicity and enlightenment programmes*

These are with respect to the publication of pamphlets, posters, leaflets and development of scripts for radio and television in English and Vernaculars. If for each of the cocoa and rubber sectors, 20,000 copies of posters, leaflets and pamphlets with diagrams/pictures are produced per state (10 states are involved) in appropriate combinations, at an average of ₦ 50.00 per copy, this makes a cost of ₦ 1.0 million per state, i.e. ₦ 10.0 million for the 10 states per year and **₦ 50 million** for five years. For airtime on radio and television, in each state, a weekly programme of two slots on Saturdays and Sundays could be adopted at a cost of ₦ 50,000 per week. This makes about ₦ 2.6 million per year for each state and ₦ 26.0 million for the 10 states. The total here for the five year period is thus **₦ 130 million.**

Pilot schemes should be funded for the University of Agriculture, Abeokuta, CRIN and RRIN to demonstrate the possibility and richness of IPM. The funding of this by UNEP and the Federal Ministry of Agriculture could be to the tune of about *₦10.0 million* per year for each organization (CRIN and RRIN) to cover reagents, equipment and training. This gives a total of **₦ 150 million** for the five years.

VIII. *Supervisory marketing agency*

This is a private sector initiative, which entails discussions with and training of the leaders of the various associations. The Federal Ministry of Commerce, the University of Agriculture, Abeokuta, NEPC, CRIN and RRIN should serve as focal points to organize such meetings, which could be held thrice a year in three strategic locations (three different

zones). Accommodation, materials, transportation, honoraria, food, etc., for about 50 people on each occasion, at a cost of ₦ 50,000 per capita will give an estimate of ₦ 2.5 million x 3 = ₦ 7.5 million per year. If administrative expenses, telephones, report preparation, etc. are added, the cost would be in the neighbourhood of ₦ 10 million. Meetings and discussions towards lobbying for legislation at the various State and National Assemblies may cost additional ₦ 5 million given the need for travelling and accommodation to various states. A total of *₦ 15 million* may be needed for this, making a total here of **₦ 75 million** for the five years.

IX. *Administrative restructuring and capacity building programme as contained in XI below*

X. *Popularization and commercialization of using cocoa pod husks*

In order to make the main source of environmental pollution in cocoa production market-oriented, the usefulness of cocoa pod husks should be popularized. The CRIN and UNAAB's Department of Agricultural Economics and Farm Management should champion this popularization and come up with cost effective modalities.

Pilot research work should be carried out to further quantify the levels of profitability of cocoa pod husk based livestock feed, soap and organic fertilizer and the packaging of dried husks. A combined research team from UNAAB and CRIN should do this. An initial research grant of *₦ 5 million* could be committed to this. The findings should be printed into posters, pamphlets, leaflets and in magazines and newspapers. About 20,000 copies of posters, leaflets and pamphlets in the right combinations should be produced annually in each state in English and Vernaculars to popularize the production and packaging of dried pod husks. These may cost *₦ 50* each giving a total of *₦ 10 million* for the 10 states, that is **₦ 50 million** in five years. Also, it would be necessary to have three-day meetings with the organized private sector for training and technical workshops thrice a year for about 50 delegates, on the production and packaging of dried husks as well as the making of soaps, organic fertilizer and livestock feed. For accommodation, transportation, feeding, materials, equipment and honoraria, an estimate of *₦ 100,000* per delegate per meeting could be made. This gives a total of *₦ 5 million* per state and for the year, *₦ 15 million*, and **₦ 75 million for five years.**

XI. *Capacity building programmes*

Two officials from each State Environmental Protection Agency, state ADPs, CDUs and Rubber Production Sections, and three members of staff from each of the Federal Ministry of Environment, the Federal Ministry of Agriculture, UNAAB, NTCDA, CRIN and RRIN should be trained yearly. The topics should include environmental assessment, environmental degradation, environmental laws, environmental toxicology, environmental economics and water resource valuation, etc. This could be a one-week course to be handled by three Nigerian and three foreign experts from UNEP and UNCTAD together with UNAAB and the Federal Ministry of Environment anchoring the yearly programme. For the expected 80 state officials (8 x 10 states) and 21 federal officials, as well as six trainers and three administrative staff, accommodation, transportation, food, research/training modules, honoraria, excursions (farm and site visits) etc., must also be costed for the two-week yearly course, as follows:

A. Variable costs

Items	Cost/period	For max. 105 participants
Accommodation	₦ 6,000/night	₦ 8.4 million
Transportation	₦ 10,000	₦ 1.0 million
Food	₦ 2,000/day	₦ 2.8 million
Excursions	₦ 20,000 for 2 trips	₦ 2.0 million
Venue/hall	₦ 30,000/day	₦ 0.42 million
Sub total		**₦ 14.62 million**

B. Trainers (resource persons)

Air fare for 3 foreign experts @ $2,200	=	$ 6,600
Local travels for 3 experts @ ₦ 20,000	=	₦ 60,000
Accommodation for 3 experts @ ₦ 25,000/night for 7 nights	=	₦ 525,000
Honoraria for 3 foreign experts @ $2,500 each	=	$7,500
Accommodation for 3 Nigerian experts @ ₦ 25,000/night for 7 nights	=	₦ 525,000
Transportation @ ₦ 20,000 each	=	₦ 60,000
Honoraria for 3 Nigerian Experts @ ₦ 150,000	=	₦ 450,000
$ cost	**=**	**$14,100**
₦ cost	**=**	**₦1.62million**

C. General costs

Administration and logistics	=	₦ 200,000
Equipment and materials e.g. photocopier, laptop, training aids, etc.	=	₦ 600,000
Snacks/refreshments at the opening and closing ceremonies (150 people each)	=	₦ 100,000
Documentation, training modules and report Preparation	=	₦ 80,000
Three administrative staff (accommodation, honoraria, food, transportation etc.)	=	₦ 550,000.
Miscellaneous	=	₦ 150,000
Sub total	**=**	**₦ 1.68 million**

TABLE 5.1

Summary for capacity building

	For 2 weeks	**For 1 week** 4 Trainers: 2 each of Nigerian/foreigners
A	₦14.62 million	₦8.81 million (one trip only)
B	(i) $14,100 (ii) ₦1.62 million	$9,400 ₦1.08 million
C	₦1.68 million	₦1.41 million
TOTAL	**₦17.92m + $ 14,100**	**₦11,3m + $ 9,400**

Note: For a one-week workshop, only 2 each of national and foreign experts will be invited as well as only one field trip.

For five years, the two-week workshop will cost ₦ 97.5 million.

XII. *NEPC's Zonal arrangement*

Three zones can be put in place in cocoa and rubber producing areas. Four graduates can be recruited as extension/mobilisation and environmental workers. Three vehicles will need to be provided @ ₦ 2.5 million each.

Cost implications

(a) Salaries and allowances of 12 graduates @ ₦ 300,000 = ₦ 3.6 million
(b) 3 vehicles @ ₦ 2.5 million = ₦ 7.5 million
(c) Training for the 12 workers = ₦ 1.0 million
(d) Administrative expenses and logistics ₦ 500,000 per year / zone = ₦ 1.5 million

The total for the five-year period is **₦ 26.5 million** for recurrent and **₦ 7.5 million** for capital expenditure.

For 5 years = ₦ 34 million

XIII. *Release of 2.5 per cent tariff*

Basically, this will need some pressure from within (the Ministry of Environment, the Ministry of Agriculture, UNAAB, CRIN and RRIN, etc.) up to the National Assembly, and from outside, e.g. UNEP, UNCTAD, UNDP, etc.

For the logistics, visits, meetings and travelling and accommodation to Abuja as well as to other areas the cost may be ₦ 10.0 million in the first six months, the total for 5 years is **₦ 10 million.** Monthly reports will be prepared. For the last half of the year, a sum of ₦ 1.5 million will be needed for a three-day seminar on how to boost cocoa and rubber exports in Nigeria. This seminar will be organized on yearly basis for the five years, costing **₦ 7.5 million.**

6. PROJECT EXPERIENCE: MAIN CONCLUSIONS

This study on export crop promotion in Nigeria has raised some issues regarding the sustainability of Nigerian agriculture. The 'Douglass definition' of agricultural sustainability as an ecological question should be adopted. It advocates that an agricultural system which needlessly depletes, pollutes or disrupts the ecological balance of natural systems is unsustainable, and should be replaced by one which honours the longer-term biophysical constraints of nature (Douglass, 1984). This may be viewed as a caution worthy to bear in mind, when considering the sustainable management of natural resources. But it should even go further than this, because a conventional science-based agriculture can be viewed as an assault not only on the environment, but also on rural people and rural communities.

The revelation by this study that some elements of unsustainable practices were fairly high in certain rural areas, arising from export crop promotion, with some potential adverse consequences, portrays a gloomy picture, indicating that an alternative method of production should be evolved. That the present situation has some advantages is not in doubt, but it has now brought into the fore the need to have an integrated or holistic system that should consider the physical, cultural and socio-economic dimensions of production and income enhancement of the people.

As observed in the case of rubber production in Nigeria, the slaughter tapping system encourages immediate gains without considering the future effects of the actions or the reactions of today. Sustainable management can only be harvested if the production and trade systems meet the needs of the present without compromising or sacrificing the ability of future generations to meet their own needs.

The major conclusions of this study are the following:

(a) Export crop promotion, through trade liberalization and trade-related policies, has enhanced the contribution of agriculture to the GDP of Nigeria and raised the foreign exchange earnings of the non-oil sector.

(b) The high level of output for cocoa during the SAP period was due to farm expansion and high output price rather than the use of agrochemicals. In fact, after the SAP period, farmers used little or no agrochemicals.

(c) The relatively high rubber price during the SAP period led to "slaughter" tapping, particularly after the SAP period, leading to dry rubber trees and abandonment of rubber farms.

(d) Whereas no form of erosion or soil loss was observed on cocoa and rubber farms, the over tapping (slaughter tapping) of rubber trees portends a dangerous opportunity for soil degradation and erosion given the absence of a canopy on the rubber farms.

(e) Mainly because very small quantities of agrochemicals were used by farmers during the post SAP period, in consequence to poor output prices relative to those of agrochemicals, the nitrate, phosphate and metal concentrations in water and soil samples were low. However, any improvement in the relative prices in favour of cocoa and rubber could lead to serious consequences in the use of agrochemicals by farmers if not properly guided and monitored.

(f) Export crop farmers were better off than other farmers in their communities largely due to trade liberalization.

The study has shown the weaknesses in just adopting trade liberalization without putting in place appropriate policies to guide its adoption. There is the need for a guiding and monitoring system, which would minimize the negative impacts of trade policies at the grassroots level. Such policies and programmes could be in the form of developing disease-resistant and early maturing varieties of cocoa and rubber, educating and sensitizing the farmers' associations, and developing rural infrastructures (roads, water, health centres, schools, etc.). These will improve the living standards of the rural people that produce these crops.

Areas for future study

One important area for future study that emanates from this work is the evaluation of the amount of agrochemicals that can be used by Nigerian tree crop farmers without impinging on the maintenance of the environment. This is an important task given that current levels of agrochemical use are far below the recommended rates. With greater availability of information and a more open economy, farmers may have greater assess to these chemicals in future. It is important therefore that the safe limits be determined far ahead of such situations. The strategies to ensure that such a situation would be properly managed must be thoroughly evaluated.

Also a close look at the fish and shrimp sector, the petroleum sector, as well as the forestry and wildlife sectors of Nigeria may well reveal significant environmental damages arising from world trade activities in these sectors. Hence, they are worthy of investigation for the purpose of capacity building and whatever other appropriate measures need to be put in place to minimize damage by other sectors.

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APPENDICES

APPENDIX 1

Export of major agricultural commodities (1993 - 1995)

Major agric. products	Values (in N million)	Contribution of each to total agric. export values %
Cocoa	1378.80	51.07
Rubber	612.80	22.70
Fish and shrimps	147.00	5.44
Cotton	101.60	3.76
Other products	92.70	3.43
Cocoa butter	84.60	3.13
Palm kernel	80.01	2.96
Spices: ginger,	71.20	2.64
vanilla, etc	53.10	1.97
Cashew juice	44.10	1.63
Wood products	19.80	0.73
Gum arabic	5.50	0.20
Coffee	4.50	0.17
Hides and skin	2.60	0.10
Palm oil	1.60	0.06
Pineapples	**2699.90**	**100.00**
TOTAL		

Sources: (1) CBN Annual Report and Statement of Account (various issues)
(2) CBN Research Dept. Occasional Paper
(3) FOS Trade Summary (various issues), Federal Office of Statistics, Lagos.

APPENDIX 2

Export of major agricultural commodities (1993-1998)

	Value (naira billion)						*Commodities as percentage of total non-oil exports*					
Commodities	***1993***	***1994***	***1995***	***1996****	***1997****	***1998****	***1993***	***1994***	***1995***	***1996****	***1997****	***1998****
Cocoa beans	1.7	1.8	5.4	12.1	15	20.2	34.00	33.33	26.87	60.20	35.97	38.70
Other cocoa Products	0.1	0.1	0.9	1.3	1.6	2.1	2.00	1.85	4.48	6.47	3.84	4.02
Palm oil	0.1	0.1	0.9	0.1	0.2	0.3	2.00	1.85	4.48	0.50	0.48	0.57
Other palm Oil products							0.00	0.00	0.00	0.00	0.00	0.00
Rubber	0.9	0.7	4.1	2.8	3.5	4.9	18.00	12.96	20.40	13.93	8.39	9.39
Others	2.2	2.7	8.8	3.8	21.4	24.4	44.00	50.00	43.78	18.91	51.32	46.74
	5	5.4	20.1	20.1	41.7	52.2	100	100	100	100	100	100

Source: The Economic and Statistical Review published by the National Planning Commission, Abuja, 1999.

APPENDIX 3

Annual average values of important policy variables and ratios by policy regimes

	Regime 2 *1970-73*	*Regime 3* *1974-79*	*Regime 4* *1980-85*	*Regime 5* *1986-93*	*Regime 6* *1993-97*
Cocoa output (000' tonne)	254	185.3	153.8	233.4	293.5
Rubber output (000'tonnes)	62.5	62	80.7	202.5	245
New plantings to cocoa (ha)	3173.5	12248.8	4066.7	1374.3	1046.8
New plantings to cocoa (ha)	n.a	n.a	68.5	84.8	326.7
Ratio of cocoa export to agric. export value	0.49	0.82	0.89	0.68	0.42
Ratio of rubber export to agric. export value	n.a	0.0031	0.0083	0.1	0.12
Ratio of agric. exports to non- oil exportation	0.75	0.68	0.76	0.83	0.8
Fungicide imports (tonnes)	n.a	2981.3	693.7	3110.2	1302.5
Insecticide imports (tonnes)	n.a	8772.6	14299.6	4309.5	4417.3
Fertilizer imports (tonnes)	n.a	24.8	146	27474.8	73203.1
Total cocoa area(000'ha)	732.2	768.7	528.2	461.6	446.5
Total rubber area (000'ha)	n.a	n.a	7.84	8.79	10.23
Ratio of cocoa real producer price to real world price	0.72	0.56	0.87	1.01	1.04

* The values here are presented in graphical analysis in histogram form.
Source: Computed by authors, October 2000.

APPENDIX 4

Result of T-test of difference of means of policy variables & ratios by policy regimes

	1970/73 vs 1974/79 Regime 2 vs 3		***1974/79 vs 1980/85 Regime 3 vs. 4***		***1980/85 vs 1986/93 Regime 4 vs. 5***
	t value	p>/t/	t value	p>/t/	t value
Cocoa output (000'tonnes)	3.36	0.01	2.53	0.03	–2.66
Rubber output (000'tonnes)	0.1	0.92	–0.63	0.54	–3.54
New planting to cocoa (ha)	-2.58	0.04	3.05	0.01	2.28
New plantings to rubber (ha)	n.a	n.a	n.a	n.a	–0.53
Ratio of cocoa export to agric. export	–4.77	0.001	–1.16	0.27	2.63
Ratio of rubber exports to agric. export	n.a	n.a	–0.95	0.41	–1.06
Ratio of agric. exports to non- oil exports	1.87	0.1	–0.26	0.8	–1.58
Fungicide imports (tonnes)	n.a	n.a	1.06	0.34	–0.72
Insecticide imports (tonnes)	n.a	n.a	-0.79	0.47	2.36
Fertilizer imports (tonnes)	n.a	n.a	–1.07	0.33	–0.9
Total cocoa area (000'ha)	–4.63	0.002	17.41	0	6.2
Total rubber area (000'ha)	n.a	n.a	n.a	n.a	–2.9
Ratio of non- oil exports to total	3.86	0.005	5.46	0.0003	–1.3
Ratio of real cocoa local price to real world price	1.33	0.21	–2.79	0.019	–1.23

Source: Computed by authors, October 2000.

APPENDIX 5

Figures according to policy regimes

Figure 1

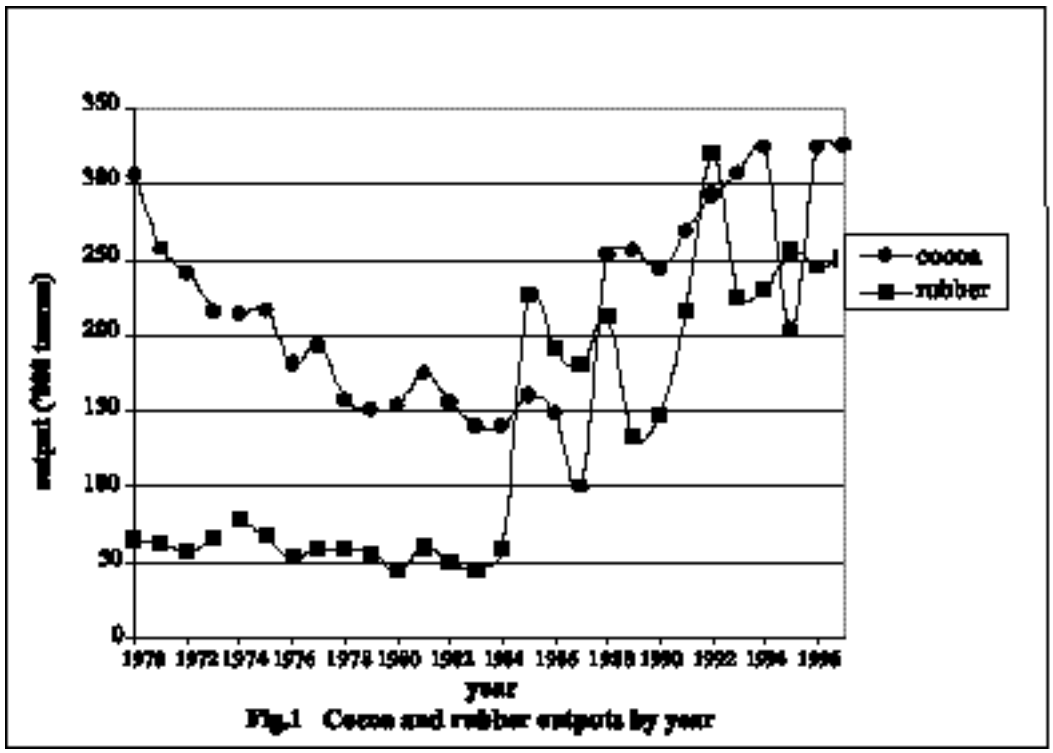

Fig.1 Cocoa and rubber outputs by year

Figure 2

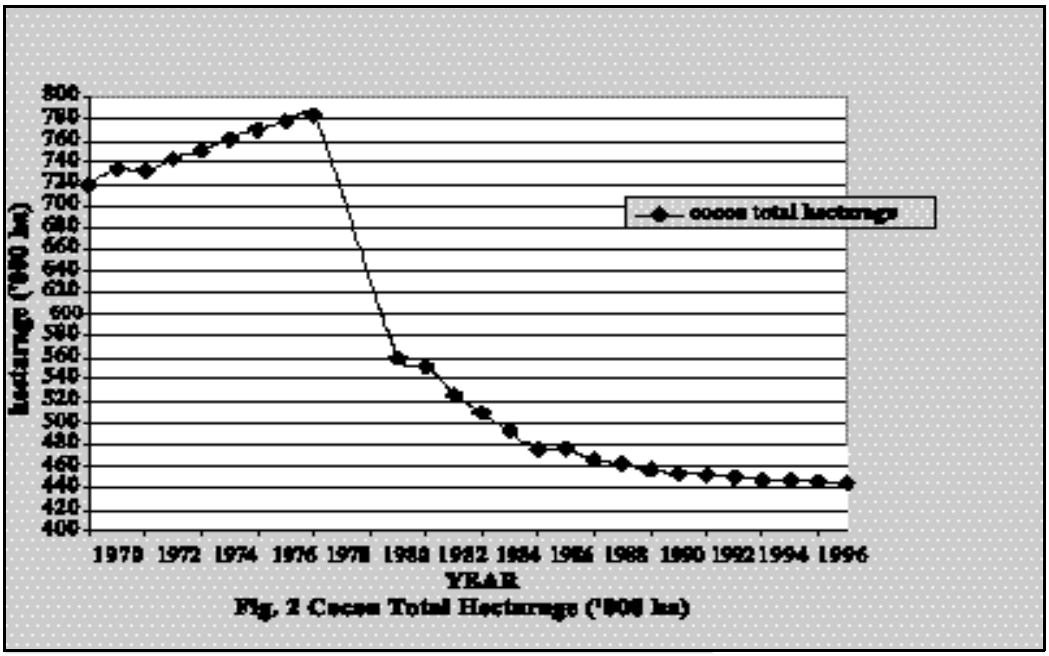

Fig. 2 Cocoa Total Hectarage ('000 ha)

Figure 3

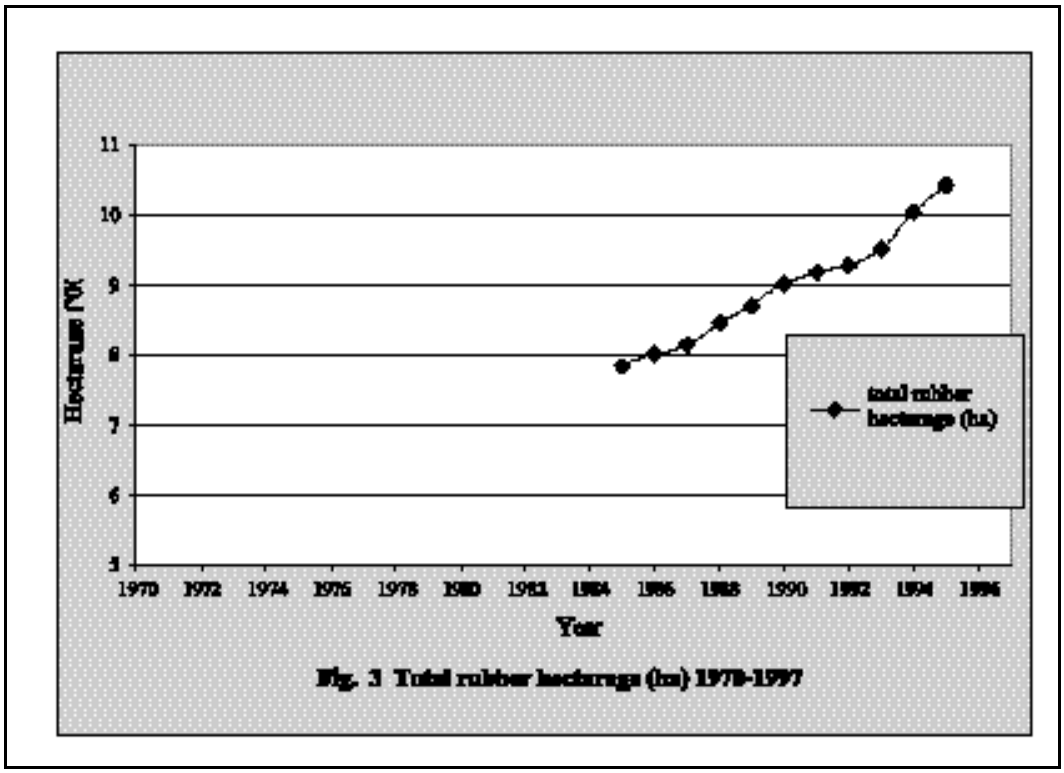

Figure 4

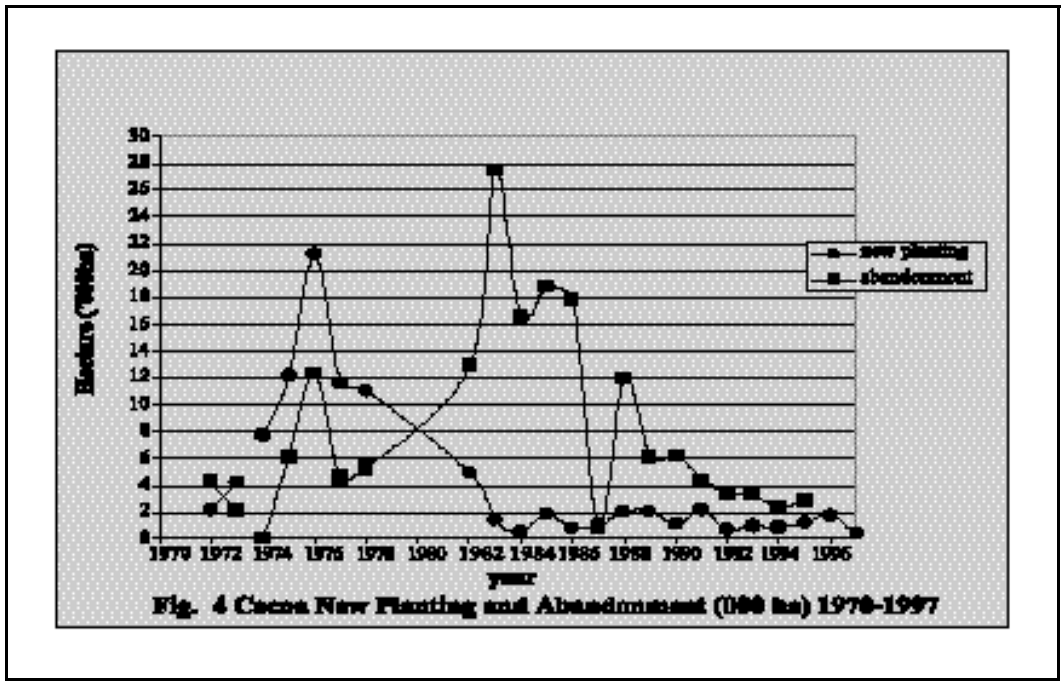

Figure 5

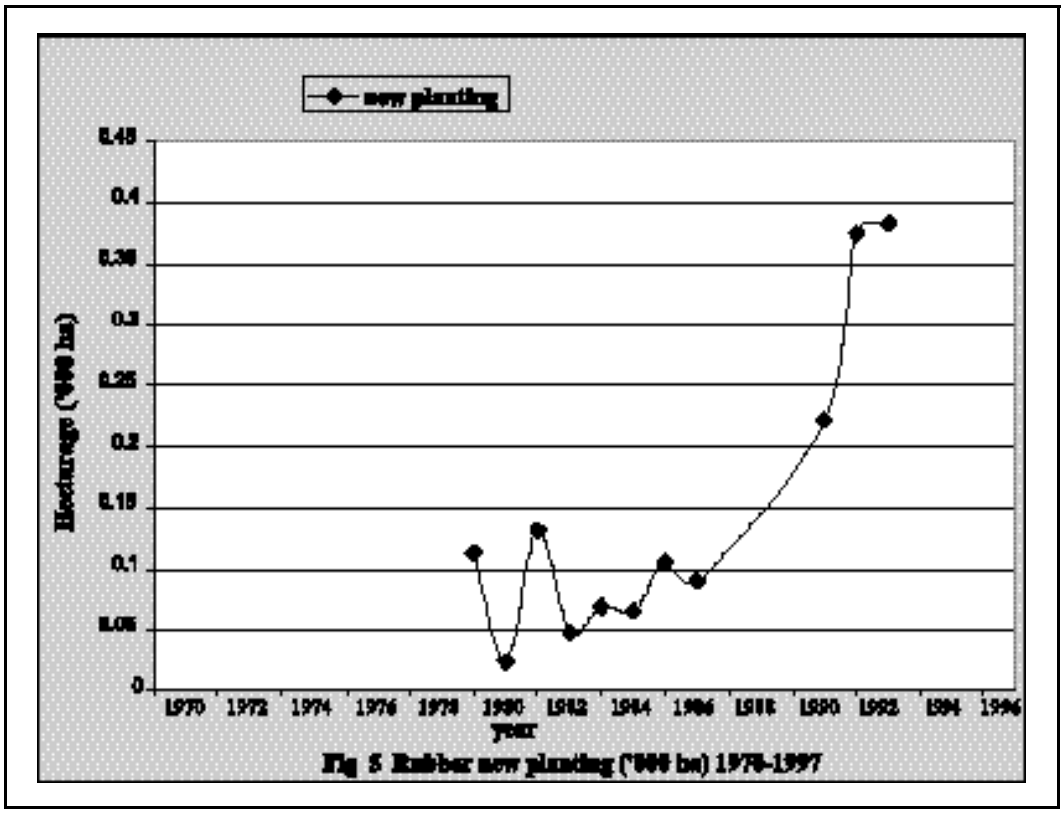

Figure 6

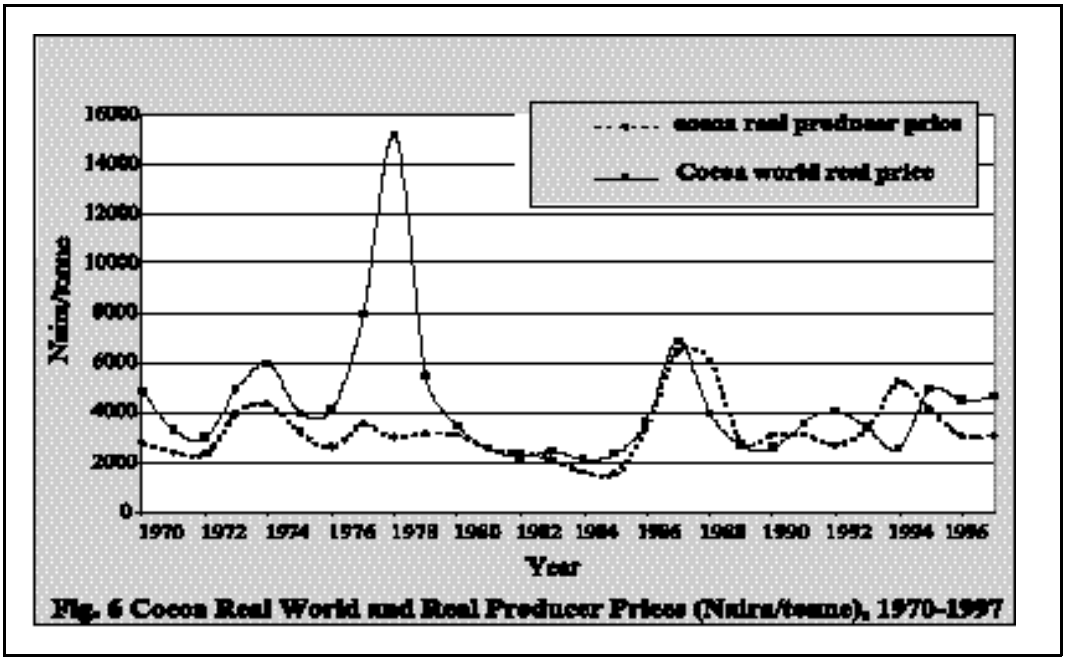

Figure 7

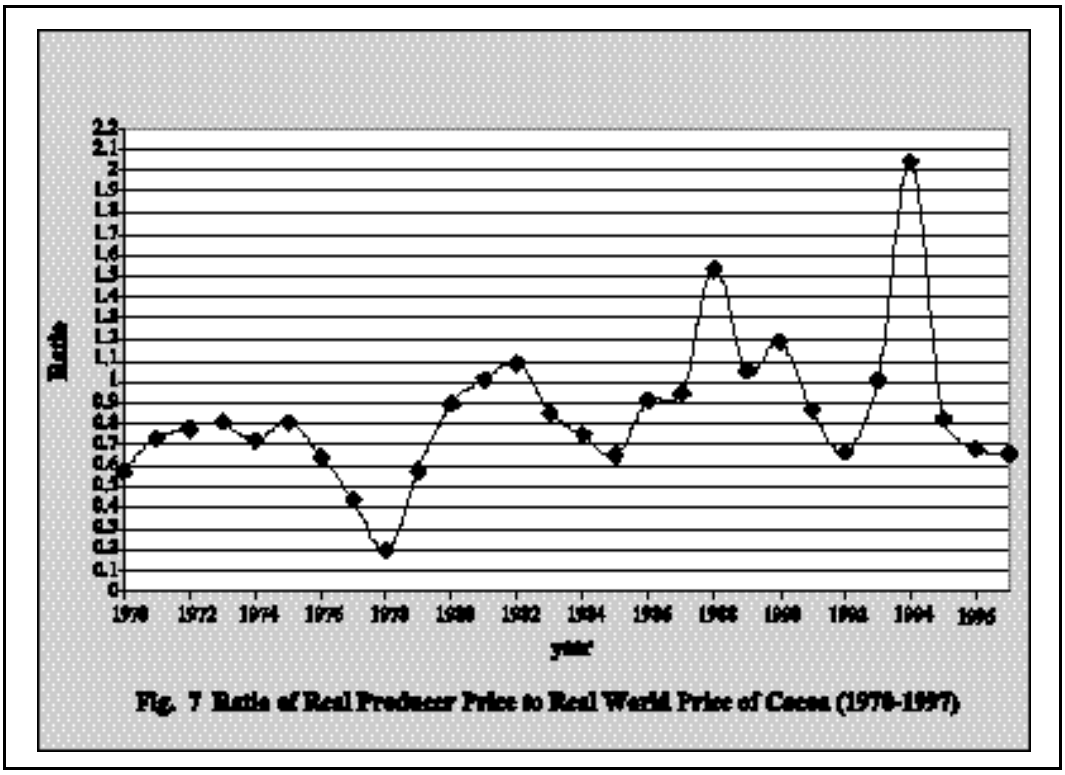

Fig. 7 Ratio of Real Producer Price to Real World Price of Cocoa (1970-1997)

Figure 8

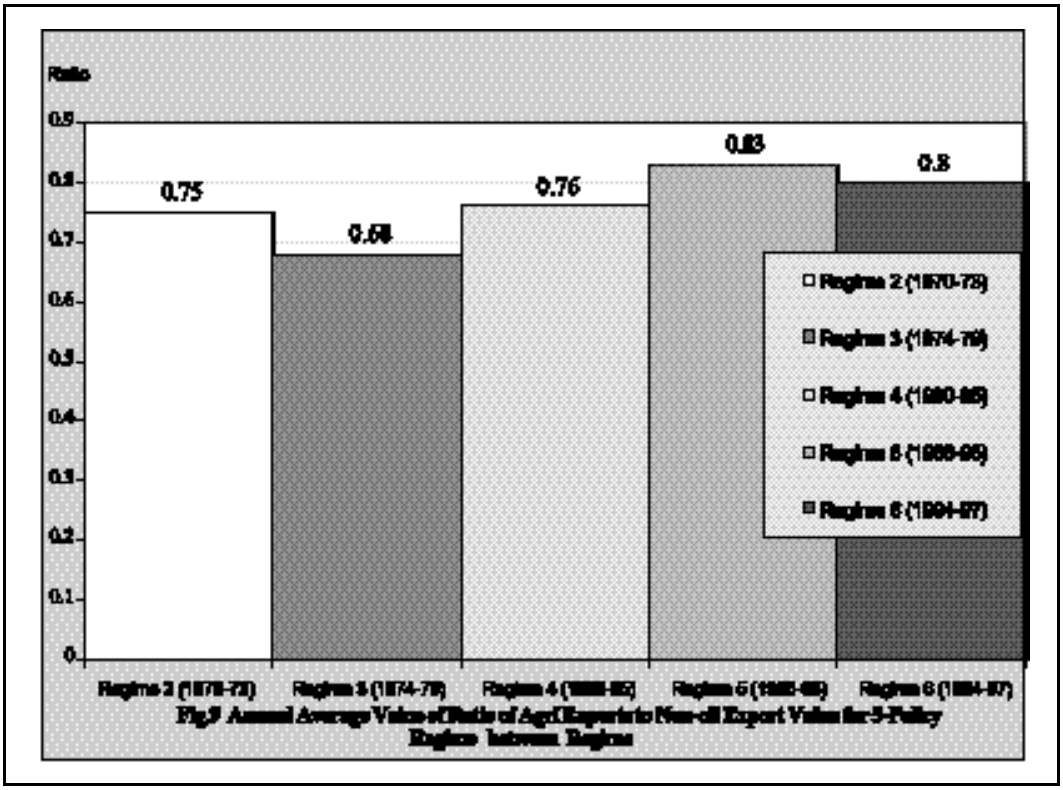

Fig.8 Annual Average Value of Ratio of Agric Exports to Non-oil Export Value for 5 Policy Regime between Regime

Figure 9

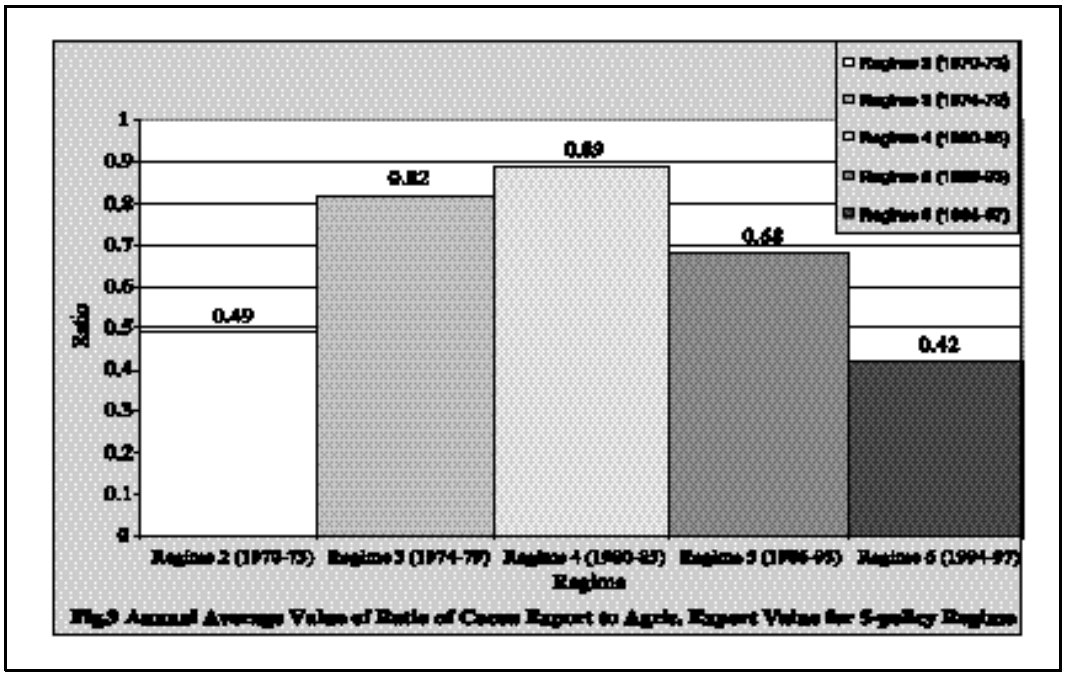

Figure 10

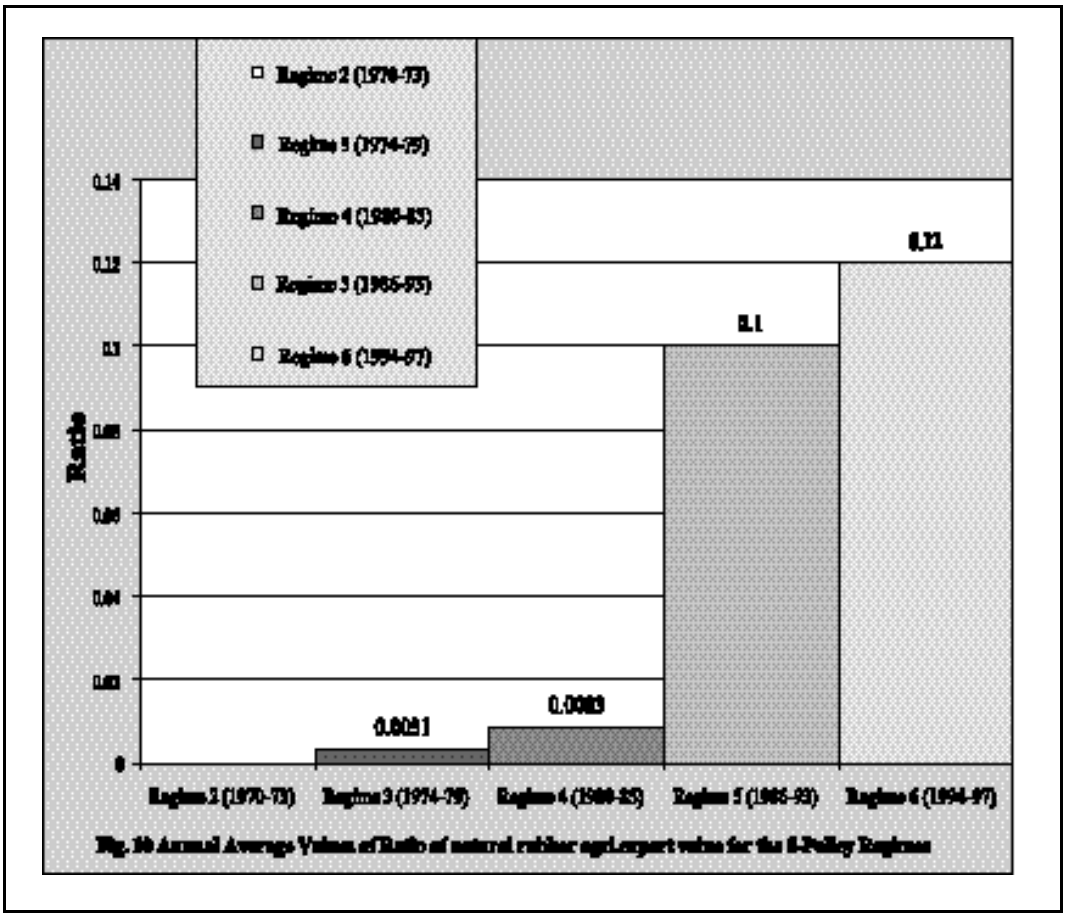

Figure 11

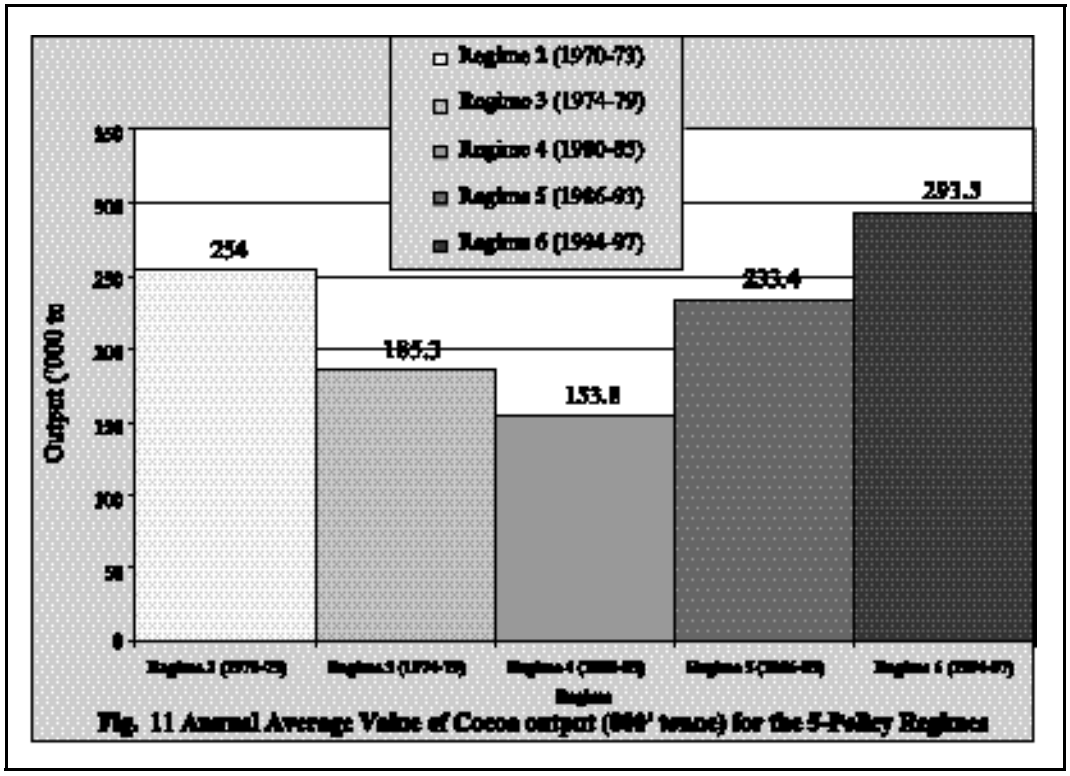

Fig. 11 Annual Average Value of Cocoa output (000' tonne) for the 5-Policy Regimes

Figure 12

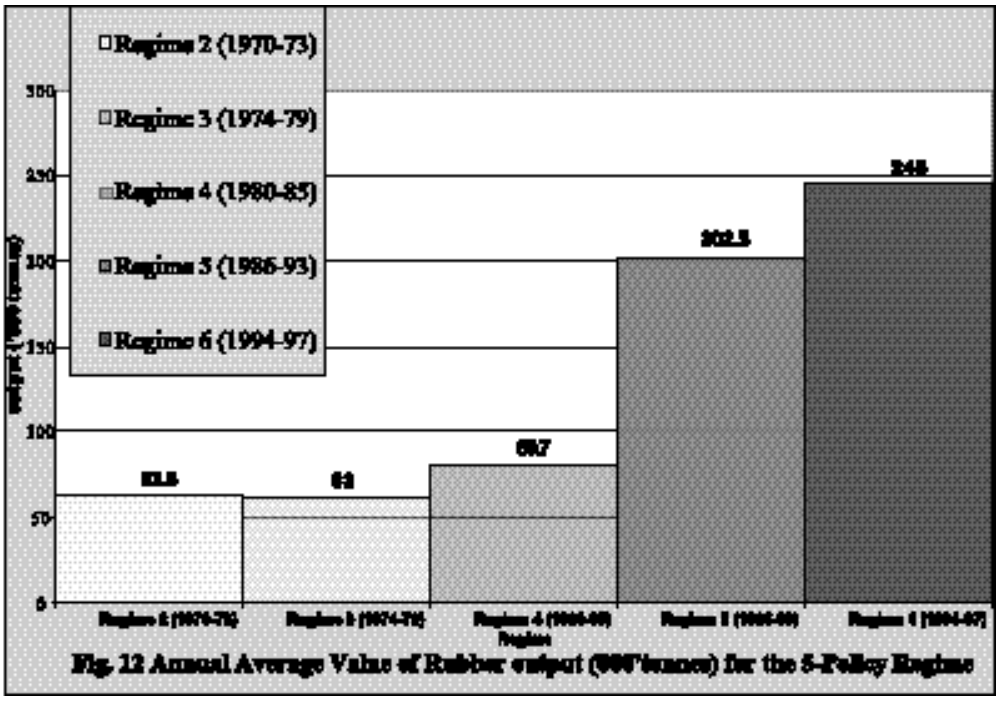

Fig. 12 Annual Average Value of Rubber output (000'tonnes) for the 5-Policy Regime

Figure 13

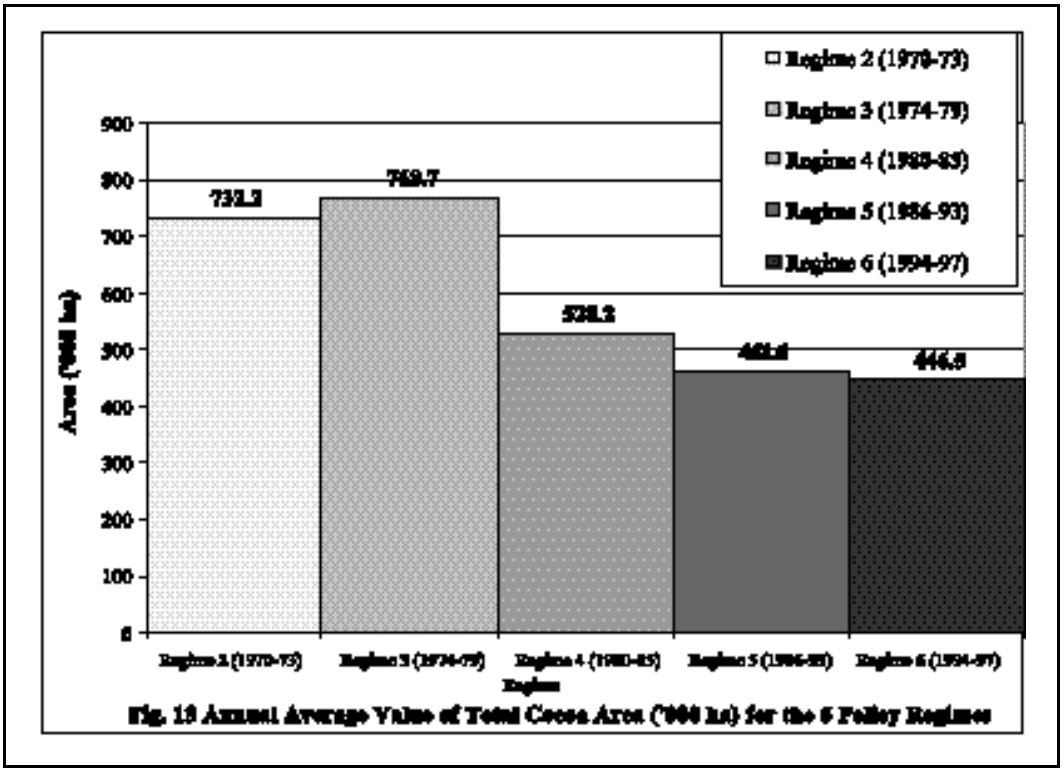

Figure 14

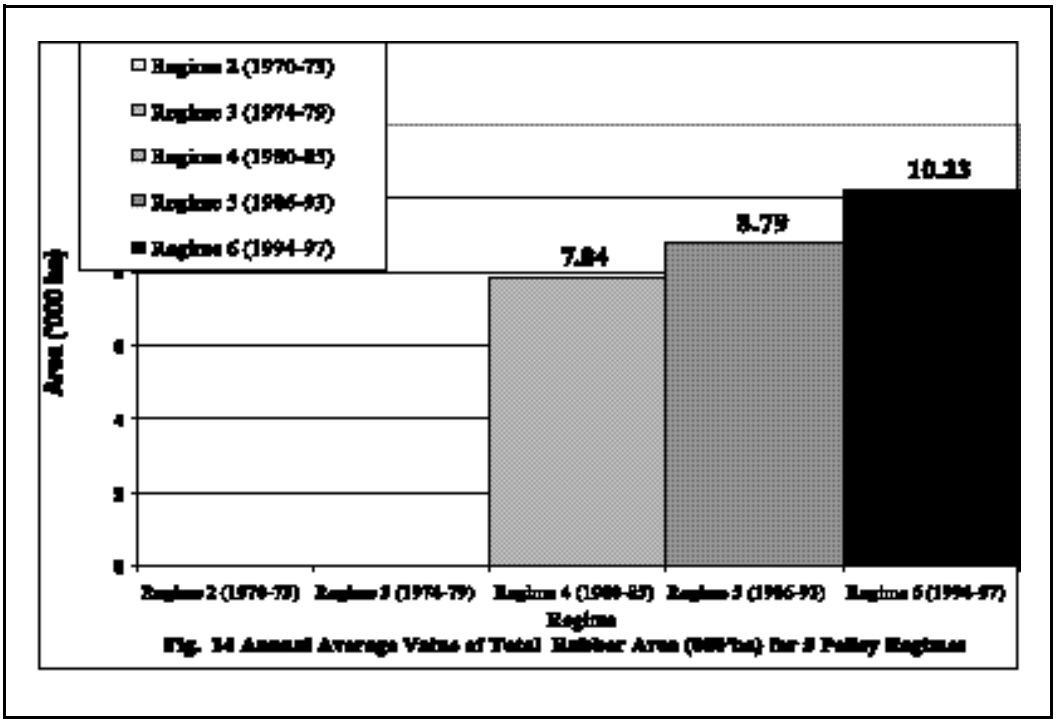

Figure 15

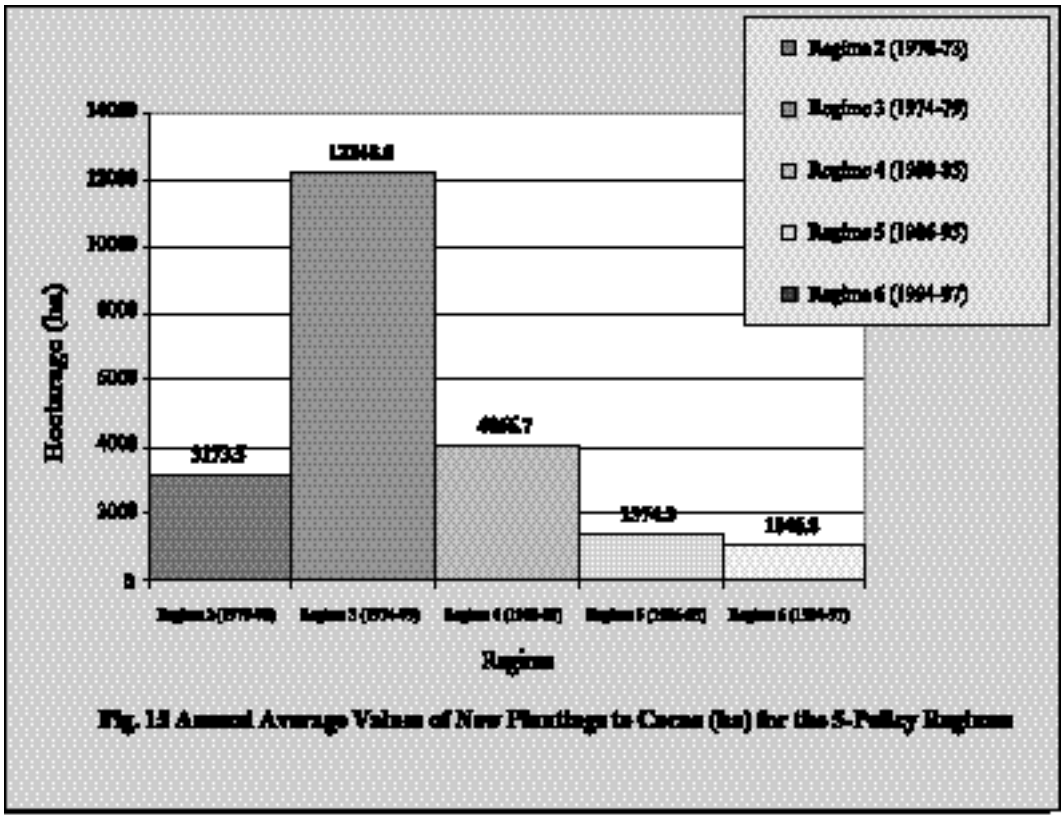

Fig. 15 Annual Average Value of New Plantings to Cocoa (ha) for the 5-Policy Regimes

Figure 16

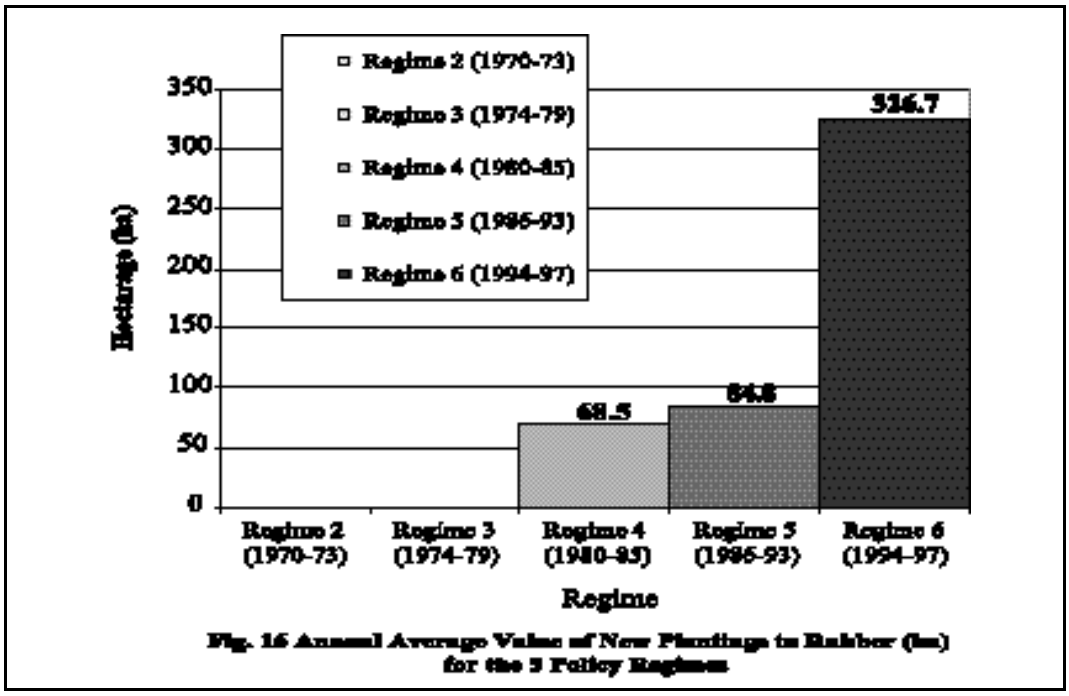

Fig. 16 Annual Average Value of New Plantings to Rubber (ha) for the 5 Policy Regimes

Figure 17

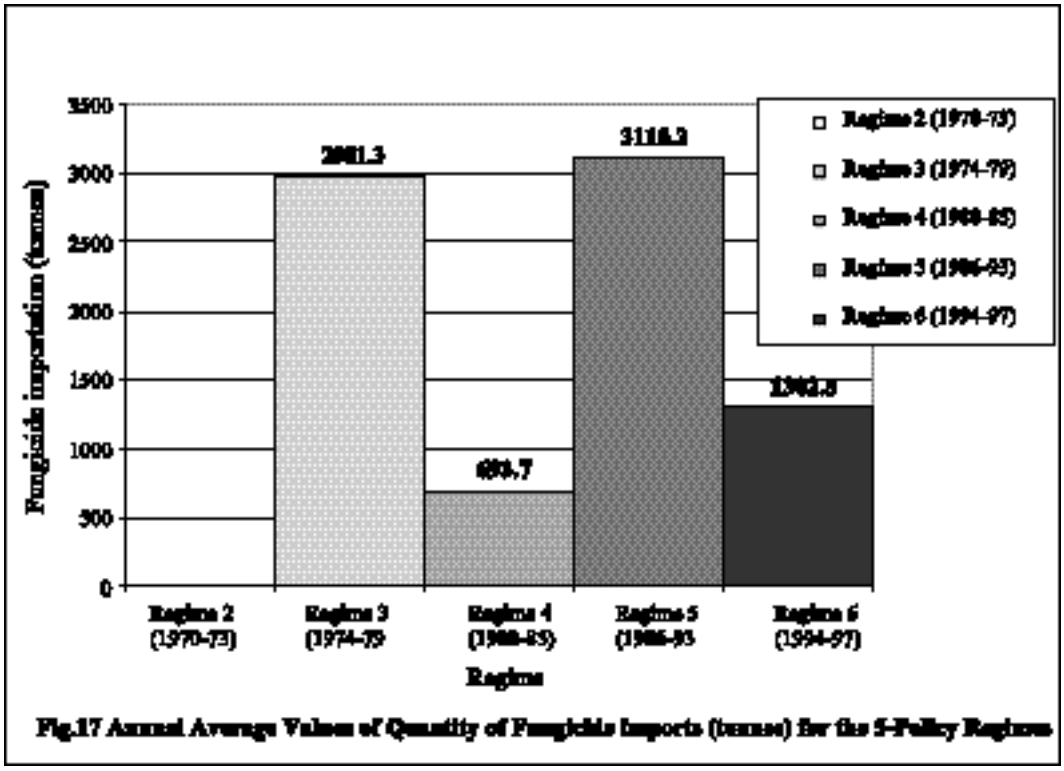

Fig.17 Annual Average Values of Quantity of Fungicide Imports (tonnes) for the 5-Policy Regimes

Figure 18

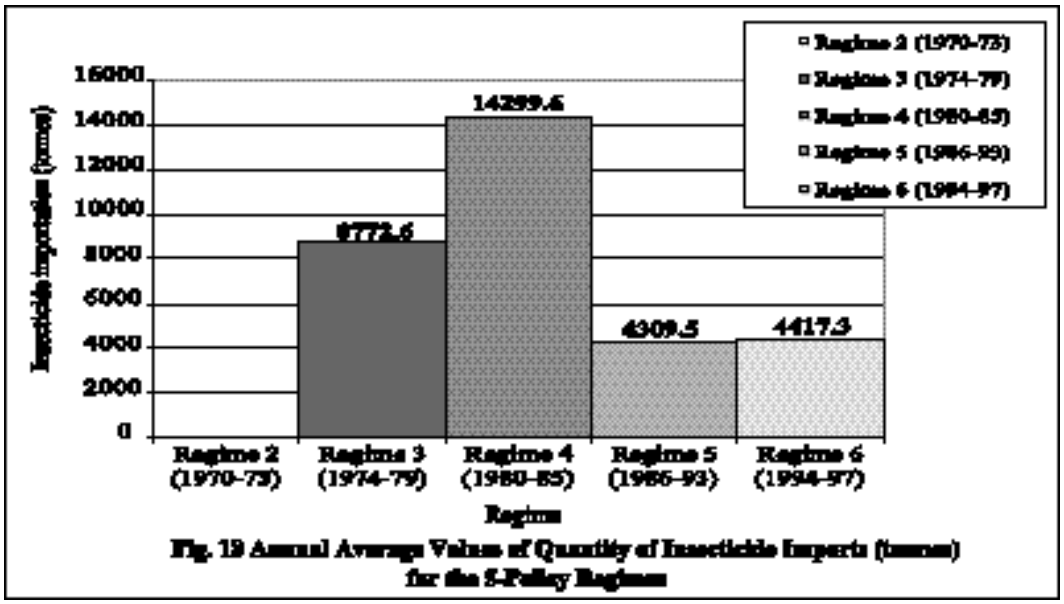

Fig. 18 Annual Average Values of Quantity of Insecticide Imports (tonnes) for the 5-Policy Regimes

Figure 19

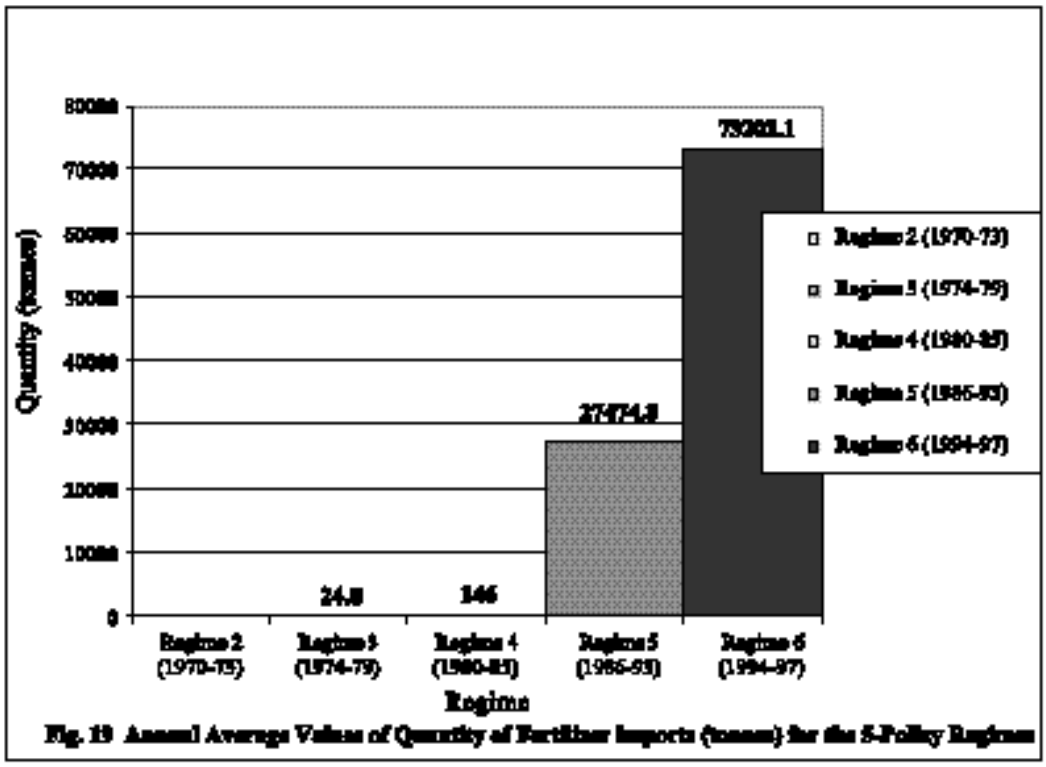

Fig. 19 Annual Average Values of Quantity of Fertiliser Imports (tonnes) for the 5-Policy Regimes

Figure 20

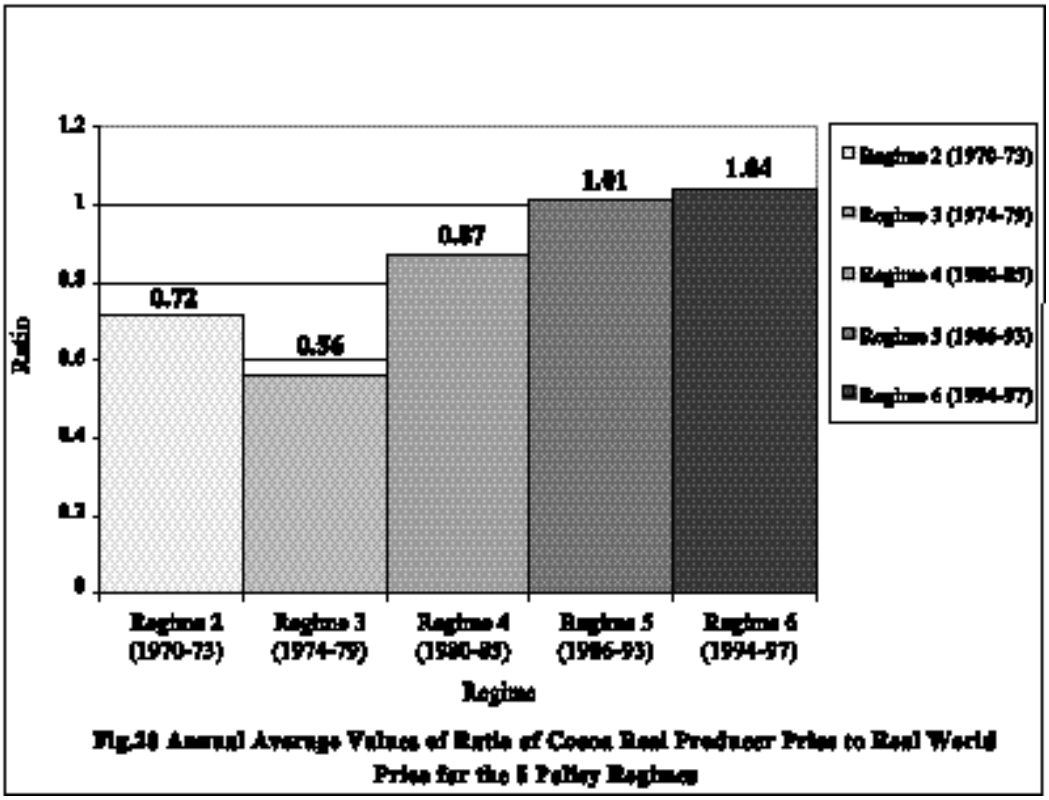

Fig.20 Annual Average Values of Ratio of Cocoa Real Producer Price to Real World Price for the 5 Policy Regimes

APPENDIX 6

List of villages covered by local government areas and states

STATE	LGA	VILLAGES/ TOWNS
OGUN	Yewa North Remo North Ogun Water Side	Igbogila Imagbon Ibiade, Iwopin, Moboluwaduro
CROSS RIVER	Etung Ikom Akpabuyo	Etomi Okangha, Mkpawi Ikot Nakanda
ONDO	Idanre Akoko South West Irele Okitipupa	Idanre Oka, Akungba, Supare Irele Ode-Aye, Igbdigo, Idepe, Okitipupa
EDO	Ikpoba Okha Owan West Uhumunede	Obarenti, Ogbekpen, Obayanto Ozalla Egba
DELTA	Ethiope West Ugheli North	Oghraefe, Ogbara Ekrehanre
ABIA	Bende Umuahia North Ikwano	Etitiulo, Bende, Isiegbu Umuahia, Umudike, Isiegbu Isiala, Okwe, Ekebedi, Ndovo Amawon Umuokwo, Ogbuebelle

APPENDIX 7

The Rapid Rural Appraisal exercise

The Rapid Rural Appraisal (RRA) as an assessment tool, is useful for gathering on-farm and hands-on information in an informal environment. Discussions were held with farmers in groups where they bared their thoughts on issues affecting their farming activities with respect to the cultivation of cocoa and rubber. The RRA was also used as a preliminary launch pad for questionnaire administration to achieve the objectives of the study.

Areas

The exercise was conducted in six states of the country namely:

(a) Abia, south-east zone

(b) Cross river State, south zone

(c) Delta and Edo

(d) Ogun and Ondo, south-west zone.

These six states are located in the southern part of Nigeria that are noted for the production of cocoa and rubber given the edaphic, biotic, abiotic factors, apart from the climatic factors.

Selection of villages

The villages in each location were selected as follows:

(1) Identification of Local Government Areas (LGAs) where these crops are grown was done first. The LGAs were categorized as:

   (a) High producing LGAs: where there is intensive cultivation of the crops under focus based on the state data presented.

   (b) Low producing LGAs: where there is lower intensive cultivation of the crops under focus relative to high producing areas.

   (c) Negligible producing LGAs: where there is very little presence of farmers cultivating the crops, if any at all.

(2) Some villages were then selected randomly within each of these LGAs for the RRA exercise. The breakdown of the villages selected is shown in Table 1.

TABLE 1

Table showing locations for the RRA exercise and crops predominantly cultivated

	State	*Crops grown*	*High producing*	*Low producing*	*Negligible producing*
1.	Ogun	Cocoa	Igbogila (Yewa South LGA)	Imagbon (Remo North LGA)	Moboluwaduro (Ogun Waterside LGA)
2.	Ondo	Cocoa	(a) Owoofewa (Idanre LGA) (Idanre LGA)	Ogunola (Akoko North/East)	Ode Aye (Okitipupa)
3.	Edo	Rubber	(a) Ologbo (b) Iyanomo (c) Paul Osa Estate (d) (Ikpoba-Okha LGA)	(a) Egba Village (b) Iyayi Estate (c) (Uhmunede LGA)	Ozalla (Owan West LGA)
4.	Delta	Rubber	(a) Pamol Estate (b) Pamol Factory (c) J.A. Thomas Estate (d) Ogharefe Community (e) (Ethiope West LGA)	Ughelli	Mbiri Farm Settlement (Ika North LGA)
5.	Abia	Cocoa & Rubber	(a) Ahaba—Oloko (b) Oro (c) Umugbalu (Ikwano LGA)	– – –	Ngbaja (Umuahia North LGA) Ihie (Umuahia North LGA)
6.	Cross River	Rubber	Etomi (Etung LGA Okangha Mkpawi (Ikom LGA)	– –	Ikot Nakanda (Akpabuyo LGA)

THE RRA TEAM

In each of the states, a state coordinator was chosen based on his wealth of experience in extension work and knowledge of the local environment. These state coordinators assisted the multidisciplinary team to execute the RRA.

The RRA team:

1. Professor P. A. Okuneye: Team Leader (Environmental Economist)
2. Professor M. T. Adetunji: (Soil Scientist)
3. Dr. A. T. Arowolo: (Environmental Chemist)
4. Dr. A. B. Aromolaran:: (Agricultural Economist)
5. Mr. K. Adebayo: (Rural Sociologist)
6. Mr. I. A. Ayinde: (Socio-Economist)

State coordinators:

1. Mr. R. A. Salawu: Director for Research, (Ogun State coordinator)
2. Mr. A. Aigbekaen: Director, Planning & Research, RRIN

3. Dr. O. Aigbodion: (Delta State coordinator)
4. Dr. N.O. Mbanabor: University of Agriculture, Umudike, (Abia State coordinator)
5. Mr. O. Adekagun: ACEO, Agric. Dev. Prog., Akure (Ondo State coordinator)
6. Mr. Kanu Edu: CPO, Agric. Dev. Prog., Calabar (Cross river State coordinator)

The Village Extension Agents (VEAs) who are based in the chosen communities and know most of the farmers also supported the above team.

FINDINGS

COCOA (*theobroma cacao*)

The high producing LGAs in the chosen states are Yewa South LGA in Ogun State, Idanre LGA in Ondo State and Ikwano LGA in Abia State. The low producing LGAs are Remo North in Ogun State and Akoko North East in Ondo State. The negligible or non-producing LGAs are Ogun Waterside, Okitipupa and Umuahia North LGAs. Farmers cultivated mainly *F3 Amazon* and the hybrid varieties. Some farmers are however skeptical of the hybrid varieties because they have problems of transplanting the seedlings. Hence most farmers re-plant their old varieties.

Use of fertilizers

Farmers said that they last used fertilizer in 1995, when it was sold for about ₦450.00 (approximately $ 4.50). It was reported that a bag of fertilizer now sells for between ₦1,600 (approximately $ 15) and ₦1,850 ($ 18). Another reason given by farmers is that fertilizer also tends to increase weed infestation. As a result, cocoa farmers do not make use of fertilizer on their cocoa farms any more.

Use of agrochemicals

The commonly used agrochemicals include *Basoin, Aldrex 40, Thionex* (insecticide). They also reported using *Gammalin 20,* used to control *blackpod* disease and *Diazinon*, used to control *dieback* disease.

However, less than 10 per cent of the farmers in Ogun State use these chemicals. One of the factors attributed to this situation is the fact that it is not profitable given the low price of cocoa relative to that of pesticides and herbicides. Farmers explained that the majority of them were spraying their cocoa farms when the price was ₦120,000 ($1140). Another reason given by some farmers is the non-effectiveness of the chemicals especially *Gamalin 20,* because adulterated forms of it is now sold in the market.

Method of application of chemicals: Farmers using chemicals apply these chemicals with the aid of knapsack sprayers. Most of them do not wear protective clothing during application of the chemicals.

Disposal of containers: Some farmers wash the empty containers of agrochemicals and use them to fetch water to drink on the farm. Others however, claimed that the containers are thrown away.

Other uses of agrochemicals: A negligible percentage of the farmers use *Gamallin 20* to control caterpillar infestation on their farm. Some of the farmers however claimed that *Gamalin 20* diluted in water can be used to cure stomach trouble, toothache and any mouth disease!

Side effects from the use of the chemicals: The farmers observed no serious human health problem associated with the use of agrochemicals. They also claimed that no illness had so far been noticed from drinking the water from streams passing through cocoa farms. Some however claimed that they suffered from itching/rashes a day or two after spraying their farms. Other minor ailments include swollen hands, watery eyes, etc.

Other environmental effects of cocoa production

Most farmers claimed that cocoa farming does not diminish the soil fertility, it rather improves the soil fertility through the rate of leaf fall and organic matter generated. Farmers also claimed that the liquid released during fermentation of cocoa beans imposes no health hazard on the farmers.

Marketing of cocoa beans

Farmers presently sell to Licensed Buying Agents (LBAs) who come to the village with scales of "doubtful measures" and buy cocoa at ridiculously low prices. Farmers wish that the Cocoa Marketing Board would be resuscitated given that it used to keep farmers abreast of world prices of cocoa. Additionally, the Board bought cocoa from farmers at reasonable prices. Apart from this, farmers also purchased unadulterated chemicals from the Board when it was still in place.

RUBBER (*hevea brasiliensis*)

Rubber is cultivated widely in the southern and eastern parts of the country. The states noted for rubber production are Edo, Delta, Cross River and Abia States. In terms of production volume, the smallest producer is Abia State.

The RRA exercise found out that a large expanse of land is cultivated for rubber in high production areas. Rubber farmers own estates ranging from 200 hectares to 1,600 hectares. There are other small units of rubber plantations of less than 5 hectares each, owned by small-hold farmers in the rubber growing areas.

Rubber production is concentrated in Ikpoba Okha, Uhumwode and Ozalla LGAs in Edo and Delta States. Rubber is mostly cultivated under plantation agriculture. Palmol Estate is the largest estate cultivating about 1,600 hectares of rubber made up of 788 hectares in Sakpoba, Edo State and 822 hectares in Oghara, Delta State. The rubber estate is virile because it is the major source of raw materials for the Palmol processing plant. There is a constant replanting programme wherein 3 per cent of the plantation is replanted each year to replace the aging trees with a productive life span of 33 years. The plantation employed about 300 staff who manned the affairs of the numerous units of the rubber plantation.

Other rubber estates

(a) Aroko Estate: which is the largest individual farmer estate in Edo and Delta States. It has a total hectarage of 200 hectares (500 acres).

(b) J. A. Thomas Estate: established in 1899, is reputed to be the first and only one in the old Western Region. It has two rubber plantations in Oghara, which has six blocks of 50 hectares each (total-300ha) and Okpakele/Mosoga Plantation, which has 12 blocks of about 50 hectares each (total - 600ha).

Forty per cent of the 25,000 (i.e. 10,000) trees in Oghara are dead while 30 per cent of the trees in Okpakele (i.e. 15,000 trees) are dead. The Oghara field was replanted in 1960/61 while the Okpakele field was replanted in 1964/65.

Rubber Factories

Palmol Factory: It is the only rubber processing factory in operation out of the 4 processing factories. However, its production level has fallen from 12,200 tonnes in 1995/97 to 50,000 in 1999. The factory had a Ribbed Smoked Sheet (RSS) machine up until 1990. The RSS machine produced a maximum of 3 tonnes of RSS per day. The RSS machine used a lot of firewood to supply smoked heat to dry rubber crumbs in 72 hours. This was later replaced by the Latex Concentrate machine and Crumb Factory machine. The Latex Concentrate machine is designed to increase the rubber content of liquid latex to 67 per cent from about 37 per cent brought from the farms. Latex is a prime product in the international market because of its flexibility in use. The plant has however been transferred to Cross river State in 1998, because the raw materials (latex) is more available there than in Edo and Delta States which has recorded over-tapped and old rubber trees.

The Crumb Factory processes: The major objective with this mechanism is the reduction of water content and increment of the rubber content in just four hours as against the RSS, which does this in 72 hours. The total installed capacity is 10 tonnes/day from 1985 to date. However, capacity utilization has fluctuated from 20 per cent (before 1986) to 97 per cent (in 1993-1997) and 60 per cent in 1999-2000. Production goes on for 16 hours per day for 365 days with the assistance of a 300–450 KVA generator as power source.

Other rubber factories

Paulosa-Ologbo Factory: This is a processing factory located in Ikpoba Okha LGA of Edo State. The factory, owned by the John Holt Company, started operation in the early 1960s. Since then, it has been re-sold twice, the last time to the present owner.

The installed capacity of the rubber crumb factory is 120 tonnes/month at an average of 10 working hours per day for 6 days in a week. The factory operated at full capacity between 1992 and 1995. Capacity utilization dropped to 45 per cent in 1995 - 1997 period. The capacity utilization further declined to 30 per cent between 1999-2000 while working days reduced to 4 days at 8 hours per day. The high cost of diesel prevented the use of the 250 KVA generator owned by the company. The company sources its raw material, from plantation owners, rubber buyers, finished rubber traders and farmers.

The factory experienced the adulteration of rubber lumps with stones, sand, iron materials, tree barks etc., to increase the weight of the rubber lump. The factory advocated for the re-introduction of the Rubber Board with monitored rubber coagulants and ensured standards.

J. A. Thomas Rubber Factory: The factory has two plants. The first is the RSS machine and the second is the crumb processing machine. Both plants are presently idle subject to the improvement in raw material supply and improvement in the company's financial situation.

Characteristics of rubber farmers

Male farmers are the dominant operators of the rubber farm. They practice 'sold cropping' techniques for rubber in the state. The other cash crop produced by the rubber farmers is palm oil.

Age of rubber farms

The age of the rubber plantations range from 30 years to 50 years. The average age of a rubber plantation based on the RRA is 33 years. Most of the rubber farms have not been replanted since they were established.

Use of fertilizers

Fertilizer use is uncommon. The reasons adduced for this are the high cost of fertilizer and the progressive reduction of the price of rubber.

Use of chemicals

None of the rubber farmers use chemicals on their rubber plantation. Some farmers make use of *Agrisol* to treat root knot disease in rubber. The use of *Agrisol* was prevalent before 1992.

Marketing arrangements

Most rubber sales have been to private processing companies in the form of rubber coagulants. The price decreased from ₦ 50/kg (N50,000 ($416) per tonne) in 1997 to ₦ 22/kg (₦ 22,000 ($183) per tonne) in 2000.

Problems

The decreasing price of rubber has forced many rubber farmers to abandon their rubber plantations. The sales boom of 1995 to 1997 resulted in "slaughter tapping" of existing rubber plantations wherein many rubber trees were killed as a result. In slaughter tapping, a tree would carry up to 4 tapping cups instead of one at a time. These, coupled with the fact that young ones who are energetic and can tend the rubber plantations are fleeing the villages, because the original owner of the rubber farmers in the state are selling off their trees for firewood because of the scarcity of kerosene. A truckload containing 30 felled trees cost ₦ 400.00. Fire has also ravaged rubber plantations lately because the undergrowth which is left uncared for, easily ignites during the dry season. Farmers are therefore gradually shifting to palm oil and cocoa production.

CONCLUSION

The RRA has provided a preliminary insight into the nature of the production of cocoa and rubber in the various locations chosen for the study. The use of agrochemicals and fertilizers for the two enterprises was very low, partly because of the high prices and the inability of farmers to purchase them.

Moreover, the level of rubber coagulant production is falling gradually over the years and the cutting of rubber trees for fuel is a dangerous signal to the future of rubber production in Nigeria in the years to come. Preliminary observations have shown that the cultivation of these crops imposes no visible environmental problem in the study area. Most of the side effects resulting from the use of agrochemicals were noted a few years ago when unadulterated chemicals were available for the use of the farmers. However, water and soil sample analysis are expected to provide more insight into this. Also, the result of the questionnaire survey is expected to throw more light into these preliminary findings and will at least compliment the findings of the RRA.

In general, most of the farmers seem to like the idea of re-introducing the Commodity Board, in a similar or modified form to cater to their needs and by-pass the exploitative tendencies of the Licensed Buying Agents. This, they expect, would generate more profit to the farmers in future, apart from providing the advisory roles needed to guide the predominately illiterate tree crop producers.

APPENDIX 8

Development of in-country methodology

Overview of methodology selection

The nature of this study could benefit from a wide range of methodologies, but funds, data and time are major constraints. The various methodologies considered for possible adoption which are quite relevant for integrated assessment of trade-related policies are briefly discussed as follows:

(a) Regression analysis

The study estimated 2 models using the ordinary least square estimation procedure.

Model 1: Output Response Model.

The study estimated a cocoa output response model for 3 periods namely 1985/86 (pre-SAP) 1992/93 (SAP) 1999/2000 (post-SAP).

The main objective of this estimation was to find out –

i) Whether prices received by cocoa farmers in period t-1 had any significant effect on output in period t, and to estimate the magnitude of this response and to compare over three distinct policy periods.

ii) Whether cocoa output responded to the level of pesticide use; to estimate the magnitude of this response; and to compare over three distinct policy periods.

The estimated model is specified as –

$$\mathbf{InCcoutp_t = bo + b1\ In\ Ccnmpr_{t-1} + b2\ lnCcfmsz_t + b3\ lnCcaget_t + lnCcpst_t + e_t}$$

Where:

$InCcoutp_t$ = natural log of cocoa output in tonnes.
$Ccnmpr_{t-1}$ = nominal price of cocoa in period t-1 (N tonne).
$Ccfmsz_t$ = cocoa farm size in period t (hectares)
$Ccage_t$ = Average Age cocoa trees (years)
$lnCcpst_t$ = Natural log of the amount of pesticides used in (litres)
t = 1 for 1985/86 period; 2 for 1992/93 period and 3 for 1999/2000 period.

Cross-sectional data generated from the field survey for each of the model variables for each of the three periods (t 1, 2, and 3) were used in the estimation. The number of observations was 39.

The model was aimed at testing these simple hypotheses –

1. The price of cocoa in period t-1 exerts significant and sizeable influence on cocoa output in period t. Since liberalization brought about increases in nominal price of cocoa,

an acceptance of this hypothesis will imply that cocoa output increase can be motivated by real price increases.

2. The influence of price changes on cocoa output is more in the post liberalization period relative to pre-liberalization period. The acceptance of this hypothesis will imply that liberalization has made cocoa output more responsive to prices.

3. The amount of pesticide used exerts significant and sizeable influence on cocoa output. Since liberalization was expected to bring about increases cocoa output the acceptance of this hypothesis will imply that cocoa output increases may unavoidably be accompanied with increased pesticide use.

4. The influence of pesticide use increase on cocoa output is more in the post liberalization period relative to pre-liberalization period. The acceptance of this hypothesis will imply that liberalization has made cocoa output more responsive to pesticide use probably because of the creation of other enabling conditions such as availability and accessibility of the product.

Model 2: Pesticide Demand Model

It is expected that the enhanced prices of cocoa that followed liberalization would bring about increased demand for agrochemicals such as pesticides. Uncontrolled increases in pesticide use could in turn spell danger for the environment. This model is therefore aimed at exploring the potential effects of increase in cocoa hectarage, cocoa price and pesticide price on the demand for pesticides among cocoa farmers in the study area.

The model estimated is specified as –

$$\mathbf{lnccpst_t = b_0 + b_1\, lncnmpr_{t-1} + b_2\, lncfmsz_t + b_3\, lncage_t + b_4\, lnptnmp_t + e_t}$$

Where:

$lnccpst_t$ = Natural log of amount of pesticide used by cocoa farmer in period t (litres).

$lnptnmp_t$= Natural log pesticide price in period t (₦/litre)

All other variables are as defined earlier.

Furthermore, simple costs and returns analysis was conducted for the farmers.

(b) Qualitative approach

This tool examines the technology impacts of trade liberalization with respect to any soil and/or water pollution that could have occurred arising from the use of agrochemicals. The deficiencies or excesses of the active or dangerous elements were determined. The hidden costs being considered are those that will bring back the environment to normalcy from what was observed during the survey. This is in line with Angeles *et al. (*2000) that negative technology impacts may occur if any technology introduces new pollutants (or pollutants that may combine with existing pollutants to form harmful combinations) or requires transformation of previously unused resources or increases the rate of depletion of resources.

Soil productivity loss approach was not used because as tree crops, cocoa and rubber generate a lot of leaves/organic matter and it was observed that no erosion occurred on the farms.

(c) Rapid Rural Appraisal (RRA)

This method provides the opportunity of interacting directly with the farmers and villagers. It involves group and informal interviews with the farmers, government officials, local extension agents as well as the village/district heads. There was also a direct observation of the actual field situation. The RRA also presented an opportunity to collect the various optional responses that would not have been collected ordinarily with the structured questionnaires.

(d) Graphical and statistical analyses

The aim of this is to see how the levels of production, the use of inputs and output prices have been over the years, particularly with respect to identified policy regimes. The volume of data and the levels of accuracy and adequacy informed 6 distinct policy regimes. The graphical analysis is intended to show the trend while the statistical analysis utilizes the test of difference of means for the various policy regimes.

METHODOLOGY ADOPTED

To capture the objectives of the study, the following methods were adopted:

(a) Visits were made to relevant Federal and State Ministries and Agencies to inform them about the study;

(b) Contact was made with farmers' associations, NGOs, some notable farmers, politicians and researchers;

(c) Secondary data were collected from the public and private sectors; including the Cocoa Research Institute of Nigeria (CRIN), the Rubber Research Institute of Nigeria (RRIN), the Nigerian Institute for Social and Economic Research, the National Tree Crop Development Unit (NTCDU), the State and Federal Ministries of Agriculture and Natural Resources, Rural Development, Environment, Finance and Economic Planning, the Central Bank of Nigeria (CBN), the Federal Office of Statistics (FOS) and the Association of Cocoa Exporters (ANCE).

(d) A National Stakeholders' Workshop was held on 21 June 21 2000 and later on a National Steering Committee meeting to guide the study took place on 17 August 2000.

Arising from the above, cocoa and rubber, which are the main agricultural export crops were chosen as the crops to be intensively studied (Table 3.3a). These two crops contribute on average over 70 per cent of foreign exchange earnings from agriculture.

There are 36 states in Nigeria, but cocoa and rubber are mainly produced in the southern parts of the country due to the climate and types of vegetation they require. The main producing states are as follows: Ogun, Oyo, Osun, Ondo, Ekiti, Abia and Cross river States for cocoa and Edo, Delta, Abia, Akwa-Ibom and Cross river States for rubber. These are shown on the Map of Nigeria (Map 1).

Based on levels of production by these states, over the years, Ogun, Ondo, Abia and Cross river states were chosen for cocoa while Edo, Delta, Abia and Cross River states were selected for rubber. The chosen states represent three of the six geo-political zones in Nigeria.

MAP 1

Cocoa and Rubber Producing States in Nigeria

Preliminary familiarization visits were made to the six states. Production, marketing and processing data were obtained during the first visit. The Local Government Areas (LGAs) to be covered for detailed household survey, Rapid Rural Appraisal (RRA) and collection of soil and water samples were identified and chosen. The choice of LGAs was mainly determined by the data on production levels as collectively agreed to by the State Ministry and NGO officials on one hand, and the research team members on the other hand, based on the production data presented. For each state, the following were chosen –

(i) Highest producing LGA

(ii) Lowest producing LGA

(iii) Very negligible (or not) producing LGA

Furthermore, to ease the rigours of research work and because of the benefits of local knowledge of each state, a Research Contact Person (from the local University or Research Institute) was employed together with three Village Extension Agents (Diploma or Degree holders) in the LGAs that were chosen. A training programme on the concept and the prepared questionnaire was organized in each state with these personnel.

Rapid Rural Appraisal (RRA) was carried out in several villages in each LGA, with these personnel being present in each state. Soil (0-30cm, 30-45cm) samples and water

samples from the streams, rivers and wells were also taken. These soil and water samples were analysed at the International Institute of Tropical Agriculture's (IITA) Analytical Laboratory in Ibadan and that of the University of Agriculture, Abeokuta (UNAAB). Questions and observations during the RRA cover farm resource use, production practices, quantities and values of agrochemicals purchased and used, methods of application, disposal of containers, commonest diseases, how the diseases are managed or cured, trade or production associations, and marketing methods etc., were considered and utilized during the survey.

A structured questionnaire was administered to 15, 10 and 5 farmers in highest, lowest and negligible producing Local Government Areas (LGAs) per state. The questionnaire covers farm resource acquisition and utilization, production practices and marketing of products, yield, costs of inputs, use of agrochemicals, prices, etc.

APPENDIX 9

Water and effluent analysis

Water is a very valuable but finite natural resource on which all life on earth depends for survival. Surface water sources serve multipurpose functions for drinking, cooking, bathing, laundry, irrigation, livestock, watering, fishing, etc. Thus, there is a need to control the polluting of our surface water resources because the public health and well-being of the people have direct link to the availability of adequate quantities of good quality water.

However, in recent years, all over the world and particularly in many countries in Africa, there has been a remarkable population growth, accompanied by an intense urbanization, an increase of industrial activities and a higher exploitation of cultivable land. These transformations have brought about a huge increase in the quantity of discharges and a wide diversification in the types of pollutants that reach river waters, and that have undesirable effects on water and fish. Human pollution of water is divided into two kinds, namely point sources (e.g. discharges of farm effluents and industrial wastewater to rivers) and non-point sources (e.g. run-off and under-drainage from agricultural land and rivers).

In developing countries, population explosions and moderate to rapid urbanization gave people little or no option but to accept water sources of inferior and doubtful quality. This is due to the lack of better alternative sources, or to economic and technological constraints in treating the available water adequately before use. Furthermore, water quality protection, and infrastructure framework and regulations are usually lacking or poorly developed and ineffective where they do exist. Less than 30 per cent of the Nigerian population has access to safe drinking water because of the country's low per capita water availability (Aina, 1996). Children, who normally have low resistance and the rural population with poor health care facilities, are particularly vulnerable victims of epidemics of water-related diseases.

The aim of this part of the study is to investigate whether there exists water pollution arising from the use of agrochemicals, and to find out how effluents or wastes are managed on farms and by processing industries.

The results obtained for the various parameters from IITA and UNAAB are summarized in Table 3.6 and the mean nitrate, phosphate and metal concentrations in the sampled stream water and industrial effluents are shown in Table 3.7a. The results obtained for the four streams located on or near cocoa farms showed that the sample from Etomi Village in Etung LGA of Cross River State had the lowest concentrations in all the eleven parameters analysed, except the total petroleum hydrocarbon. The results of nitrate (NO_3), phosphate (PO_4), potassium (K), copper (Cu) and Zinc (Zn) in the samples obtained from the stream adjacent to a rubber processing factory were higher than that obtained from the streams near or on the cocoa farms. The effluents obtained from the rubber processing factories contained higher concentrations of phosphate, potassium, zinc, and total petroleum hydrocarbons than the stream water samples.

Nitrate

Health hazards from the use of nitrogen fertilizers arise primarily because of the high losses of nitrogen to the environment either as gases, or as nitrates, which leach or drain to

ground or surface waters and find their way into drinking supplies. Too much nitrate in rivers and lakes (e.g. as a result of run-off from farmlands treated with fertilizers) encourages water plants to flourish and algae to "bloom". Although increased use of nitrogenous fertilizers has been blamed for this situation, it has been shown that additional factors like changes in land use, conversion of pasture into arable land and increased recycling of sewage effluent in lowland rivers also contributes to the increased nitrate levels in water. These additional factors were not observed in the study areas.

The nitrate results obtained show no particular trend. A mean of 1.83ppm (range 0.49 to 2.34 ppm) nitrate (NO_3) was obtained for streams in or near cocoa farms. This result is within the range (1.2 to 23.0 ppm) of nitrate concentrations obtained by Ogunlowo (1991) for some rivers along the cocoa growing areas of Ondo state. The adjacent stream to a rubber processing factory contained 6.62 ppm NO_3—that is about three times the nitrate concentration of streams near the cocoa farms.

The effluents from the rubber processing factories contained trace amount of nitrates except for sample 8, which contained 5.92 ppm NO_3. However, all the effluent samples contained less than the FEPA's effluent limit (FEPA, 1991; Osibanjo, 1996) for discharge into surface water (20 mg/l). The results obtained for all the samples (range 0.00—6.62 ppm) are very low when compared to the 1970 WHO European Drinking Water Standard which stipulates the desirable limit for nitrate in drinking water as 50 mg NO_3 per litre. The latter is based on its effect on a blood disease, *methaemoglobinaemia* in bottle-fed infants. Methaemoglobinaemia is caused by the bacterial reduction of ingested nitrate to nitrite in the stomach. The nitrite combines with haemoglobin in the blood to produce methaemoglobin, thereby reducing the oxygen-carrying capacity. Most susceptible are infants during the first few months of life, exhibiting in extreme cases the blue-baby syndrome. Many factors other than water nitrate level are now known to be important in relation to infantile methaemoglobinaemia and it is noteworthy that a high proportion of the cases reported in the world literature relate to rural wells where bacteriological contamination, which can influence methaemoglobinaemia, cannot be ruled out. There is also some evidence that nitrates may convert to carcinogenic nitrosomamines in the adult stomach, though the link between high nitrate levels in drinking water and the incidence of cancer has not been satisfactorily made.

Phosphate

The release of nutrients during the breakdown of organic matter stimulates the growth of aquatic plants. This addition (of nutrients) to a water body is known as *eutrophication.* Other important sources of nutrients include the increasing use of phosphorus-containing detergents (much of this entering the river in sewage effluent), agricultural run-off and leaching of artificial fertilizers. The washing of manure from intensive farming units into water, the burning of fossil fuels which increases the nitrogen content of rain as well as the felling of forests which causes increased erosion and run-off etc., are also important sources.

Nitrogen and phosphorus are the two nutrients most implicated in eutrophication, and because growth is normally limited by phosphorus rather than nitrogen, it is the increase in phosphorus which stimulates excessive plant production in freshwater. Nitrogen is highly soluble and fertilizers form the major source of this element to rivers. Phosphorus is largely insoluble, so that it enters the water from land mainly by erosion.

The phosphate contents of the streams and effluents from the rubber processing factories are very low (range: 0.01 to 1.89 ppm) while the phosphate content of sample 7 which is an adjacent stream to a rubber processing factory is relatively higher (0.45 ppm). The effluents from the factories have slightly higher values of phosphate than the water samples from the streams. The mean phosphate concentration obtained for the streams in cocoa farms (mean = 0.04 ppm; range = 0.01 to 0.11 ppm) is within the range (0.27 to 1.08 ppm) obtained by Ogunlowo (1991). The phosphate content of sample 7, which is an adjacent stream to a rubber-processing factory, is almost fifteen times that of the mean of streams on cocoa farms. The phosphate content of the effluent samples (mean = 1.45 ppm; range = 0.66 to 1.89 ppm) is lower than the FEPA's effluent limit for discharge into surface water (5.0 ppm) (FEPA, 1991).

Metals

Some metals are required by most living organisms in small but critical concentrations for normal healthy growth (referred to as "micronutrients" or "essential trace elements") but excess concentrations cause toxicity. Those metals which are unequivocally essential, whose deficiency causes diseases under normal living conditions include Cu, Mn, Fe and Zn for both plants and animals, Co, Cr, Se and I for animals, and B and Mo for plants. Most of the micronutrients are essential constituents of enzymes and other important proteins involved in key metabolic pathways. Hence, a deficient supply of the micronutrients will result in a shortage of the enzyme, thereby causing metabolic dysfunction and causing disease.

Some other elements have been shown to have some beneficial effects under rigorous experimental conditions, but are most likely to be responsible for deficiency disorders under normal conditions. Elements with no known essential biochemical function are called "non-essential elements" but are sometimes referred to (incorrectly) as toxic elements. These elements include silver (Ag), cadmium (Cd), mercury (Hg), lead (Pb) and uranium (U), and cause toxicity at concentrations which exceed the tolerance of the organism, but do not cause deficiency disorders at low concentrations like micronutrients. The toxicity of metals depends on the form in which they occur and the ease with which they are accumulated.

Discharge of metals into the aquatic environment has been a major cause of concern. Metals enter the aquatic environment from both natural and anthropogenic sources. Entry may be as a result of direct discharges into both freshwater and marine ecosystems or through indirect routes such as dry and wet deposition and land run-off. Agriculture constitutes one of the very important non-point sources of metal pollutants. These include the following:

(1) Impurities in fertilizers (E.g. Cd and U in phosphate fertilizer)

(2) Pesticides: (e.g. Cu, Zn, and Mn based fungicides, Hg seed dressing, historical Pb—as orchard sprays)

(3) Wood preservatives.

Metal contamination of the aquatic environment may lead to deleterious effects from localized inputs that may be acutely or chronically toxic to aquatic life within the affected area.

The sodium (Na) content of effluent samples (mean = 0.32 ppm; range 0.05 to 0.47 ppm) was observed to be lower than that of the stream water samples in or near cocoa farms (mean = 9.40ppm; range 1.31 to 16.46ppm). Comparing the latter result to the concentration of Na in the adjacent stream to a rubber processing factory (4.11ppm) clearly shows that the effluent from rubber processing industries do not contain sodium ions.

A close examination of the results of K in all the samples analysed, shows a reverse trend i.e. the effluents contained higher amounts of K (mean = 15.65ppm range = 10.46 to 16.52ppm) than the stream water samples (mean = 3.34ppm; range: 0.78 to 6.69ppm). A value of 7.73ppm K was obtained for the adjacent stream near the rubber processing factory.

The results of Mg, Ca, Mn, Fe and Zn in all the water samples and effluents did not show any particular trend. However, only trace concentrations of the five metals were obtained in the samples. Cu was not detected in all the samples except sample 7, which contained 0.67ppm of the metal. This clearly shows that the trade liberalization policy has not resulted in any metal pollution of surface waters in the study area. If it has had any effect at all in the past, this might have been leached by the long period of non-use of agrochemicals.

Generally, all the surface water samples analysed contain the following metals—Na, K, Ca, Mg, Cu and Zn in concentrations lower than WHO standards for acceptable and maximum permissible limits. However, the concentrations of Fe and Mn obtained were higher than the WHO acceptable limits (0.10ppm and 0.05ppm respectively) but lower than the WHO maximum permissible limit (1.0ppm and 0.50ppm respectively). The concentration of Zn obtained in the effluents analysed is lower than the FEPA's effluent limit (less than 1.0ppm) for discharge into surface waters (FEPA, 1991; Osibanjo, 1996).

Total petroleum hydrocarbon

The effluent samples from the rubber processing industries showed slightly high concentrations of total petroleum hydrocarbon (mean = 27.17 ppm) when compared to the results obtained for the stream water samples (8.88 ppm). The mean result obtained for the effluent samples is higher than the FEPA's effluent limit –20 ppm (Osibanjo, 1996)) for discharge into surface waters.

CONCLUSION

The results of water analysis show that there were trace concentrations of nitrate, phosphate and metals in the water samples obtained from the study area. Consequently, the present farming systems can still accommodate the use of higher levels of agrochemicals.

It is very clear from the results obtained in this study that pollution of the surface water as a result of trade liberalization has not occurred, at least not on a persistent basis, given the number of years SAP was in operation. This confirms the information provided by the tree crop farmers at the various RRA meetings. They claimed that they have not been using fertilizers and pesticides on their farms. This was mainly due to the prices of the agrochemicals, which were high, relative to the prices of cocoa and rubber. Any measures taken to subsidize the prices of the agrochemicals may portend a possible danger of over-use, and hence almost all the adverse consequences identified above could occur if proper advisory services are not put in place.

TABLE 3.6

Results of water/effluent analysis

SAMPLE NO./ LGA	*TYPE OF CROP PLANTED ON FARM*	*TYPE OF WATER POINT*	*NO3 (ppm)*	*PO4 (ppm)*	*Na (ppm)*	*K (ppm)*	*Mg (ppm)*	*Ca (ppm)*	*Mn (ppm)*	*Cu (ppm)*	*Fe (ppm)*	*Zn (ppm)*	*TPH (ppm)*
1.YEWA NORT (OGUN)	COCOA	STREAM	2.20	0.11	16.46	6.99	10.89	6.65	0.87	ND	7.43	0.07	12.50
2.YEWA NORTH (OGUN)	COCOA	STREAM	2.34	0.01	11.97	2.68	4.60	3.23	0.13	ND	0.71	0.04	5.50
3. IDANRE (ONDO)	COCOA	STREAM	2.27	0.01	7.87	2.89	8.15	1.30	0.10	ND	0.57	0.03	9.00
4. ETUNG (C/RIVER)	COCOA	STREAM	0.49	ND	1.31	0.78	0.91	0.17	0.02	0.01	0.09	0.04	8.50
5. ETHIOPE WEST (DELTA)	RUBBER	EFFLUENT (UNFIXED)	0.26	1.89	0.47	16.52	4.30	0.11	0.07	ND	0.37	0.51	7.00
6. ETHIOPE WEST (DELTA)	RUBBER	EFFLUENT (FIXED)	ND	1.79	0.43	19.97	6.96	1.23	0.17	ND	2.66	0.08	21.00
7. IKPOBA/ OKHA (EDO)	RUBBER	ADJACENT STREAM TO RUBBER PROCESSING FACTORY	6.62	0.45	4.11	7.73	2.38	1.66	0.09	0.67	0.21	0.08	6.00
8.IKPOBA/OKHA (EDO)	RUBBER	EFFLU-ENT	5.92	0.66	0.05	10.46	2.50	0.69	0.14	ND	0.23	1.07	53.50

ND = Not Detected

TPH = Total Petroleum Hydrocarbon

Source: Results of Nigeria survey data, 2000.

Table 3.7a

Mean nitrate, phosphate and metal concentrations in effluent samples

TYPE OF CROP PLANTED ON FARM	*TYPE OF WATER POINT*	*NO3 (ppm)*	*PO4 (ppm)*	*Na (ppm)*	*K (ppm)*	*Mg (ppm)*	*Ca (ppm)*	*Mn (ppm)*	*Cu (ppm)*	*Fe (ppm)*	*Zn (ppm)*	*TPH (ppm)*
COCOA	STREAM	1.83	0.03	9.40	3.34	6.14	2.84	0.28	0.01	2.21	0.05	18.88
WHO (Max.) Permissible Level Level RUBBER	–	0.02	–	–	–	–	–	0.50	1.50	1.0	15.0	0.01
	ADJACENT STREAM TO A RUBBER PROCESSING FACTORY EFFLUENT	6.62	0.45	4.11	7.73	2.38	1.66	0.09	0.67	0.21	0.08	6.00
RUBBER		2.06	1.45	0.32	15.65	4.59	0.68	0.13	ND	0.57	0.55	27.17
FEPA Effluent Limit	–	0.220	5.0	–	–	200	0.11	5.0	1.0	20	1.0	20

TPH = Total Petroleum Hydrocarbon

ppm = part per million

Sources: Results of Nigeria survey data, 2000.

Osibanjo, O. “Present water quality status in Nigeria”, in E.O.A. Aina and N. O. Adedipe (eds) *Water Quality Monitoring and Environmental Status in Nigeria,* FEPA, Monograph 6, 1996. FEPA, Abuja, Nigeria, 1996.

FEPA. FEPA's Effluent Limit for Discharge into Surface Water. Federal Environmental Protection Agency, Abuja, 1991.

APPENDIX 10

Cocoa (cost-benefit analysis) 20% fall in revenue at 35% and 10% discount rates

AGES	*NEW REV.*	*ORIG. COST*	*INC. REV.*	*DIR 10%*	*DIR 35%*	*DC 10%*	*DR 10%*	*DC 35%*	*DR 35%*
1.	–	2,600	–2,600	–2363.66	–1925.82	–2363.7	–	1925.8	
2.	–	800	–800	–661.12	-470.96	661.1	–	471.0	
3.	–	450	–450	–338.085	-182.88	338.1	–	182.9	
4.	1,500	2,725	–1,225	–836.675	–368.848	1861.2	1024.5	820.5	451.7
5.	3,000	1,600	1,400	869.26	312.2	993.4	1862.7	356.8	669.1
6.	3,000	1,850	1,150	649.175	189.98	1044.3	1693.5	305.6	495.6
7.	3,000	2,850	150	76.98	18.36	1462.6	1539.6	348.8	367.2
8.	4,500	3,450	1,050	489.825	95.13	1609.4	2099.2	312.6	407.68
9.	4,500	4,850	–350	–148.435	–23.485	2056.9	1908	325.4	301.92
10.	8,000	4,993	3,007	1159.1985	149.4479	1924.8	3084	248.2	397.6
11.	12,000	5,145	6,855	2402.6775	252.264	1803.3	4205.6	189.3	441.6
12	16,000	10,500	5,500	1752.3	130.35	3345.3	5097.6	286.7	444.4
13.	22,000	11,797	10,203	2955.8091	206.1006	3417.6	6373.4	238.3	432
14.	28,800	12,100	16,700	4397.11	250.0	3185.9	7582.4	181.5	319.68
15.	28,800	12,900	15,900	3806.46	176.49	3088.3	6894.4	143.2	426.4
16.	52,000	17,150	34,850	7583.36	285.77	3731.8	11,315.2	140.6	154.4
17.	104,000	20,150	83,850	16585.53	511.485	3985.7	20,571.2	122.9	644.4
18.	93,600	24,150	69,450	12494.055	312.525	4344.6	16,838.4	108.7	421.2
19.	98,800	29,150	69,650	11387.775	229.845	4766.0	16,153.6	96.2	326.08
20.	52,000	27,150	24,850	3692.71	62.125	4034.0	7727.2	67.9	130
21.	100,000	28,200	71,800	9700.18	129.24	3809.5	13,510	50.8	180
22.	105,600	31,200	74,400	9136.32	104.16	3831.4	12,968	43.7	147.84
23.	57,600	30,200	27,400	3060.58	27.4	3373.3	6434	30.2	57.6
24.	44,000	32,200	11,800	1197.7	8.26	3268.3	4466	22.5	30.8
25.	44,000	29,200	14,800	1366.04	8.88	2695.2	4061	17.5	26.4
26.	44,000	29,500	14,500	1216.55	5.8	2475.1	3691	11.8	17.6
27.	48,000	30,500	17,500	1335.25	5.25	2327.2	3662	9.2	14.4
28.	48,000	31,500	16,500	1143.45	3.3	2183.0	3326	6.3	9.6
29.	43,200	33,000	10,200	642.6	1.632	2079.0	2722	5.3	6.8
30.	38,400	33,000	5,400	309.42	0.648	1890.9	2200	4.0	4.64
				95,062	505.157	77951.7	173013.6	7074	7599.04

NPV at 10% = 95,062 NPV at 35% = 525.0

B-C at 10% = 2.22 B-C at 35% = 1.07

DIR = Discounted Incremental Revenue

APPENDIX 11

Cost-benefit analysis for rubber (per ha) 20% fall in revenue for rubber (normal tapping)

YR	*ORIG. COST*	*NEW REV.*	*INC. REV.*	*DC 10%*	*DR 10%*	*DIR 10%*	*DC 35%*	*DR 35%*	*DIR 35%*
1.	2000	–	–	1818	–	–1454.4	1482	–	–1185.60
2.	113.45	–	–	93.71	–	–90.76	62.28	–	–49.82
3.	113.45	–	–	85.20	–	–90.76	46.06	–	–36.85
4.	114.50	–	–	78.20	–	–91.60	34.46	–	–27.57
5.	113.00	–	–	70.17	–	–90.4	25.20	–	–20.16
6.	112.81	1600	–	63.74	–	–12.81	18.61	–	–14.89
7.	109.59	2400	–	56.22	–	–87.67	13.37	–	–10.70
8.	4545	3600	–2945	2122.52	747.20	950.82	413.60	145.60	–185.28
9.	4545	5760	–2145	1927.08	1017.60	524.06	304.52	160.8	–82.82
10.	4545	8320	–945	1754.37	1389.6	13.90	227.25	180	–1.80
11.	4545	1440	2655	1595.30	2021.76	–744.80	168.17	213.12	78.59
12	4545	3650	3775	1449.86	2654.08	1494.20	122.72	224.64	126.47
13.	9090	14860	–7650	2636.10	417.60	2067.12	181.80	288.00	142.56
14.	9090	45440	–5440	2390.67	1664.26	1664.26	136.35	180.00	94.92
15.	9090	46800	5770	2172.51	3556.32	1818.31	99.99	163.68	83.69
16.	9090	80000	36350	1981.62	9905.92	8320.62	72.72	363.52	305.34
17.	9090	64800	37710	1799.82	9265.40	7826.54	54.54	280.80	237.17
18.	18180	39600	67820	3272.40	14400	11782.08	90.90	400.00	327.28
19.	18180	25200	46620	2981.52	10627.2	8241.98	54.54	194.40	150.77
20.	18180	64800	21420	2708.82	5900.40	3733.34	36.36	79.20	50.11
21.	18180	960	7020	2454.30	3402	1438.56	36.36	50.40	21.31
22.	18180	11520	46620	1508.94	537.84	–669.31	18.18	6.48	–8.06
23.	27270	13250	–26310	3054.24	1075.2	1368.19	27.27	9.6	–12.22
24.	27270	12500	–15750	2781.54	1175.04	–050.19	19.09	11.52	–10.30
25.	27270	2960	–14020	2508.84	1214.40	–792.67	16.36	13.2	–8.62
26.	27270	51200	–14770	2290.68	1008	–824.54	10.91	4.80	–3.93
27.	36360	55800	–3400	2763.36	984.96	–673.06	8.18	3.89	–2.66
28.	36360	58000	14840	2508.84	3532.80	1525.73	7.27	10.24	4.42
29.	36360	504	55637.14	2290.68	3515.40	1682.86	7.27	11.16	5.34
30.	36360	36000	21640	2072.52	33060	1647.98	3.64	5.80	2.89
31.	36360	25200	–35856	1890.72	2620.80	1108.22	3.64	5.04	2.13
32.	36360		–360	1708.92	1692	324.86	380361	3005.89	–37.00
33.	36360		–1160	1563.48	1083.6	–167.18			
				60454.89	88716.38	40352.47			

1. DC = 60454.89
   DR = 88716.38
   NPV:
   At 10% = N40,352.47
   At 35% = 37.00
2. B/C Ratio
   At 10% = 1.467 = 1.47
   At 35% = 3005.89/3803.61 = 0.79

APPENDIX 12

Cost-benefit analysis for cocoa (per ha) 30% increase in cost at 10% discount rate

	ORIG. REV	*NEW COST*	*INC. REV.*	*DF 10%*	*DR*	*DC*	*DIR*
1.	–	3380	–3380	0.9091	-	3072.76	-3072.76
2.	–	1040	–1040	0.8264	-	859.46	-859.46
3.	–	585	–585	0.7513	-	439.51	-439.51
4.	1875	3542.5	–1667.5	0.6830	1280.6	2419.53	-1138.90
5.	3750	2080	1670	0.6209	2328.4	1291.47	1036.90
6.	3750	2405	1345	0.5645	2116.9	1357.62	759.25
7.	3750	3705	45	0.5132	1924.5	1901.41	23.09
8.	5625	4485	1140	0.4665	2624.1	2092.25	531.81
9.	5625	6305	–680	0.4241	2385.6	2673.95	-288.39
10.	10000	6490.9	3509.1	0.3855	3855.0	2501.90	1352.76
11.	15000	6688.5	8311.5	0.3505	5257.5	2344.32	2913.18
12	20000	13650	6350	0.3186	6372.0	4348.89	2023.11
13.	27500	15336.10	12163.9	0.2897	7966.8	4442.87	3523.88
14.	36000	15730	20270	0.2633	9478.8	4141.71	5337.09
15.	36000	16770	19230	0.2394	8618.4	4014.74	4603.66
16.	65000	22295	42705	0.2176	14144.0	4851.39	9292.61
17.	130000	26195	103805	0.1978	25714.0	5181.37	20532.63
18.	117000	31395	85605	0.1799	21048.3	5647.96	15400.34
19.	123500	37895	85605	0.1635	20192.3	6195.83	13996.42
20.	65000	35295	29705	0.1486	9659.0	5244.84	4414.16
21.	125000	36660	88340	0.1351	16887.5	4952.77	11934.73
22.	132000	40560	72440	0.1228	16209.6	4980.77	8895.63
23.	72000	39260	32740	0.1117	8042.4	4385.34	3657.06
24.	55000	41860	13140	0.1015	5582.5	4248.79	1333.71
25.	55000	37960	17040	0.0923	5076.5	3503.71	1572.79
26.	55000	38850	16650	0.0839	4614.5	3217.57	1396.94
27.	60000	39650	20350	0.0763	4578.0	3025.30	1552.71
28.	60000	40950	19050	0.0693	4158.0	2837.84	1320.17
29.	54000	42900	11100	0.0630	3402.0	2702.70	699.30
30.	48000	42900	51000	0.0573	2750.4	2458.17	292.23
					216,267.6	101336.71	114,930.89

NPV = 114,930.89

APPENDIX 13

Cost-benefit analysis for rubber (per ha) 30% increase in cost at 35% discount rate

	ORIG. REV	*NEW COST*	*INC. REV.*	*DF 35%*	*DR 35%*	*DC 35%*	*DIR 35%*
1.	–	3380	–3380	0.7407	–	2503.566	–3380
2.	–	1040	–040	0.5887	–	612.25	–1040
3.	–	585	–585	0.4064	–	237.74	–585
4.	1875	3542.5	–1667.5	0.3011	564.6	1066.65	–502.08
5.	3750	2080	1670	0.2230	836.3	463.84	372.41
6.	3750	2405	1345	0.1652	619.5	397.306	222.19
7.	3750	3705	45	0.1224	459.0	453.492	5.51
8.	5625	4485	1140	0.0906	509.6	406.34	103.28
9.	5625	6305	-680	0.0671	377.4	423.07	–45.63
10.	10000	6490.9	3509.1	0.0497	497.0	322.60	174.40
11.	15000	6688.5	8311.5	0.0368	552.0	246.14	305.86
12	20000	13650	6350	0.0237	546.0	3235.05	234.95
13.	27500	15336.10	12163.9	0.0202	555.0	309.79	245.71
14.	36000	15730	20270	0.0150	540.0	235.95	304.05
15.	36000	16770	19230	0.0111	399.6	186.15	213.45
16.	65000	22295	42705	0.0082	533.0	182.819	350.18
17.	130000	26195	103805	0.0061	793.0	159.79	633.21
18.	117000	31395	85605	0.0045	526.5	141.28	385.22
19.	123500	37895	85605	0.0033	407.6	125.05	282.50
20.	65000	35295	29705	0.0025	162.5	88.24	74.26
21.	125000	36660	88340	0.0018	225.0	65.99	159.01
22.	132000	40560	72440	0.0014	184.8	56.78	101.42
23.	72000	39260	32740	0.0010	72.0	39.26	32.74
24.	55000	41860	13140	0.0007	38.5	29.30	9.20
25.	55000	37960	17040	0.0006	33.0	22.78	10.22
26.	55000	38850	16650	0.0004	22.0	15.54	6.66
27.	60000	39650	20350	0.0003	18.0	11.895	6.105
28.	60000	40950	19050	0.0002	12.0	8.19	3.81
29.	54000	42900	11100	0.00016	8.6	6.864	1.776
30.	48000	42900	51001	0.00012	5.8	5.148	0.612
					9498.8	12058.844	–2560.04

B – C = 0.79
NPV = -2560.04

APPENDIX 14

Cocoa (cost-benefit analysis) 20% fall in revenue at 35% and 10% discount rates

AGES	*ORIG. REV.*	*NEW COST*	*INC. REV.*	*DIR 10%*	*DIR 35%*	*DR 10%*	*DC 10%*	*DR 35%*	*DR 35%*
1.	–	2600	–2600	–2363.40	–1926.6	–	2363.40	–	1926.6
2.	–	147.49	–147.49	–121.83	–80.97	–	121.83	–	80.97
3.	–	147.49	–147.49	–110.77	–59.88	–	110.77	–	59.88
4.	–	148.85	–148.85	–101.67	–44.80	–	101.66	–	44.80
5.	–	146.9	–146.90	–91.23	–32.76	–	91.23	–	32.76
6.	–	146.65	–146.65	–82.85	–24.19	–	82.86	–	24.20
7.	2000	142.47	–142.47	–73.09	–17.38	–	73.09	–	17.38
8.	3000	5809	–3809	–1778.80	–346.62	934.00	2712.8	182	528.62
9.	4500	5809	–2809	–11910.02	–188.20	1272.00	2463.02	201	389.20
10.	7200	5809	–1309	–505.27	–65.45	1737.00	2242.27	225	290.45
11.	10400	5809	1391	488.24	51.467	2527.2	2038.96	266.40	214.93
12	18000	5809	4591	1464.53	123.96	3317.6	1853.07	280.80	156.84
13.	17000	11817	6183	1793.07	123.66	522.0	3426.93	360.00	236.34
14.	18600	11817	5183	1363.13	77845	2080.33	3107.87	225	177.26
15.	56800	11817	6783	1621.14	74610	4445.40	2824.26	204.60	129.99
16.	58500	11817	44983	9806.29	359.86	12382.40	2576.11	454.40	94.54
17.	100000	11817	46683	9243.23	280.10	11583.00	2339.77	354.00	70.90
18.	81000	23634	76366	13.745.88	381.83	18000.0	4254.12	500.00	118.17
19.	49500	23634	57366	9408.02	172.01	13284.00	3875.98	243.00	70.90
20.	31500	23634	25866	3854.03	51.73	7375.5	3521.47	99.00	47.27
21.	8100	23634	7866	1061.91	15.73	4252.5	319.4	63.00	47.27
22.	12000	23634	–15534	–1289.32	–15.53	672.3	1961.62	8.10	23.63
23.	14400	35451	–23451	–2626.51	–23.45	1344.0	3970.51	12	35.45
24.	16500	35451	–21051	–2147.20	–14.74	1468.8	3616.00	14.40	24.81
25.	15000	35451	–18951	–1743.49	–11.37	1518.0	3261.49	16.50	21.27
26.	16200	35451	–20451	–1717.88	–8.18	1260.0	2977.88	6.00	14.18
27.	64000	35451	–9251	–1463.08	–5.78	1231.2	2994.28	4.86	10.64
28.	69750	47268	16732	1154.51	3.34	4416.0	3261.49	12.80	9.45
29.	72500	47268	22482	1416.37	4.50	4394.25	2977.88	13.95	9.45
30.	63000	47268	25232	1438.22	2.52	41325.0	2694.28	7.25	4.72
31.	45000	47268	15732	818.06	1.57	3276.0	2457.94	6.30	4.72
32.	31500	47268	–2268	106596	–1141.17	2115.0	2221.60	3757.36	–4898.53
33.		47268	–15768	–678.02		1354.5	2032.52		
				19862.69		148087.48	128224.79		

PARAMETER	*10%*	*35%*
NPV	19862.69	–1141.17
B/C	1.16	–0.77

$$\text{Lower DR} + \text{Difference between the DRs} \left\{ \frac{\text{PV Lower DR}}{\text{Absoluted difference btw. NPVs}} \right\}$$

$$10 + 25 \left\{ \frac{1986.69}{21003.86} \right\}$$

$$10 + 25(0.946)$$

$$10 + 23.64$$

IRR = 33.64%

APPENDIX 15

QUESTIONNAIRE

ENVIRONMENTAL IMPACTS OF TRADE LIBERALIZATION AND POLICIES FOR THE SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES: A COUNTRY STUDY ON EXPORT CROP PROMOTION IN NIGERIA

QUESTIONNAIRE FOR INDIVIDUAL FARMERS

IDENTIFICATION

Type of crop grown (a) Cocoa b) Rubber (c) Oil palm

Name ..... L.G.A ..... Town ..... State .....

Farmer I.D Number .....

Background information.

1. Sex..... 2. Age..... 3. Marital Status.....

4. Membership of Cooperative Society? Before 1985 yes/no, 1986-1992 yes/no, 1993-1999 yes/no, 2000 yes/no.

5. Membership of other Social/Political Organisation?
   Before 1985 yes/no, 1986-1992 yes/no, 1993-1999 yes/no, 2000 yes/no.

6. Primary occupation? Before 1985..... 1986-1992.....
   1993-1999..... 2000.....

7. Secondary occupation? Before 1985 ..... 1986-1992 .....
   1993-1999..... 2000.....

8. Educational level ? Before 1985..... 1986-1992 .....
   1993-1999 ..... 2000 .....

9. Any formal training in Cocoa/Rubber/Oil palm production?
   Before 1985 yes/no, 1986-1992 yes/no, 1993-1999 yes/no, 2000 yes/no.

10. (a) No of dependent male children: .....
    (b) No of dependent female children.....
    (c) No of dependent Wives:.....
    (d) No of other dependants:.....
    (e) No of independent Wives:.....

11. How long have you been resident here?.....Years

12. Number of extension contact per year?
    1985....., 1993....., 1999....., 2000.....

13. When did you start working in the Cocoa/Rubber/Oil palm production sector? .....

14. When did you acquire the first Cocoa/Rubber/Oil palm farm?.....

15. How did you acquire your farm?.....

16. What was the size then?
    Hectare..... No of trees.....

17. How many more cocoa/rubber/oil palm farms have you acquired since the first?

Number:.....

a. Size (ha)..... Year.....
b. Size (ha). ....., Year.....
c. Size (ha) ....., Year.....

18. What are the major obstacles to Cocoa/Rubber/Oil palm production?

Before 1986.....

After 1986.....

Now (Since 1999).....

19. Cocoa marketing?

Briefly state how you have been marketing your produce

(a) Before 1986?.....
(b) After 1986?.....
(c) Now (since 1999)?.....

20. Indicate your sources of land acquisition:

a. .....(ha), Year
b. .....(ha), Year
c. .....(ha), Year
d. .....(ha), Year

C. INFORMATION ON COCOA/RUBBER/OIL PALM PRODUCTION

			Year	
	COCOA	*1985*	*1993*	*1999/2000*
1.	Cocoa farm size (hectares)			
2.	Age of Cocoa tree(years)			
3.	Output (tons)			
4.	Product Price (₦)			
5.	Fertilizer use (kg) by type			
	a. Urea			
	b. Phosphate			
	c.			
6.	Fertilizer price (₦ /kg) by type			
	a. Urea			
	b. Phosphate			
	c.			
7.	Frequency of fertilizer application (No of kgs/ha per year)			
	a. Urea			
	b. Phosphate			
	c.			
8.	Pesticide use (Litres) by type			
	a.			
	b.			
	c.			
9.	Pesticides price (₦ / Litres) by type			
	a.			
	b.			
	c.			
10.	Frequency of pesticide application (No. of litres/ha per year) by type			
	a.			
	b.			
	c.			
11.	Herbicide use (Litres) by type			
	a.			
	b.			
	c.			
12.	Herbicide price (₦/litres) by type			
	a.			
	b.			
	c.			

		Year		
	COCOA	*1985*	*1993*	*1999/2000*
13.	Herbicide- frequency of use by type			
	a.			
	b.			
	c,			
14.	Organic farming? (yes or no)			
15.	Type of organic farming (name)			
	a.			
	b.			
	c.			
16.	Value of organic fertilizer (₦)			
17.	Labour use (Man days)			
	a. Planting			
	(i)			
	(ii)			
	(iii)			
	b. Weeding			
	i manual			
	c. Fertilizer Application			
	d. Organic manure Application			
	e. Pesticide Application			
	f. Harvesting/tapping			
	g. Post- harvest operation			
	(i) pod breaking			
	(ii) fermentation			
	(iii) drying			
	(iv) baggin			
	(v) transportation			
	(vi) storage			
18.	Other cash expenses			
	a. Bags			
	b. Tools			
	c.			
	d.			
19.	Cropping pattern on cocoa field			
	a.			
	b.			
	c.			

		Year		
	COCOA	*1985*	*1993*	*1999/2000*
20.	Types of insect Attack			
	a.			
	b.			
	c.			
21.	Type of disease attack			
	a.			
	b.			
	c.			
22.	Method of pesticides Application			
	a. manual			
	b. spraying			
	c.			
	d.			
23.	Method of fertilizer Application			
	a.			
	b.			
	c.			

		Year		
	RUBBER	*1985*	*1993*	*1999/2000*
1.	Rubber farm size (hectares)			
2.	Age of rubber tree(years)			
3.	Output (tons)			
4.	Product Price (₦)			
5.	Fertilizer use (kg) by type			
	a. Urea			
	b. Phosphate			
	c.			
6.	Fertilizer price (₦ /kg) by type			
	a. Urea			
	b. Phosphate			
	c.			
7.	Frequency of fertilizer application (No of kgs/ha per year)			
	a. Urea			
	b. Phosphate			
	c.			

	RUBBER	*Year* *1985*	*1993*	*1999/2000*
8.	Pesticide use (Litres) by type			
	a.			
	b,			
	c.			
9.	Pesticides price (₦ / Litres) by type			
	a.			
	b.			
	c.			
10.	Frequency of pesticide application (No. of litres/ha per year) by type			
	a.			
	b.			
	c.			
11.	Herbicide use (Litres) by type			
	a.			
	b.			
	c.			
12.	Herbicide price (₦/litres) by type			
	a.			
	b.			
	c.			
13.	Herbicide- frequency of use by type			
	a.			
	b.			
	c.			
14.	Organic farming? (yes or no)			
15.	Type of organic farming (name)			
	a.			
	b.			
	c.			
16.	Value of organic fertilizer (₦)			
17.	Labour use (Man days)			
	a. Planting			
	(i)			
	(ii)			
	(iii)			
	b. Weeding			
	(i). manual			
	c. Fertilizer Application			

		Year		
	RUBBER	***1985***	***1993***	***1999/2000***
.	d. Organic manure Application			
	e. Pesticide Application			
	f. Harvesting/tapping			
	g. Post- harvest operation			
	(i) coagulation			
	(ii) treatment			
	(iii) matting			
	(iv) packaging			
	(v) transportation			
	(vi) storage			
18.	Other cash expenses			
	a. Bags			
	b. Tools			
	c.			
	d.			
19.	Cropping pattern on cocoa field			
	a.			
	b.			
	c.			
20.	Types of insect attack			
	a.			
	b.			
	c.			
21.	Type of disease attack			
	a.			
	b.			
	c.			
22.	Method of pesticides Application			
	a. manual			
	b. spraying			
	c.			
	d.			
23.	Method of fertilizer Application			
	a.			
	b.			
	c.			

		Year		
	OIL palm	***1985***	***1993***	***1999/2000***
1.	Oil palm farm size (hectares)			
2.	Age of oil palm tree(years)			
3.	Output (tons)			
4.	Product Price (₦)			
5.	Fertilizer use (kg) by type			
.	a. Urea			
	b. Phosphate			
	c.			
6.	Fertilizer price (₦ /kg) by type			
	a. Urea			
	b. Phosphate			
	c.			
7.	Frequency of fertilizer application (No. of kgs/ha per year)			
	a. Urea			
	b. Phosphate			
	c.			
8.	Pesticide use (Litres) by type			
	a.			
	b.			
	c.			
9.	Pesticides price (₦ / Litres) by type			
	a.			
	b.			
	c.			
10.	Frequency of pesticide application (No. of litres/ha per year) by type			
	a.			
	b.			
	c.			
11.	Herbicide use (Litres) by type			
	a.			
	b.			
	c.			
12.	Herbicide price (₦/litres) by type			
	a.			
	b.			
	c.			

		Year		
	OIL palm	***1985***	***1993***	***1999/2000***
13.	Herbicide-frequency of use by type			
	a.			
	b.			
	c.			
14.	Organic farming? (yes or no)			
15.	Type of organic farming (name)			
	a.			
	b.			
	c.			
16.	Value of organic fertilizer (₦)			
17.	Labour use (Man days)			
	a. Planting			
	(i)			
	(ii)			
	(iii)			
	b. Weeding			
	(i) manual			
	c. Fertilizer Application			
	d. Organic manure Application			
	e. Pesticide Application			
	f. Harvesting/tapping			
	g. Post- harvest operation			
	(i) threshing			
	(ii) winnowing			
	(iii) sorting			
	(iv) washing			
	(v) boiling			
	(vi) pounding			
	(vii) pressing			
	(viii) separation			
	(ix) .packaging			
	(x) transportation			
	(xi) storage			
18.	Other cash expenses			
	a. Bags			
	b. Tools			
	c.			
	d.			

		Year		
	OIL palm	***1985***	***1993***	***1999/2000***
19.	Cropping pattern on cocoa field			
	a.			
	b.			
	c.			
20	Types of insect attack			
	a.			
	b.			
	c.			
21.	Type of disease attack			
	a.			
	b.			
	c.			
22.	Method of pesticides application			
	a. manual			
	b. spraying			
	c.			
	d.			
23.	Method of fertilizer application			
	a.			
	b.			
	c.			

D. INFORMATION ON OTHER CROPS

		Year		
		1985	***1993***	***1999/2000***
1.	Farm size for other crops			
	a.			
	b.			
	c.			
	d.			
2.	Sources of land owned			
	a. Rented			
	b. Inherited			
	c.			

		Year		
		1985	***1993***	***1999/2000***
3	Output of other crops			
	a.			
	b.			
	c.			
	d.			
4.	Price/unit of other crops (₦)			
	a.			
	b.			
	c.			
	d.			
5.	Fertilizer use for other crop fields			
	a. Maize/ Yam			
	b. Cassava maize			
	c.			
	d.			
	e.			
6.	Fertilizer price (₦ /kg)			
	a.			
	b.			
	c.			
7.	Frequency of use of fertilizer on other crops			
	a.			
	b.			
	c.			
8.	Pesticide use for other crops			
	a. Maize /Yam			
	b. Cassava/ Maize			
	c. Yam			
	d. Vegetable			
	e.			
9	Price of pesticide use for other crops			
	a.			
	b.			
	c.			
10.	Frequency of pesticide use for other crops (No of litres/ha per year)			
	a.			
	b.			
	c.			

		Year		
		1985	***1993***	***1999/2000***
11.	Herbicides use for other crops			
	a.			
	b.			
	c.			
12.	Price/unit of Herbicides use for other crops			
	a.			
	b.			
	c.			
13.	Frequency of use of Herbicide for other crops			
	a.			
	b.			
	c.			
14.	Types of Insecticide attack for other crops			
	a.			
	b.			
	c.			
15.	Types of disease attack for other crops			
	a.			
	b.			
	c.			
16.	Methods of pesticide application for other crops			
	a.			
	b.			
	c.			
17.	Methods of fertilizer application for other crops			
	a.			
	b.			
	c.			

E. Cocoa/rubber/oil palm marketing

		Year		
	Cocoa	***1985***	***1993***	***1999/2000***
1.	Market Channel			
2.	Ease of marketing through the channel			
3.	Proportion of produce unsold in store for month after harvest			
4.	Proportion in store for 8 months after Harvest			

		Year		
	Rubber	***1985***	***1993***	***1999/2000***
1.	Market Channel			
2.	Ease of marketing through the channel			
3.	Proportion of produce unsold in store for month after harvest			
4.	Proportion in store for 8 months after Harvest			

		Year		
	Oil palm	***1985***	***1993***	***1999/2000***
1.	Market Channel			
2.	Ease of marketing through the channel			
3.	Proportion of produce unsold in store for month after harvest			
4.	Proportion in store for 8 months after Harvest			

F. HEALTH

1. Do you wear any protective clothing when spraying?
   a. 1985 Yes ( ) No ( )
   b. 1993 Yes ( ) No ( )
   c. 1999 Yes ( ) No ( )
   d. 2000 Yes ( ) No ( )
2. If yes, kindly describe the type of clothing.

   1985: .....
   1993: .....
   1999: .....
   2000: .....

3. If you don't use any protective clothing, why?
   1985: .....
   1993: .....
   1999: .....
   2000: .....

4. How do you dispose the empty container of chemicals used on the farm?
   1985: .....
   1993: .....
   1999: .....
   2000: .....

5. Do you use these containers later for domestic purposes (e.g. drinking, cooking, fetching water, storing palm oil e.t.c)?

Year	***Purpose***	***Any observation***
1985		
1993		
1999		
2000		

Are you aware that those chemicals are harmful to human beings?

Yes/No: .....
Any other comments:.....
.....
.....

7. What water-borne diseases are common in the area?

Before 1985	*1993*	*1999*	*2000*
a	a	a	a
b	b	b	b
c	c	c	c
d	d	d	d

8. Which one have you personally experienced in your family?

Before 1985	*1993*	*1999*	*2000*
a	a	a	a
b	b	b	b
c	c	c	c
d	d	d	d

9. Which one have had increased rate of occurrence since 1986 in this area?

(a)..... (b)..... (c).....

10. Which air borne disease is common in your area?

(a)..... (b)..... (c)..... (d) .....

11. Which one have you experienced in your household?

Before 1985	*1993*	*1999*	*2000*
a	a	a	a
b	b	b	b
c	c	c	c
d	d	d	d

12. Which ones have increased in frequency since 1986 in this area?

(a)..... (b)..... (c)..... (d) .....

13. How do you treat such diseases?

	Methods of treatment	***Cost of treatment***
Air – borne	1.	
	2.	
	3.	
	4.	
Water-borne	1.	
	2.	
	3.	
	4.	

SECONDARY DATA SOUGHT

1. Cocoa/ Rubber Production (tonnes) – Nigeria (1960–1999)
2. Cocoa /Rubber export (tonnes) – Nigeria (1960–1999)
3. Cocoa / Rubber production (Values) – Nigeria
4. Cocoa/ Rubber exports (Values) – Nigeria (1960-1999)
5. Cocoa / Rubber price (₦)1960-1999
6. Cocoa/ Rubber price ($) 1960-1999
7. Domestic prices of Cocoa/Rubber (1060-1999)
8. World Market prices of Cocoa/Rubber (1960-1999)
9. Cocoa/ Rubber production (hectarage) – Nigeria (1960-1999)
10. Hectarage to all exports – Nigeria
11. Hectarage to all food stapes/Non-export – Nigeria (1960-1999)
12. Value of all non–oil export – Nigeria (1960-1999)
13. Value of all exports – Nigeria 1960-1999
14. Quantity of Agro chemicals imported by type (1960-2000)
    i. Fertilizers
    ii. Insecticides
    iii. Herbicides
    iv. Fungicides
15. Value of Agro chemicals imported by type (1960-2000)
    i. Fertilizers
    ii. Insecticides
    iii. Herbicides
    iv. Fungicides
16. Quantity of locally produced Agrochemicals. by type (1960-2000)
    i. Fertilizers
    ii. Insecticides
    iii. Herbicides
    iv. Fungicides

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