A CASE STUDY ANALYSIS OF THE EFFECTS OF STRUCTURAL ADJUSTMENT ON AGRICULTURE AND ON FOREST COVER IN CAMEROON

FINAL REPORT

APRIL 1999

PREPARED BY

JAMES K.A. BENHIN

AND

EDWARD B. BARBIER
ENVIRONMENT DEPARTMENT, UNIVERSITY OF YORK, UK

FOR THE

CENTER FOR INTERNATIONAL FORESTRY RESEARCH (C I F O R)

AND THE

CENTRAL AFRICAN REGIONAL PROGRAM FOR THE ENVIRONMENT

(CARPE)

Acknowledgements

This study was a project activity of the Center for International Forestry Research (CIFOR). The activity was funded both by CIFOR and by the Central African Program for the Environment (CARPE). The work was undertaken at the Environment Department (formerly the Department of Environmental Economics and Environmental Management (EEEM)) of the University of York, UK. In producing this report, the authors wish to take the opportunity to acknowledge with thanks the support of the sponsors and the help of all persons and institutions in making the study possible.

Particular thanks are due to Dr. William Sunderlin of the CIFOR and Dr. Laurent Somé of CARPE. Many thanks are also due to Prof. Charles Perrings, Head of the Environment Department, Dr. Jon Lovett and Ms. Joanne Burgess all of the Environment Department, and Dr. David Kaimowitz of CIFOR, for their invaluable comments at various stages of the work.

Others who helped the study greatly include, Dr. Ndoye Ousseynou and Dr. James Gockowski of the International Tropical Timber Organization (ITTO) office in Cameroon.

Many others have helped in this project, and although unmentioned by name, are sincerely thanked.

Table of contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

ADB	African Development Bank
BEAC	Banque des Etats de l=Afrique Centrale
CCCE	Caisse centrale de Coopération Economique
CENADEFOR	National Centre for Forest Development
CFA	Communauté Financière Africaine
CIDA	Canadian International Development Agency
CIFOR	Centre for International Forestry Research
CITES	Convention on International Trade in Endangered Species of World Fauna and Flora
cum	cubic metres
ECOFAC	European Community Central African Forest Project
ERP	Economic Recovery Programme
EU	European Union
FAO	United Nations Food and Agriculture Organization
FIMAC	Fonds d=Investissement de micro-Realisation Agricoles
FOB	Free on Board
FONADER	Fond National de Development Rural
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
GIS	Geographical Information Systems
ha	hectares
HEVECAM	Hévéaculture du Cameroon (Cameroon Company for Rubber Production)
IDA	International Development Association
IFS	International Financial Statistics
IIED	International Institute for Environment and Development
IMF	International Monetary Fund
IRA	Institute of Agronomic Research
ITTO	International Tropical Timber Organization
IUCN	The International Union for Conservation of Nature and Natural Resources
MIDEVIV	Mission de development des Cultures Vivrieres (Food Development Authority)
MINAGRI	Ministry of Agriculture
NCCB	National Cocoa and Coffee Board
NGO	Non-governmental Organization
NPMA	National Produce Marketing Board
ODA	Overseas Development Agency
ONADEF	National Forests Development Office
ONAREF	National Office of Forest Regeneration
PAGE	Economic Management Support Project
PE	Public enterprises
QR	Quantitative Restrictions
SAL	Structural Adjustment Loan

SAP	Structural Adjustment Programme
SDA	Social Dimensions of Adjustment
SFID	Société Forestière Idustrielle de la Doumé
TFAP	Tropical Forestry Action Plan
THF	Tropical High Forest
UNDP	United Nations Development Programme
UNVDA	Upper Nun Valley Development Authority
USAID	United States Development Programme
WCMC	World Conservation Monitoring Centre, UK
WRI	World Resources Institute
WWF	World Wide Fund for Nature

Exchange rates (CFA F/US$), 1965-95

Year	CFA F/US$	Year	CFA F/US$
		1980	211.28
1965	245.06	1981	271.73
1966	245.08	1982	328.61
1967	246.00	1983	381.61
1968	247.56	1984	436.96
1969	259.96	1985	449.26
1970	276.40	1986	346.31
1971	275.59	1987	300.54
1972	252.03	1988	297.85
1973	222.89	1989	319.01
1974	240.70	1990	272.26
1975	214.31	1991	282.11
1976	238.95	1992	264.69
1977	245.68	1993	283.16
1978	225.66	1994	555.20
1979	212.72	1995	499.15

Source: IMF, International Financial Statistics (IFS), Yearbooks 1992 and 1998.

Chapter 1: Introduction

1.1 Background and statement of the problem

A number of recent studies have analysed the relative importance of various economic activities including timber extraction and agriculture expansion in causing tropical deforestation (see Barbier et al., 1994, Brown and Pearce, 1994; Kaimowitz and Angelsen, 1997 for a review). Some have incorporated either timber extraction or agriculture expansion in their analyses while others have attempted to include both factors in their studies. Some studies have further looked into how various policy changes through their impacts on demand and supply for these two commodities, by the specific incentives of prices they influence, have tended to aggravate or mitigate the problem of deforestation in the tropics. This study, following the latter studies, is a theoretical and empirical investigation into the impacts of the Structural Adjustment Programme (SAP) on deforestation in Cameroon between the period 1965-95.

In the 1980's Cameroon experienced a transition from an economic boom into a deep recession. In 1978, oil was discovered in the western part of the country and up to 1985 the country benefited from the increase in oil prices and from the high prices in the international cash crop markets for coffee and cocoa. However, 1986 marked the onset of the recession: oil prices started to fall, oil reserves were discovered to be smaller than expected, and cocoa and coffee prices also went through a deep trough. The consequences affected the economy as a whole, leading to balance of payments and budget deficits, falling Gross National Product (GNP), and high inflation rates

This economic crisis led to the implementation of similar adjustment policies as in most African countries in 1989, including the removal of subsidies, price liberalization and devaluation to boost productivity especially in the agricultural sector. The reforms also resulted in a cut in government expenditure, improvement in tax collection to reduce the fiscal deficit, and the liberalisation of interest rates and control of money supply to check inflation. Of these policies, the removal of subsidies on agricultural inputs, increased producer prices, liberalisation of interest rates and the more flexible exchange rates are thought to have had the strongest impact on timber, food and cash crop production, and therefore on deforestation in Cameroon.

There is a general consensus that the most direct contribution to deforestation or forest loss is the agricultural sector in developing countries (Amelung and Diehl 1992; Barbier et al., 1994)[1]. Cameroon

[1] Several definitions of forest loss can be identified, such as those used by the WWF, IUCN and WCMC (Sayer, et al, 1992) and the various definitions of the FAO and WRI (see Fairhead and Leach, 1998; FAO, 1981 and Lanly, 1982). For the purpose of this paper forest loss is simply defined as the physical reduction in forest cover. This include forest degradation and forest conversion to other uses such as crop and timber production.

is still richly endowed with tropical forests of high quality. In fact, in terms of quality, its forest is second only to Zaire. Although deforestation in Cameroon does not take place at a high rate yet (Myers, 1988; Tchoungui, et al., 1995), steps need to be taken to avoid what is happening to most tropical forest in West Africa. Amelung and Diehl (1992) have estimated that conversion of forested land for agricultural purposes is the cause of approximately all deforestation in Cameroon. These findings are confirmed by Thiele and Wiebett (1993). Most of the deforestation is the result of small-scale agricultural activities: shifting cultivators are estimated to be responsible for 79 to 95 per cent of all deforestation in Cameroon (Amelung and Diehl, 1992). However, van Soest (1996) has noted the indirect role played by timber in deforestation in Cameroon. Both inefficient logging methods and road building by timber concessions open up the forest for agricultural purposes. Although the expansions of agricultural and timber production activities are basically the proximate factors causing deforestation in Cameroon, the more important underlying factors are the various economic incentives determining the extent and magnitude of these activities. These may have in turn been influenced by the SAP implemented in Cameroon since the late 1980s.

There is prima facie evidence that human activity such as agriculture and timber exploitation are eroding the biological resources and diversity of the forest in Cameroon. However, estimating the precise rates of this loss, or the current status of species, is challenging because no systematic monitoring system is in place and much baseline information is lacking (Glowka et al., 1994). Few data are also available on which genes or species are particularly important in the functioning of the forest ecosystem so it is difficult to specify the present and future costs of loss of the forest biodiversity[2].

Sustainable use of the tropical high forest of the two countries is dependent on the economic uses of the

---

[2]Biodiversity, according to the Convention of Biological Diversity, is the variability among living organisms from all sources incuding intera alia, marine and other aquatic ecosystems and the ecological complexes of which they are a part, this include diversity within species, between species (defined by their genes) and of the ecosystems (Glowka et al., 1994). The Global Biodiversity Assessment (UNEP, 1995) also defines biodiversity as >the total diversity and variability among living things and of the systems of which they are a part, which covers the total range of variation in and variability among systems and organisms, at the regional, landscape, ecosystem and habitat level, at the various organism levels down to species, population and genes and the complex sets of structural and functional relationships within and between these different levels of organizations, including human action, and their origins and their evolution in space=.

forest[3]. The most commonly perceived (though not the most valuable) uses of the forest are timber and agriculture production. But also of great importance are non timber and forest products such as resin, honey, fruits and nuts. There are also the displacement uses of the forest, that is, its uses for other purposes, such as the construction of hydro dams, the building of roads, and so on. Finally, there are the values of the forest in conservation. These include key ecological functions, recreation and tourism; the option value of the future use of the forest resource; and non-use and bequest values (Barbier et al., 1991).

An economically efficient strategy for the forest should maximize the net benefits from all uses. Many of the uses of the forest mentioned have market values, and therefore their benefits can be estimated. Unfortunately, non market values of the forest are more difficult to measure and not easily expressed in monetary terms, and thus are often ignored in the allocation and use of the forest resources. The environmental values are reduced by the use of the forest either for selective cutting or clear felling of timber and/or conversion to agriculture. But the resulting loss of benefits (e.g. ecosystem functions, non-timber products and biodiversity loss) are seldom accounted for. The increase in the production of timber and agriculture from converted forest land are influenced by economic policies, which if poorly designed can lead to the over exploitation of the forest and subsequent biodiversity loss. Moreover, many macroeconomic policies (such as prescribed by the SAP) that are designed for other purposes, such as monetary, fiscal or trade and exchange rate reform, can have unintended side effects on the forest resources through positively influencing the incentives to exploit timber and expand agricultural activities. The problem is that the policies may be designed to >improve= the overall macroeconomic performance in the economy, but because of the presence of market failures, the result may be incentive effects that may worsen forest loss and subsequent biodiversity loss. Economists generally refer to this as the problem of the >second best=. Policies designed with the intention of correcting or improving fiscal, monetary or trade >imbalances= inadvertently exacerbate another allocative failure, such as the presence of market failures with regard to biodiversity and other environmental values of the forest (Barbier et al., 1995).

[3] Sustainable use in this context means the use of the components of biodiversity in a way and at a rate that does not lead to the long-term decline of biodiversity, thereby maintaining its potential to meet the needs and aspirations of the present and future generations (Glowka et al., 1994). ASustainable use≅ has its parallel in Asustainable development≅ defined as meeting the needs of the present generation without compromising the needs of the future generations (1987 World Commission on Environment and Development, also known as the Brundtland Commission).

1.2 Objectives and approach of the study

The following study seeks to examine the causes and consequences of forest loss in Cameroon, and in particular the influence of structural adjustment policies on deforestation. It examines the underlying causes of deforestation, and evaluates how policies have affected the sustainable use of the forest. Specific questions addressed include:

! determining the relative importance of food and cash crops and timber production as causes of forest loss;

! examining the underlying economic forces and other factors that have aggravated or mitigated the problem; and

! identifying the specific impacts of structural adjustment reforms on the process of deforestation.

To achieve these objectives, the study first develops a model based on a dynamic optimal control problem of renewable resource exploitation. The model comprises three-sector approach to tropical forest land use (cash crop, food crop and timber extraction) with well-behaved production functions. The model is used to derive relationships for forest land conversion to cash crop and food crop lands and timber exploitation as functions of output and input prices. A forest loss equation is also derived. These equations are estimated for Cameroon over the period 1965-1995. Various regression approaches are used to investigate the extent to which the Structural Adjustment Programme, implemented in Cameroon over 1989-1995, has impacted on the forest through its influences on input and output prices.

The next five chapters of the report are as follows. The next chapter provides a broad overview of land use, forestry and agriculture in Cameroon. Chapter 3 reviews the Structural Adjustment Programme in Cameroon and policies influencing deforestation. Chapter 4 describes the methodological approach and development of the analytical model of forest land use and derives the demand for land equations to be estimated. Chapter 5 provides details of their estimation and discusses the results. The final chapter contains a brief summary, conclusions and policy implications.

Chapter 2: Land use, forestry and agriculture and the implications for biodiversity in Cameroon

2.1 Introduction

Agriculture and forestry have been important to the economy of Cameroon since independence in 1960. Expansion of the two sectors, however, has had significant implications for forest loss. For agriculture, the high dependence of production on the traditional methods of shifting cultivation and slash and burn, has led to a high dependence on the forest. In spite of the efforts made at providing inputs to the sector, most farmers still have little access to improved technology and are highly dependent on the nutrients from the burnt forest for increased agricultural production. Timber extraction also entails over-use of the forest resource. Although harvesting can lead to minimal forest loss if the extraction is done in an efficient way and on a sustainable basis, studies have shown that this is not the case in Cameroon. In recent times (given its dwindling oil reserves), Cameroon=s economy has come to rely even more on the forestry sector, leading to increased exploitation of timber. Unsustainable timber extraction in most cases complements agricultural production by making the forest area increasingly accessible to farmers. These land uses which may lead to forest loss also have implications for the loss of biodiversity. This chapter of the paper describes the structure/production of the three main industries that utilize the forest (forestry - timber; cash crops; and food crops) and their implications for Cameroon=s forest and biodiversity. The descriptions, in most cases, follow the four main economic eras in Cameroon since 1960. These are the pre-oil boom (1960-1977), oil boom (1978-1986), economic crisis (1987-1988) and Structural Adjustment Programme (SAP) and devaluation (1989 to 1993, 1994 to present) (Ndoye, 1997). The following chapter includes a description of land use and the forest in Cameroon over the past three decades; a discussion of biodiversity in Cameroon=s forest; a description of the trends in deforestation, forest degradation and biodiversity loss in Cameroon=s forest; a discussion of the causes of deforestation; a review of the forestry sector; a review of the structure/production trends of cash and food crops; and finally, some conclusions.

2.2 Land use and forests in Cameroon

Cameroon is roughly triangular in shape with a base of about 700 km and a height of 1200 km. It has an area of 475,440 sq. km, of which 8,536 sq. km are under water and a 400 km coastline on the Gulf of Guinea. The country lies between latitudes 2^0 and 13^0 N and between longitudes 8^0 and 16^0 E. It is bounded to the south by Equatorial Guinea, Gabon and Congo, to the north by Chad, to the east by the Central African Republic and to the west by Nigeria and the Atlantic Ocean (Green and Brown, 1994; Sayer et al., 1992). Cameroon has been described as Aall of Africa in one triangle≅, since the country boasts a wide range of climates and ecosystems, from a Sahalien region to an Afromontane region (Green and Brown, 1994). In the north and extreme north extending up to Lake Chad, the country is covered by Sahelian Savanna, the centre has the characteristics of high altitude moist savanna and the south is covered by dense tropical rainforest (Horta, 1991) (See Appendix 2.1).

The constitution of land area in Cameroon has been described by many studies. There are a few discrepancies in the statistics, though they are not very relevant. According to Tambi (1984), about 6 per cent of the land area is under agriculture, 17 per cent is under grazing, 18 per cent is fallow, 50 per cent forest and 9 per cent is watershed and waste land.

According to Green and Brown (1994), Cameroon retains about 40 per cent of its original forest, consisting of four principal types: Atlantic forests, Pluvial forest, the High Altitude forest, and the Guinea-congolese forest. The forest zone houses the highest variety of plant species and has an endemism rate of 80 per cent. The forest also holds approximately 25 billion hectares of marketable wood.

The country contains moist forest of two of Africa=s four major biogeographical regions: the Afromontane and the Guinea-Congolene (White, 1983). The Afromontane region comprises two major domains, Afro-subalpine grassland and montane forest, both of limited extent. These regions cover about 725 sq. km, or less than 1 per cent of the land area. The Guinea-Congolean region which includes submontane forests and extensive dense, humid, evergreen forest as well as semi-deciduous forests of middle and low elevation, covers a total of 267,000 sq.km or 56 per cent of the land area of the country; about 66 per cent of the region remain forested (see Appendix 2.2) (Sayer et al., 1992).

Five species of trees characterise the montane zone: *Nuxia congesta, Podocarpus latifolius, Prunus africanus, Rapanea melonopholoeos* and *Syzygium staudtii. Arundinaria alpina* also occurs, and *Olea hochstetteris* is found in the drier montane forest. Other montane species include *Crasseocephalum mannii, hpyericum lanceolatum, Myrica arborea, Philippia mannii* and *Schlefflera abyssinica*. While levels of endemism are fairly high, species diversity is low.

The submontane forest zone is found between 800 and 2,200 m in the south of the country and from 1,200 and 1,800 m in the north. It is characterised by floral uniformity and an abundance of plants of the family Guttiferae. At lower altitudes, the specie structure of the forest is similar to that of the adjacent lowland forests; as elevation increases the epiphytic flora, principally orchids and mosses, increase and tree species not found in lowland forests (e.g. *Caloncobo lophocarpa, Crotonogynopsis manniana, Dassylepsi racemosa, Erythrococca hispida, Prunus africanus* and *Xylopia africana*) begin to appear. The submontane forests are very poorly known biologically compared to both the lowland and montane types (Sayer et al., 1992).

Medium and low altitude forest are found from sea level to 800 m in the south and from sea level to 1,200 m in the north of Cameroon. Within this domain, the dense, humid, semi-deciduous forest is often fragmented and it is seriously endangered by bushfires set during the dry season. This forest types covers around 40,000 sq. km or about 8.6 per cent of national land. The dense humid evergreen forest covers about 27.5 per cent (128,000 sq. km) of the country=s land area and is made up of two principal zones: evergreen Cameroon-Congolese forest and evergreen Atlantic forest.

The evergreen Cameroon-Congeolese zone of medium altitude forest covers about 81,000 sq. km or 17.4 per cent of the national land. The floristically diversity of this zone tends to be lower than that of the Atlantic coastal forest. Principal affinities are with the Congo basin forests with such species as *Lannea welwitschii, Cleistopholis patens, Xylopia staudtii, Bombax buonopozense, Cordia platythyrsa, Swartzia fistuloides, Irvingia grandifolia* and *Entandrophragma utile*. With the notable exception of *Gilbertiodendron dewevrei*, this forest, unlike parts of the Atlantic zone, is not characterised by gregarious Caesalpiniaceae. Associations found within this zone include the swamp forests of the Upper Nyong with

Stercullia subviolacea and *Macaranga* spp., swamp forest with *Phoenix reclinata* and *Raphia monbuttorum* and forests with *Guibourtia demeusei*.

The evergreen Atlantic (or Nigerio-Cameroon-Gabon) zone of the low and medium altitude forest covers about 47,000 sq. km or 10.1 per cent of national land. The floristic diversity is very high and there is marked endemism. The flora has affinities with the forests of South America. For instance, the trees *Erismaldephus exsul* and *Sacoglottis gabonensis* belong to families poorly represented in Africa, but which are abundant in South America. *Andira inermis*, which have a very local distribution in this forest zone, is another species that is also found in South America. This zone is the centre of diversity for various plant taxa including the genera *Cola*, *Diospyros*, *Garcinia* and *Dortenia*. In addition, many narrow endemics occur in the forest including *Hymenostegia bakeri*, *Soyauxia talbotii*, *Deinbollia augutifolia*, *D. Saligna*, *Oouratea dusenii*, and *Medusandra richardsiana*. The forest shares species with the Ituri forest of eastern Zaire (e.g. *Diospyros gracilescens*), with the forests of the Congo basin (e.g. *Oubanguia alata*, *Afzelia bipindensis* and *Enantia clorantha*) and with those of the Upper Guinea (e.g. *Dispyros kamerunensis* and *D. piscatoria*). These species shared with other regions evidence of past connections between the forests (Sayer et al., 1992).

The forest also consists of some mangroves. It is estimated that by 1985, about 2,434 sq. km of mangroves remained. The mangroves and the adjacent coastal waters of up to 50 m in depth nurture and protect fishery resources of greater economic and nutritive importance for Cameroon. But this has been destroyed by the use of pesticides and fertilizers on the large industrial plantations (chiefly for rubber, oil palm and bananas). Fertilizer, for example, causes eutrophication and algal growth which interfere with mangrove transpiration.

The rainforest of Cameroon, covers about 175,200 sq. km or 37.6 per cent of the country=s land area. The dense humid evergreen and semi-deciduous forest, covering 168,000 sq. km, make up the majority (FAO, 1990; IIED, 1987). Other estimates in 1985, show a slightly lower total rainforest of 155,330 sq. km or 33.4 per cent of total land area (Table 2.1).

Many of Cameroon=s forest are subject to an equatorial climate with four seasons per year (a long and a short dry season and a long and a short rainy season), but the coastal and montane forest tends to have an anomalous climate with only two seasons (a long wet season and a short, albeit often severe, dry seasons) (Sayer et al. 1992).

Table 2.1: Estimates of rainforest extent in Cameroon

Rainforest	Area (sq. km)	per cent of land area
Lowland	147,480	31.7
Montane	3,186	0.7
Mangrove	2,434	0.5
Swamp	2,230	0.5
Totals	155,330	33.4

Source: Sayer et al. (1992). *The conservation atlas of tropical forests: Africa*. IUCN. p.112.

2.2.1 Reserve Forests and conservation areas

The protected areas in Cameroon cover about 8.4 per cent of the country=s land area. The national goal, however, set by a law in 1981 is 20 percent. There are seven national parks, eleven faunal reserves and nine wildlife reserves under the jurisdiction of the Ministry of Tourism. In addition, there are approximately 125 forest reserves (about 4 per cent of the total land area), with varying sizes from a few hectares to 300,000 hectares. This is under the control of the Ministry of Agriculture (MacKinnon and MacKinnon, 1986; Gartlan, 1989). The national parks cover an area of 10,319 sq. km, of which 1,260 sq. km is in the dense forest zone and the faunal reserves cover more than 10,372 sq. km. The total area covered by the wildlife reserves are 9,890 sq. km, while the forest reserves cover an area of around 18,600 sq. km. There is also legal protection of river banks and watercourses. The law of 1981 requires no environmentally destructive activities within 50 m along each river bank and 100 m around springs. There is, however, little enforcement of the law (Tchoungui et al., 1995; Gartlan, 1989).

Forest reserves (production and protection forests) are state property and part of them (the protection forests) comprise part of the protected area system. However, most are apparently destined for production forests. The percentage of protection to production forest intended by the government is small and probably will not exceed 1 per cent of the area under production forest (Gartlan, 1989).

Six of the seven national parks are in the Savanna zone with only Korup National Park in the dense forest zone. Korup National Park (1,260 sq. km) lies in the dense evergreen Biafran coastal forest which is particularly high in biodiversity. Seven of the nine wildlife reserves are in the dense forest zone.

Most of the reserves are in poor condition. Four of the reserves in the dense forest zone, Campo (2,700 sq. km), Douala -Edea (1,600 sq. km), Lake Ossa (40 sq. km) and Sanaga lie in the high biodiversity coastal Atlantic forest zone. The Sanaga reserves, established to protect the hippopotamus population of the lower reaches of the Sanaga River, has more or less disappeared with the hippos. A long-term logging concession (25 years) has been granted in the Campo Reserve and much of its important biodiversity destroyed. Douala - Edea is under-protected, and there is proposal for partial degazating of part of the northern sector. Illegal human habitation on the shores of lake Tissongo has been regularised by the administration, thus compromising its future. Seismic exploration for petroleum caused severe degradation to the reserve. The forest around lake Ossa has been severely degraded but it still contains populations of the manatee, *Trichechus senegalensis* (Tchoungui et al., 1995).

The Nango-Eboko wildlife reserve (160 sq. km) on the northern limits of the semi-deciduous forest/savanna transition zone, has been hunted out and serves no current wildlife purpose. The Santchou wildlife reserve (70 sq. km) lies in the forest transition between lowland and montane. It has been severely affected by incursions from agricultural land and settlement and up to 50 per cent of its area may have been lost. The vast area of the Congolese forest is protected by the Dja Wildlife Reserve (5,260 sq. km). This forest is subject to severe pressures but these are being addressed by a project funded by the European Union (ECOFAC) whose aim is conservation of the forest through sustainable development activities of the people in the vicinity of the reserve (Tchoungui et al., 1995).

As stated earlier, farming activities have contributed immersely to the degradation or destruction of some of the reserves. For instance, 45 per cent of the Santchou Faunal Reserve in the Western province has been converted to farms and plantations. (Sayer et al., 1992).

Other problems with the reserves are the few and ill-equipped guards to protect them. In comparison to the national parks, reserves have not been developed as tourist attractions, and thus receive low budgetary and infrastructure priority. Realistically, in the dense forest zone, only the Korup National Park, Dja Faunal Reserve (also a Biosphere reserve and a World Heritage site) and the southern sections of the Douala-Edea Reserve are protected. Moreover, proposed declassifications and reclassification of faunal reserves may result in completely degraded forest (Sayer et al., 1992).

The coverage of protected areas is seen to be inadequate. Montane, submontane and semi-deciduous forest are barely represented. The coastal forests need additional protection because much of the area has already been logged-over and degraded; parts of the Douala-Edea and the Campo Reserves have been effectively lost. The Congolese forests are under-protected. A scheme for extending protection for adequate coverage of the dense forest zone was presented by the IUCN (Gartlan, 1989). It is, however, clear that if the intention is to double the output of timber, then it is even more important to implement an ecologically sound and effective scheme for the protection of all the various types of forest that make up the dense forest.

2.2.2 Unreserved forest, non-forest lands and forest plantations

Information is ambiguous with respect to areas of intact closed forest outside reserves. Unreserved forest however, have generally been planned for conversion to agriculture. Most of the unreserved forests have been converted to farm lands and fallow areas, in most cases after they have been extracted for timber.

Non-forest lands are mainly areas under cash and food crops and fallow lands. These have increased over the last 30 years given the high dependence of the economy on agriculture. What is not estimated is the level of infiltration of agriculture into the reserved forest, which may be very substantial. It is true that farm and fallow lands may still hold some forest resources due to the nature of dominant farming systems in the high forest zone. However the fact that most of the trees have been removed and burnt to make room for cash crops and other crops have, in itself, degraded the biodiversity of the natural forest. Moreover, the combination of factors such as the neglect of most of these cocoa and coffee farms and the conversion of most of these farms to food crops during the economic crisis period, and the movement of people, mostly, after the oil boom, to the high forest zones may have rendered and continue to render most of these farms and fallow lands and the forest itself bare of trees.

Cameroon has very few forest plantations. A reafforestation plantation was established in the South Province concerned only with the southern part of the Kienké reserve, with a total of 7,258 ha. There is little possibility of extending plantation activities owing to the lack of resources (Tchoungui et al., 1992).

2.3 Biodiversity in Cameroon=s forest

Cameroon=s forests, as discussed above, are complex, heterogenous and contain a high rate of endemism. The forest offers the highest species density rate of any African country. It is the twenty-third largest country in Africa, but has the fifth highest number of species of mammals and populations of more than forty globally threatened animals (Sayer, et al., 1995). In the Korup Reserve more than 3,000 species have been identified (Green and Brown, 1994).

About one-third of the land is covered by one of Africa=s most ancient forest blocks. These forests are home to tens of thousands of indigenous Baka and Bakola people[4]. Aside from its human population, Cameroon=s rainforests are extraordinarily rich in wildlife, including a high number of endemic species. Among the wildlife are primates and other large mammals, many of which are listed by the International Union for Conservation of Nature and Natural Resources (IUCN) as rare, endangered or threatened with extinction. The country=s biological wealth has led the World Bank and IUCN to classify Cameroon as a Amegadiversity≅ country. This means that high percentage of the World=s biodiversity will be lost if Cameroon=s biological resources are not adequately protected (Horta, 1991)

There are 9,000 species of plants in the forest, with at least 156 endemic including 45 on Mt. Cameroon alone. A recent survey found more than 200 species of woody plants in a sample site of 0.1 ha, a level of diversity comparable with the highest in the world. Some 260 to 297 species of mammals, 848 species of birds, 542 species of fresh and brackish water fish (17 per cent endemic) have been found in the region. More than 1000 butterfly species have been recorded from the forest of the Bight of Biafra. This area is also a centre of diversity of frogs. Eight genera of frogs are limited largely to the region (Tchoungui et al., 1995; Sayer et al., 1992; Stuart et al., 1990; Gartlan, 1989).

Plant and animal endemism is highest in the moist evergreen forest belt along the coast and decreases as biomes become drier. The geographical distribution of many endemic forest species is very narrow compared with that of the drier biomes. The total distribution of Drill, *Mandrillus leucophaeus*, a forest baboon, is 100 per 50 sq. km, whereas the savanna baboon of Cameroon, *Papio anubis*, extends from Senegal east through northern Republic of Congo (formerly Zaire) to Ethiopia, Kenya, Uganda and northern Tanzania (Tchoungui et al., 1995).

The Cameroon forests are the major centres of endemism for the genger and arroroot family (Zingberaceae). One species, *Aframomum giganteum*, also found in Gabon, has fronds reaching up to 6 m and is the tallest ginger plant in the world. *Cola lepidota* and *C. Pachycarpa*, small trees bearing large, edible fruit, are also endemic to Cameroon. The yam, *Dioscorea*, is indigenous to the forest of the Bight of Biafra. There are several species within the genus but all protect their tubers from toxins. These were relied upon as food some centuries ago. Cameroon=s forests are the centre of dispersion for the world=s premier oil-producing plant, the oil palm *Elaeis guineensis*, and its major pollinator, *Elaeidobius kamerunicus*. These are endemic to

[4]The Baka and Bakola people are normally referred to as APygmies≅ meaning people of small stature. They are mainly hunting and and gathering societies depending so much on the forest for their livelihood. There is estimated 20,000-35,000 Baka people in Cameroon=s south-eastern forest while the Bakola, estimed to number about 3,500, are dispersed in the cosatal forests of the south-west (Horta, 1991).

Cameroon. This weevil was exported to Southeast Asia in 1981 where, within one or two years of its introduction, oil production rose by almost 20 per cent.

The montane forests of Cameroon, though not as rich in number of birds species as the lowland forests, are particularly important for the 22 endemic bird species they support (Stuart, 1986). Bannerman=s turaco *Tauraco bannermani*, is restricted to the montane forest, while Mt Cameroon has an endemic francoline *Francolinus camerunensis*. The mount Kupe bush-shrike *Malaconotus kupeensis*, another montane species, is one of the rarest birds in Africa. Endemism in this area is also high among animals that are poor dispersers such as amphibians and invertebrates (Sayer et al., 1992).

The lowland forests of Cameroon are of particular importance for the conservation of primates. With 29 primate species, the country is the second richest in Africa in this respect. It contains much rare and threatened species as the drill *Mandrillus leucophaeus* and the mandrill *Mandrillus sphinx*. Other species of the conservation concern in the country include the gorilla *Gorilla gorilla* and the chimpanzee *Pan troglodytes*, the black colobus *Colobus santanas*, Preuss=s guenon *Cercopithecus preussi* and the red-eared guenon *Cercopithecus erythrotis*.

Cameroon is the major squirrel centre in Africa and includes endemics such as *Paraxerus cooperi*, which are restricted to the montane forest of Mt. Cameroon. The flightless scaly-tailed squirrel *Zenkerella insignis* is also endemic to Cameroon and is a very rare mammal belonging to a family, which, 30 million years ago, contained the dominant rodents in Africa. All other members of the family, the anomalures, are gliders with broad membranes between their legs but *Zenkerella* has no such membrane and is probably close to the primitive condition. Additional information on the biogeography of Cameroonian mammals can be found in Kingdom (1990).

Given such a high diversity in Cameroon=s forest, it is important to control the rate of forest loss, in order to conserve this diversity and sustain the other important uses of the forest discussed in the introduction

2.4 Deforestation, forest degradation and biodiversity loss

Over the last two decades, Cameroon has been cited as one of the nine key tropical countries which have had the highest rates of deforestation. This rate of deforestation is, however, not much higher than the average for Africa as a whole, which was about 0.6 per cent over the period 1976-1986 (WRI, 1990) and 0.7 per cent in 1990-95 (World Bank, 1998).

Deforestation in Cameroon is difficult to quantify. Partly because of the differences in definition and partly because of the difficulties in assessment, estimates of loss of forest cover, or of deforestation, vary considerably. For instance, FAO (1988) gives a figure of 800 sq. km lost per year during 1981-5, while IIED (1987) estimated an annual loss of 1500 sq. km. Current estimated rates of deforestation vary from 1000 sq. km (WRI, 1990) to 2000 sq. km per year (ONADEF, 1992; World Bank, 1998). These figures give an annual loss of forest of 0.5-1 per cent. The IUCN conservatively estimates that the rate of deforestation in Cameroon=s dense forest is 10-11 times higher than the rate of regeneration (Horta, 1991). At the current rate of deforestation, it is estimated that all Cameroonian forests will disappear in 150 years. Of even greater concern is the rate of forest degradation. For instance, intact forest which has lost one or more key mammal species, is much higher and true primary forests are now virtually restricted to a few areas in the Southeast of the country (Tchoungui et al., 1995; Sayer et al., 1992). Although a large part of the country=s forest area is still untouched, these trends in deforestation in Cameroon should be of much concern. We have already noted the rate of destruction in the reserves and also the implications that the rate of forest loss will have on the high diverse forest of Cameroon and the other important functions of the forest.

The increasing loss of Cameroon=s forest and tree species have implications for the variety of fauna in the forest. The first reaction of many animals during and after logging operations and farming activities is, in the short term, to move away (Burgess, 1971). This will disrupt the complex interrelationships between plants and animals which will, in turn, greatly influence the mechanisms (and rates) of regeneration, reproduction and speciation in tropical forests. A variety of faunae are increasingly becoming rare in Cameroon as a result of declining forest. Some of these faunae, have already been mentioned.

The very small and declining population of forest elephants (*Loxondonta african cyclotis*) in Cameroon is considered to have very severe repercussions for the natural (and sparse) regeneration of a very important timber species, makore, (*Tieghemella heckelii*) and others of potential commercial interest (Hall and Swaine, 1981). These are all trees with large seeds which are known to be dispersed only by sizeable mammals. The elephant is known to favour fruits from makore, as the seed passes through the animal=s intestine unharmed and germinates very successfully in its dung (Martin, 1990).

The overall consequence of elephant loss on the composition, richness and diversity of plant species in Cameroon=s forest may be substantial. In neighbouring Cote d=Ivoire, for example, 30 per cent of the seeds of tree species and 41 per cent of the seeds of tree individuals are dispersed by elephants (Alexandre, 1978). Furthermore, the decline of natural elephants browsing tracks and pathways in primary forest, is one reason cited for the now very small population of White-breasted Guineafowls (*Agelastes meleagrides*) which only exist in open floors beneath closed, canopy forest (Kingdom, 1990).

Other species which disperse fruits and seeds, and which are vulnerable to logging throughout West Africa, include, the dwarf hippo (*Choeropsis lieriensis*) and the giant forest hog (*Hyclochoerus meinertzhagen*) (Martin, 1990). The absence of such feeding specialists will greatly influence the natural regeneration particularly for those species where seed, seedling or sapling mortality is high close to the parent tree (usually because of insect predation but also natural autotoxicity). In such instances, seed dispersal is vital. For example, sapling of idigo/framire (*Terminalia ivorensis*) are unable to mature anywhere near a full-grown parent tree of the same species (Kingdom, 1990).

In fact the rate of fauna lost maybe underestimated. In a recent survey in the Cameroon forest, it was found that there are still some species of faunae which are unknown. Such species could be drawn to extinction by the destruction of the forest without any knowledge of their existence and extinction. These faunae may perform some very important ecological and other functions.

In addition, forest disturbance, either by excessive timber exploitation and/or farming activities, can radically change the microclimate of the area. The rapid transformation to a more open, dry and sunlit environment has disruptive effects on wildlife and the natural regeneration (succession) of trees. Logging has been shown to cause rapid but aberrant, rank secondary growth overtopping usual colonizers of more natural gaps in the forest canopy (Jacobs, 1988). Large scale mechanised logging operations, currently practised throughout the tropics, can retard natural succession of primary tree species by as much as 20 years.

Soils become compacted and new seed banks and seedlings are destroyed under heavy logging equipment (Gartlan , 1990). Nutrient loss is significantly higher on exposed soils than under a heavy canopy. Such events will further slow regeneration and influence species composition during succession. Moreover, soil erosion in Cameroon under shifting cultivation (a phenomenon that so often follows logging) may exceed that for natural forest (i.e. depending on the slope and the types of soil). Water courses can also be greatly affected through siltation.

Furthermore, the regulatory role of the forest in maintaining the atmosphere=s carbon dioxide balance - the main greenhouse gas, is reduced and sometimes worsens, by deforestation. An estimated one -fifth of gases responsible for global warming is caused by the loss (particularly through burning) of tropical forests (Myers, 1989).

In addition, deforestation and biodiversity loss have an impact on the livelihood of local people. Non-timber forest products (NTFPs) play important part in the everyday lives of many Cameroonians, particularly several tens of thousands of indigenous forest dwellers refer to as >Pygmies=, which include the Baka and Bakola people. The population regularly eats bushmeat, as well as a wide range of forest fruits. Plants are often used in construction or in the production of other goods (such as mats, baskets, furniture, dyes, resins and gums). The rural population (almost without exception) relies on the use of traditional medicine, which is based on forest plants, as their main (and often only) source of health care (Horta, 1991). These benefits will be lost through excessive timber extraction and farming activities.

2.5 Causes of deforestation and forest degradation

Forest loss in Cameroon has been caused by the interaction of different factors: social, cultural, political and economic. But as noted from the preceded section, logging activities, agricultural encroachment and fire are the main proximate (direct) causes of forest loss in Cameroon (Green and Brown, 1994; Sayer et al., 1992). To a lesser extent fuelwood exploitation has also been cited as a proximate cause. Agricultural encroachment has been said to be the major direct cause of forest loss (Amelung and Diehl, 1992). This has been exacerbated by population increases and what has been termed as return-migration to the rural areas (Ndoye, 1995). The discussions that follow assess the roles of fuelwood extraction, fire and more importantly logging and agricultural conversion on the forest in Cameroon. Other mainly indirect causes of forest loss are dis cussed in the next chapter.

About 10.1 million cubic metres (cum) of wood are used for fuel in Cameroon, mostly as firewood with about 10 percent being made into charcoal. Firewood represents a value of more than US$200 million per year. There is little control of this resource. This may lead to over-extraction and impact on the forest. However, this may not necessarily lead to forest loss if it is done in a sustainable manner. In fact a recent survey shows no relationship between fuelwood extraction and the rate of forest lost in Cameroon. Its impact on forest loss is therefore expected to be very minimal. Fire has destroyed some parts of the montane and semi-deciduous forest. As noted earlier, the semi-deciduous forest of the Eastern Province may be damaged by fires due to repeated logging activities, since the logging makes it easier for the fires to spread.

Much forest loss has been attributed to the direct and indirect result of vastly increased commercial logging operations in the country. Freshly logged areas, are said to look as if they have been devastated by warfare. Although logging companies only retrieve a small number of tree species, the cutting and hauling of these trees with heavy equipment destroy everything in their path. The open access to forest lands created by logging leads to increased immigration from the centre and northern parts of the country and has already led to a massive land grabbing in the area of the provincial capital of Bertoua (Horta, 1991).

Most logging activity is said to be extremely selective, mainly because of economic reasons. The amount extracted per hectare can be as low as 2 or 3 cum (compared with 10 -20 times as much as in Southeast Asia). In felling trees, however, as much as 30 - 50 per cent of the remaining trees can be destroyed, the soil can become so impacted as to impede regeneration and up to 25 per cent of trees are left to rot in the forest. In other areas close to Douala, such as the Littoral Province, logging is less selective and the forest have already been logged several times since the colonial period. Logging in the coastal forest is likely to do more ecological damage as the forests in this area are old growth and rich in *Caesalpiniaceae*. The semi-evergreen forests of the Congolese sector show many characteristics normally associated with the second-growth forests and as a consequence may be more tolerant to logging activities (Tchoungui et al., 1995).

Concessions have been granted on at least 80,000 sq. km of forest, which is on more than half the land area officially classified as exploitable. It was estimated that by 1992, 50 per cent of production forests area will have been logged three or four times and thus will affect the regenerative capacity of the forest. Moreover, only a few of the tree species are extracted leading to over cutting. Of the 49 tree species officially recognised as commercial, only about 30 are used. Three species ayous (*Triplochiton scleroxylon*), sapele (*Entandrophragma cylindrincum*) and azobé (*Lophira alata*) account for almost 60 per cent of production. Ayous (known as obéché or samba in West Africa) is a white wood, while azobé is a hard and heavy redwood (Sayer et al., 1992).

There is also high wastage in the extraction and processing industries. The average recovery rate of timber from raw logs processed for exports is about 30 per cent but can be as low as 20 per cent. Furthermore, it is estimated that as much as 20-35 per cent of each felled tree is lost at the logging stage. As a result, the waste from tree to sawn products is as high as 65 - 75 per cent. Part of the reason for this is that concessions are granted for a five-year renewable period and, under the current rules, sawmills-based concessions have a working life of only nine years before their licence expires. This does not make it economically viable to invest in expensive, efficient machinery. Instead, old, outdated and inefficient machines tend to be used (Sayer et al., 1992).

Logging also provides access to forest areas by farmers and hunters. Slaughter by hunters will slow down or stop the ecological succession process. For example, a forest without some seed-dispersing duikers, elephants and hornbills, may look the same as one with them, but it is a forest which will certainly change in composition and become less diverse. For example, forests in Cameroon=s Littoral and Southwest Provinces had elephants in pre-colonial times but most of these have gone since then.

According to Amelung and Diehl (1992), the main direct cause of deforestation in Cameroon is agriculture, at least over the period 1981-1990. Shifting cultivators accounted for 95 per cent of deforestation, while permanent agriculture accounted for the remaining 5 per cent. Agriculture has also degraded most of the reserves and it is putting pressure on others, for example, the Santchou reserve in the Western Province, the

Ngango-Eboko reserve and the Dja reserve. The increasing population in the rural areas, due also to the return migration after the oil boom period may have worsened the situation. It must be noted, however, that logging provides easy access to the forest. Given this, and the fact that logging activities are not sustainable, suggest that logging is an important cause of forest loss in Cameroon. Unsustainable logging also reduce the rotation period in land use, and the forest does not have enough time to regenerate. The soils then become exhausted and the absence of trees renders the remaining fertile soil layer susceptible to erosion, leading to permanent deforestation.

2.6 The forestry industry

The forestry industry consists of all the sectors of the economy that directly or indirectly utilizes forest resources for production. In this study however, the definition is narrowed to sectors that deals with the extraction and processing of logs in Cameroon over the period 1965-95. This section focuses on the specific role of the timber industry in the economy, the nature of the sector, and the main trends in production and export levels of logs. We also discuss the problems and constraints faced by the sector to which the Structural Adjustment Programme (SAP) has tried and trying to find solutions. Actual timber policies implemented under the SAP are addressed further in Chapter 3.

2.6.1 The role of the forestry industry in the Cameroon economy

Cameroon is currently the seventh largest exporter of tropical timber in the world and third in Africa after Côte d=Ivoire and Gabon. In 1992, the country produced 4.2 per cent of total African hardwood, and 1.6 per cent of the world total. The timber industry is one of the important sectors in the economy of Cameroon. Timber products are the fourth important export, after petroleum, coffee and cocoa beans, and account for 2 per cent of GDP. Foreign exchange from timber exports has increased by about 63 percent from 56 billion CFA F (US$176 million) in 1989/90 to 149.6 billion CFA F (US$269 million) in 1994/95 (Ndoye, 1997). Government revenue from timber taxes increased by about 75 percent from 6.2 billion CFA F (US$21 million) in 1987/88 to 24.5 billion CFA F (US$86.5 million) in 1993/94. This was expected to increase further (after the devaluation in 1994) to 37 billion CFA F (US$74 million) in 1995/96 fiscal year. Current government policy aims to put the timber industry as the driving force of economic growth. Production is targeted at 4 million cum by the year 2000 and 5 million cum by the year 2010. The sector engages about 20,000 persons in full-time employment, representing about 9 percent of the total industrial workforce.

2.6.2 Structure of the forestry sector

The Forestry Directorate, of the Ministry of The Office National de Régénération des Foréts (ONAREF) has responsibility for forest inventories, the development of management plans, the promotion of wood and wood products, forest regeneration and increasing forest productivity. However, its responsibility for land management and regeneration is limited to state lands. Although ONAREF has carried out inventories for almost 110,000 sq. km, it has provided management plans for very few of the state forests. ONAREF is also responsible for the application of forestry legislation as it concerns production and protection forests and for the supervision and control of forestry exploitation at both central and regional levels (Sayer et al., 1992).

In order to obtain a forest licence, companies must first obtain a forest certificate of admission into the forest industry. Certificates are awarded to companies on the basis of wood processing equipment and/or financial resources and forest exploitation experience. The National Technical Commission, which meets two times a year, determines whether a company has the capacity and experience to be certified to work in Cameroon. Once the National Technical Commission has awarded the certificate, a company is allowed to bid on a concession. Concessions are generally up for bid once a year and the region and area available can vary each year. After a public notice is released, interested parties have a month to respond, after which time a commission (formed of various ministries including representatives from the Ministry of Environment) make a selection. The entire process, from the acquisition of a certificate, to bidding, to actual exploitation, rarely takes less than one year, and can take up to three or four years (Green and Wood, 1994).

Concessions range from between 20,000 and 200,000 hectares, depending on the processing capacity of the company (the larger the capacity the larger the concession size). Upon being awarded the concession, a company is required to conduct surveys. An initial survey is used to finalize agreement with the government on the size of the concession. Each concession is then divided into blocks of 2,500 hectares (ha) each and a second survey is required on one of these 2,500 ha blocks. This survey is intended to provide various information including road input, assembly points, estimated compensation for crop damage, and total volume to be harvested. Exploitation then begins block by block. The concessionaire is allowed five years to harvest each block, at which point theoretically it must leave the area to allow for regeneration. ONAREF is responsible for ensuring that the area is left abandoned after this five-year stint (Green and Brown, 1994).

ONAREF is also responsible for ensuring that the companies only harvest a 2,500 hectare plot at a time, only exploit the agreed upon type of tree species, and respect the agreed upon stump size, and that other forest products are not being exploited. In theory, this is done through forest spot checks by forest agents, although the number of personnel, and their resources, serving on the ground in the provinces is very limited. In most cases, the forestry companies themselves have to go and pick up government forestry personnel and take them into the field so they could Apolice≅ the exploiter=s work (Green and Brown, 1994).

Each logging company is required to pay a series of taxes and fees to the government, including a 40 per cent export tax, an exploration tax, a fixed tax, a reforestation tax, and a felling tax, making the logging industry at least in theory one of the most heavily taxed sectors in Cameroon=s economy. In spite of this, the sector generated only 1.7 per cent of the total estimated government revenues in 1991/92. There is a problem of collection of these taxes because of institutional corruption and inefficiency, combined with the lack of resources required to enforce the laws (Green and Brown, 1994). Most of the forestry taxes are expected to be fed back to the regions and communities from whence the logs came, with a significant amount to be used for forest regeneration (distributed as 40 per cent to ONADEF, 50 per cent to the Ministry of Finance, 10 per cent to the Ministry of Environment and Forests). As the transparency, and reliability, of the various government agencies has deteriorated over the years, it has proved impossible to determine what has actually happened to the collected revenue.

The five-year length of harvesting each block appears to prohibit long term investments. Also the system of >policing= and collecting forest taxes does not augur well for the efficient management of the forest, since the extractors seem to have more control than government agencies who are expected to monitor harvesting activities.

2.6.3 The operation of the timber industry in Cameroon

The logging industry is mostly controlled by foreign companies, mainly French, German, Dutch and Italian (Horta, 1991). In 1987/88 there were 67 foreign exploiters with a total of 54,00 sq. km of concession areas, 49 nationals with a total of only 12,000 sq. km. The smaller national companies tend to concentrate on the more accessible areas. A syndicate of 34 wood producers and exporters account for almost three quarters of the total annual production. French and Italian companies in turn dominate the market, which also include Dutch, Greeks, Lebanese, and Cameroonian companies (Green and Brown, 1994).

The volume of timber exports is approximately 1.2 million cum per year, of which 62 per cent are raw logs and the rest processed wood. Countries of the EU, principally Belgium, France, Germany, Greece and Holland, take 85 per cent of the exported logs and 91 per cent of the processed wood. Over half of the production comes from the semi-deciduous and Cameroon-congolese moist forest in the east of the country (areas which are also important for cocoa, coffee, maize and plantain production).

The government policy is that 60 per cent of the logs are processed locally. This may rise to 70 per cent and eventually exports of unprocessed logs will be banned. The impact of this on forest loss will depend on how efficient these processing companies are. As of 1993 there were 59 sawmills, 4 plywood factories, 1 veneer mill, 1 box assembly plant, 2 panel mills, and 1 match factory. Most of the sawmills equipment are assumed to be old and inefficient (Green and Brown, 1994). Average yields of logs are about 2-5 cum per hectare, which is low by standards elsewhere in the tropics. This indicates the high selective nature of logging but with associated high logging wastes.

2.6.4 Production and export performance of the timber industry

Production and exports of logs have followed an increasing and a decreasing trend which more often correspond to the trends dictated by the various economic eras (see Table 2.2 and Appendix 2.3). During the pre-oil boom the forest resource was the main source of revenue. Timber production increased by about 60 per cent between 1970 and 1977 (Table 2.2). Exports of timber also increased from 218,000 cum in 1965 to 511,000 cum in 1970 and then fell to 397,000 cum in 1977. In the pre-oil boom period therefore, although timber production showed an increasing trend, exports showed more of a declining trend. In fact, exports as a percentage of total production of timber in the pre-oil boom period fell from 43 per cent in 1970 to 21 per cent in 1977 (Table 2.2).

In the oil boom period from 1978 to 1986, timber production continued to rise. The rate of increases in timber production was, however, not as high as the pre-oil boom period. For example, between 1980 and 1986, a period of 6 years, the increase in timber production was about 27 per cent, as compared to a 60 per cent increase in production between 1970 and 1977, a period of 7 years, in the pre-oil boom period. Export was also not comparatively higher. Although exports of timber increased in 1978, by 1986 the rate of increase was negative. Between 1980 and 1986 export growth experienced a fall of about 45 per cent. Exports as a percentage of total timber production was also not as high as in the pre-oil boom period. The proportion of exports to total production fell to 15 per cent by the end of the oil boom in 1986 (Table 2.2). One can attribute the lower rates of increase in both production and exports to the more dependence of the economy on oil revenue during this period (Ndoye, 1997).

During the economic crisis period (1987-88), when oil became less important, timber production continued to rise, although the increase was still not very high. In fact between 1987 and 1988 timber production experienced a negative growth (Table 2.2). Exports, however, experienced an increase of about 22 per cent between 1987 and 1988, and exports as a proportion of total production also increased to 20 per cent, higher than the 15 per cent in 1986. The inference is that, although the economic crisis did not encourage domestic production of timber, the dependence on timber for revenues encouraged exports. Moreover, because the exchange rate was low, the only way to increase revenue was to increase exports.

In the SAP period and before the devaluation (1989-1993) timber production experienced a positive growth (Table 2.2). Between the end of the economic crisis in 1986 and 1994, the increase in timber production was about 22 per cent as compared to fall in production of about 2.6 per cent between 1986, the end of the oil boom period and 1988 the end of the economic crisis period. Exports of timber in the SAP period (1989-1993) also showed an upward trend (see Appendix 2.3 and Table 2.2). In fact the rate of growth in exports between 1990 and 1994 was as high as 75 per cent, and timber exports as a percentage of total production was also as high as 33 per cent between 1990 and 1994 (Table 2.2). The inference here is that the policies under the SAP instigated increases in both production and exports of timber in Cameroon.

When the CFA F was devalued by 50 per cent in 1994, it further simulated both production and exports Table 2.2). The devaluation may have influenced exports more than production. This is expected, since devaluation is expected to have more impact on exports. Table 2.2 shows that although the growth in exports was not very high, the proportion of exports to total production increased from 33 per cent in 1994 to 41 per cent in 1997. Both the SAP and the devaluation therefore led to increased timber production and timber exports. Moreover, the number of timber species exported has increased and new export markets have been opened in South Korea, Sweden, Malaysia, Turkey and Japan (Ndoye, 1997).

Table 2.2 Production and exports of industrial roundwood in Cameroon (1965 - 1997) (>000 cum)

Industrial roundwood	Pre-oil boom period			Post-oil boom period					SAP period				
				Oil boom			Economic crisis		Before devaluation			After devaluation	
	1965	1970	1977	1978	1980	1986	1987	1988	1989	1990	1994	1995	1997
Total production	917	1195	1915	2154	2196	2779	2803	2708	2872	3136	3311	3336	3386
% change in total production	-	30.3	60	12.5	1.9	26.5	0.86	-3.39	6.06	9.19	5.58	0.76	1.49
Total exports	218	511	397	654	743	411	442	537	456	623	1091	1236	1373
% change in total exports	-	134	-22.3	64.7	13.6	-44.7	7.5	21.5	-15.1	36.6	75.12	13.2	11.1
Total exports as a % of total production	23.8	42.8	20.7	30.4	33.8	14.8	15.8	19.8	15.9	19.9	33	37	41

Source: Data from FAO (1999), FAOSTAT database, CD-ROM

2.6.5 Conclusions

The discussion of the timber industry has shown the importance of economic trends as portrayed by net benefits or expected returns from timber and timber products. The net returns from timber production and the incentives to extract and export timber also appears to be influenced by the different economic eras and policies undertaken. These policies may have led to a greater or lesser impact on forest loss, depending on their influences on the relative net returns from timber. Given the significant direct and indirect implications of timber harvesting on deforestation in Cameroon, where the economic trends, especially in the SAP and devaluation eras, have led to higher production of timber, higher levels of forest loss may have also occurred.

2.7 The agricultural sector: cash and food crops

This subsection overviews the agricultural sector and its main production process. We also examine the extent to which food and cash crop production have influenced forest loss in Cameroon. The discussion will also briefly describe the main trends of agricultural policies on the sector and their likely impacts on the forest.

2.7.1 Relationship between cash crops and food crops

There are two main cash crops in Cameroon, cocoa and coffee (*arabica and robusta*). These are mainly grown in the forest regions of Cameroon where food crops are also important. Cocoa is grown principally in the Centre, South, Littoral, Southwest and Eastern Provinces where the food crop plantain is also important.

Coffee, particularly *arabica* coffee, is grown in the upper grassland areas of the Western and Northwest Provinces, while *robusta* coffee is grown mainly in the Southwest, Littoral, East and to a lesser extent in the West and Northwest Provinces where plantain and maize are also important (Amin, 1995). There therefore appears to be significant competition in the demand for agricultural and forest land in crop production in Cameroon.

2.7.2 The role of agriculture in Cameroon

Agriculture is the largest sector in the economy of Cameroon. National economic development has been closely linked with the performance of the sector, with export crops playing a crucial role particularly with respect to increased revenue for developmental projects. Food crops have also been promoted to attain national food sufficiency (Tambi, 1984; Amin, 1995).

Before the oil boom of the late 1970's, agriculture=s share in the GDP was 32 per cent. The agricultural sector employed about 75 - 80 per cent of the total active population of Cameroon by 1988 and was a source of livelihood for 80 per cent of the total population (MINAGRI, 1990). Agricultural exports constitute about 80 per cent of total exports, and consist mostly of cocoa, coffee and cotton. Government revenue from export taxes on agriculture is large - amounting to some 124 billion CFA F (US$276 million) in the 1985/86 fiscal year from cocoa and robusta coffee alone (World Bank, 1989; Amin, 1995).

2.7.3 The nature and state of agriculture production in Cameroon.

The vast majority of crops in Cameroon are derived from individual smallholder farming. Some export crops are derived from industrial plantations of parastatal and private organisations such as the Cameroon Development Corporation, SOCAPALM, Hévéaculture du Cameroon (Cameroon Company for Rubber Production), HEVECAM, and Del Monte (rubber, palm oil, tea and banana). Most agricultural produce is grown on small plots; average household land holdings are approximately 2 ha in area. These small plots occupy about 90 percent of the cultivated area and supply 90 per cent of agricultural production and 80 per cent of marketed products (Tambi, 1984).

As noted earlier, the country is characterised by heterogeneity in agricultural production patterns. Crops like cocoa and plantain production are important in the Centre South Province, while coffee and maize are grown predominantly in the Western Province. The production mix represents a logical response to a highly diversified set of ecological and climate conditions as well as diversified consumption habits among the population (Tambi, 1984). Agriculture is carried out in soils of high, medium and low fertility and in zones with marked climatic gradation ranging from an equatorial climate with two seasons and more than 4500 mm of rainfall per year in the Southwest to the semi-desert dry Northern region. In the humid forest zone of Cameroon, plantain and yam can be grown under different forest conditions, including in cleared forest areas. Temple (1994) describes the production system of plantain in the Southwest of Cameroon, distinguishing four types, although new cleared forest seemed very important because of its nutrients after burning. The majority of other food crops such as groundnuts, cocoyam, and maize are mostly cultivated in a mixed crop field. This represents 75 per cent of all fields planted by a sample of 39 households in four villages in the Centre Province of Cameroon (Ndoye, 1997; Russell, 1993).

Land is the major input in agriculture production. Until colonial times, the use of land and natural resources was regulated by customary law. However, since then, all >unoccupied= land has been treated as government-owned. The country=s land now falls into three legal categories: state property, private property and national lands. National lands are further divided into: (1) lands occupied with houses, farms and plantations and grazing lands, manifesting human preserve and development; and (2) lands, free of any effective occupation. Those who develop land (*mise en valur probante*) may apply for land certificates to register the land as private property. This effectively encourages farmers to develop unoccupied (mainly forested) land in order to gain title to it. Currently, the land dedicated to permanent agriculture (plantation) is about 8,000 ha per year. In contrast 75,000 and 95,000 ha are cleared each year for slash-and-burn farming. With rapid population growth and recent reversing urban-rural migration, there has been an increase in the demand for new land and a shortening of fallow periods.
In rural communities, land is often still allocated by traditional authorities who also arbitrate in the settlement of land disputes. However, as state lands have been allocated over areas where there are traditional land claims it is difficult to design a rational and sustainable land-use policy. This also leads to frequent land use conflict and reduced investments in lands. Moreover, without legally recognized tenure of either trees or land, farmers take a short-term view of land management. They are unlikely to plant trees or conserve if they are unable to profit from these activities. Only through security of tenure can sustainable practices be encouraged (Tchoungui et al., 1995).

Traditional farming methods rely on the clearing of vegetation using matchets and fire (slash-and-burn). Many large trees, especially useful species and hardwood, are often left during clearing operations. Some may be killed by burning trash around the base and through ring-barking. Cleared land is used for about 2 - 3 years. Traditionally, land has been left to fallow for 10 -25 years before being cleared again, depending on soil type and availability. This cycle has usually been long enough to permit the soil to recover sufficient fertility to produce acceptable farm yields in the next phase of the cycle. Currently, however, the fallow periods are being significantly decreased, with consequent soil degradation and decrease in productivity (Tchoungui et al., 1995). Cocoa production, for example, takes place after clearing primary forests. The main reason is that, cocoa plantations confer property rights to the farmer, and thus it makes sense to the farmer to clear a piece of land that have never been occupied or cultivated before. However, during certain economic periods, abandoned cocoa plantations have been brought back to cultivation, as was the case after the devaluation in 1994 when both newly cleared lands and abandoned plantations were both cultivated.

Traditional farming methods are hampered by limited access to agricultural inputs, such as fertilizer and pesticides, and use of simple equipment such as hoes, axes and cutlass. Annual expansion in agricultural production may more be attributable to area under cultivation (Tchoungui et al., 19995; Tambi, 1984). Farming relies heavily on unskilled labour, mostly from within farming households. The 1984 census reported that 85 per cent of the farms use only unskilled labour, 12 per cent use cattle to cultivate the land, 2 per cent use tractors and 1 per cent use donkey. There appears to have been little change in cultivation practices since the census. The total dependence on hand labour decreases as farm size increases but even on the larger farms (greater than one hectare of cultivated area) more than 60 per cent of the farmers depend on labour only (Tchoungui et al., 1995).

Cash crops (e.g. cocoa and coffee) are cultivated predominantly by men, whereas food crops (e.g. plantain, maize, yams and cocoyam) are grown mainly by women. With falling world prices of cocoa and coffee since the 1980s men have tended into shift to food crops. Food production by women uses traditional methods with negligible use of fertilizer and pesticides. Fertilizers, pesticides, fungicides and extension and marketing services are mainly concentrated in cash crops.

Area cultivated, productivity and production levels for cash and food crops have generally responded to the trends and policies corresponding to the various economic era - pre-oil boom, oil boom, economic crisis, and the SAP and devaluation periods. There are, however, several different statistics (See Tambi, 1984, Ndoye, 1997 and FAO, 1999) with regards to land area cultivated, productivity and production levels of crops, such that it is very difficult to get a clear trend between the period 1965 and 1995. However, the general conclusion from most studies is that, apart from the oil-boom period, productions of agricultural crops have been more due to land expansion than to productivity. In the discussions that follow we review some of these studies, supporting them where appropriate with data from the FAO[5], with regards to the area harvested, production and productivity of cocoa, coffee, maize and plantain over the pre-oil boom period, post-oil boom period and the SAP period.

Cocoa was introduced by the Germans in 1886 and it gained prominence in Southern Cameroon from 1924. During the pre-oil boom, cocoa=s share of total exports increased from 30.2 per cent in 1970/71 to 36 per cent in 1977/78. Cocoa yields, however declined in that period (Table 2.5). The increases in production have therefore mainly been attributable to expansion in cocoa land. Coffee had a similar increase in production, which was also attributable to the expansion in cultivated coffee area, since yields declined (see Table 2.3 and 2.5). The total food production index increased from 92 in 1960 to 125 in 1977 (Tambi, 1984), with plantain, maize, cassava, yam, groundnut and cocoyam being very important. Increased in production were also due to expansion in land. From Table 2.3, the land area under maize and plantain between 1970 and 1977 increased by 16 per cent and 300 per cent respectively, while yields for the two crops increased by only 0.33 per cent and 25 per cent in the same period (Table 2.5). For both crops, however, production levels increased between 1970 and 1977 (Table 2.4).

In the oil boom period of 1978-86, there was an increased production in cash crops but not so much for food crops (Tambi, 1984). Increases in cocoa and coffee production were more due to increased yields and productivity, thus indicating intensification in production. Table 2.4 indicates increased production levels for cocoa and coffee between 1978 and 1986 accompanied by increased yields in the same period (Table 2.5), however, for both crops there was a decline in land area harvested (Table 2.3). This was mainly attributable to rising producer prices and the improved accessibility of inputs. For example, during the oil boom there were increased subsidies, and efforts were made at providing needed inputs through the various institutions created for that purpose. In some instances, cocoa farms were sprayed free of charge by the government. There was also increased investment in research for high yielding seeds. All these additional investments in cash crops were made possible from oil revenues. Area cultivated for food crops (for example maize and plantain) declined (Table 2.3), due mainly to rural-urban migration. Although productivity (except for plantain) increased, total production fell because the decline in area cultivated was far greater than the increases in productivity.

[5]It has been argued that there a lot of questions with regard to land and agricultural statistics from the FAO. However, the FAO data is the most credible data available for studies such as this one. Many empirical studies have also depended on similar data from the FAO.

During the economic crisis period of 1987 and 1988 area cultivated for cocoa, coffee, plantain and maize experienced a net decline (Table 2.3) The main problem was the falling producer prices for cash crops, which declined for two main reasons: low exchange rates coupled with falling world prices. The world market price of cocoa, for example, halved from about $2369 per tonne in the 1983/84 season to about $1295 in the 1989/90 season. Food crop prices were also not attractive to farmers. With the declining oil economy the government could not supply the necessary inputs. This led to fallen agricultural output levels. From Table 2.5, although there were some increases in productivity between 1987 and 1988, total production for cocoa, maize and plantain fell, mainly because of the fall in land area over the period.

In the early SAP period cocoa production continued to decline from 124,356 tons in 1989 to 76,283

Table 2.3 Land area harvested of some selected agricultural crops in Cameroon (1965 -1995) (>000 ha)

Crops	Pre-oil boom period			Post-oil boom period					SAP period				
				Oil boom			Economic crisis		Before devaluation			After devaluation	
	1965	1970	1977	1978	1980	1986	1987	1988	1989	1990	1994	1995	1997
Cocoa	380	396	431	425	444	410	440	420	420	360	350	360	360
Coffee (*arabica and robusta*)	160	220	378	354	372	350	320	310	300	300	270	270	300
Maize	435	460	532	537	497	203	203	187	200	277	401	na	na
Plantain	106	171	693	702	592	429	198	170	200	169	253	na	na

Source: FAO (1999), FAOSTAT database, CD-ROM; Ndoye, O. (1997), The impact of macroeconomic and agricultural policies on forest conditions in Cameroon; Tambi, E.N. (1984), Agricultural development policy and performance in Cameroon, 1960-1980.

Table 2.4 Production of some selected agricultural crops in Cameroon (1965 -1995) (>000 mt)

Crops	Pre-oil boom period			Post-oil boom period					SAP period				
				Oil boom			Economic crisis		Before devaluation			After devaluation	
	1965	1970	1977	1978	1980	1986	1987	1988	1989	1990	1994	1995	1997
Cocoa	79	134	107	110	117	123	132	129	125	115	108	137	126
Coffee	74	93	86	107	112	132	82	119	115	100	24	31	66
Maize	330	412	477	400	413	389	386	366	387	369	450	654	600
Plantain	585	695	864	1100	1020	1310	944	854	1136	870	950	970	1030

Source: FAO (1999), FAOSTAT database, CD-ROM

Table 2.5 Yield per hectare (ha) of some selected agricultural crops in Cameroon (1965 -1995) (Kg/ha)

Crops	Pre-oil boom period			Post-oil boom period					SAP period				
				Oil boom			Economic crisis		Before devaluation			After devaluation	
	1965	1970	1977	1978	1980	1986	1987	1988	1989	1990	1994	1995	1997
Cocoa	207	343	248	260	264	300	302	308	299	319	308	380	352
Coffee	463	422	228	304	301	377	258	385	386	336	89	115	220

Maize	758	895	898	747	832	1924	1913	1960	1864	1854	2017	2180	2000
Plantain	5522	4058	5082	5789	5230	3046	4790	5023	5681	5115	4750	4850	5150

Source: FAO (1999), FAOSTAT database, CD-ROM tons in 1992 (see also Table 2.4). Exports also fell over the period from 108,100 tons to 82,600 tons, and from 41 billion CFA F to 31.7 billion CFA F in value terms. In 1993 both the quantity and value of cocoa exports further declined to 77,745 tons and 30.5 billion CFA F respectively. Between 1989 and 1994, coffee also experienced a sharp decline in production (Table 2.4) and productivity (Table 2.5) and a fall also in land area (Table 2.3). Among the many factors responsible for these performances were the continuing internal economic problems, which included low producer prices, low productivity due to unavailability of inputs. These problems were exacerbated by low world prices and the overvaluation of the CFA F (Ndoye, 1997). However, during the early SAP period, the area cultivated for food crops such as plantain and maize increased (Table 2.3), with corresponding increases in production between 1989 and 1994 (Table 2.4). The productivity of maize increased while that for plantain fell. The likely causes of this land expansion include the increased urban-rural migration, (due to the restructuring of the public sector and dwindling oil revenues), the diversion from cash crops to food crops production and the inaccessibility of crop inputs.

When the CFA F was devalued in 1994, the area cultivated and productions of both cash and food crops increased (see Table 2.3 and 2.4). Area cultivated under cocoa increased from 350,000 hectares in 1994 to 360,00 hectares in 1995. Production of cocoa increased from 108,000 tons in1994 to 137,000 in 1995 (Table 2.4). Exports of cocoa also increased from 84,000 tons in 1993/94 to 90,261 tons in 1994/95. However, the dismantling of the National Produce Marketing Board (NPMB) has led to poor quality of cocoa beans resulting in a discount of 30 CFA F per kg on Cameroon cocoa in the international market. Similar trends were recorded for coffee production (See Tables 2.3 and 2.4). Production and cultivated area for plantain, maize and cassava also increased (Ndoye, 1997). This period clearly showed the importance of prices, in this case influenced by the devaluation, in influencing agricultural expansion, especially in the case of cash crop production. There also has been increased exploitation of NTFPs for exports (Ndoye, 1997).

An important conclusion from the above discussion is that increases in harvested areas for most crops in Cameroon correspond with increases in production. However, the availability of inputs and subsidies, in some cases, as in the oil boom period may reduce the dependence of production on land. Moreover, relative prices, especially during the SAP period also influences land expansion and land allocation among crops, especially between cash crops and food crops.

2.7.4 Development problems and constraints

The performance of Cameroonian agriculture has been greatly affected by many factors, including primary resources and institutional and infrastructural factors (Amin, 1996). The main resources used in agricultural production are land, labour, capital and water. The land quality based on agroclimatic conditions favourable for production of a great variety of crops. On the other hand, Cameroon agriculture is a rain-fed system, so that crop production is subject to the vagaries of climatic conditions. There are very few irrigation-fed agriculture in the country. Moreover, the agriculture labour force is said to be aging. The situation has been worsened by migration of young people to non-agricultural areas - particularly to the cities. Labour shortages both in quantity and quality are a serious long-term problem, especially as Cameroon=s agriculture is labour intensive. This problem may have been limited with the return-migration from the economic crisis period. Other problems including poor infrastructure, the lack of appropriate inputs and poor extension services are discussed below.

Infrastructure

The infrastructure that links production locations with other parts of the country, particularly consumption areas, is important. Storage and transportation facilities including roads are very poor. Cameroon now suffers from deteriorating roads and lack of rural infrastructure. The total classified road network (paved and earth), which was 32,714 km in 1982, has not greatly increased (Amin, 1991). Since then, even paved roads have deteriorated because of lack of maintenance. In fact, the kilometres of classified road per head have declined. In 1981/82 the ratio was 0.0037 but in 1989/90 the ratio decreased to 0.003. The combination of poor storage facilities and the limited road and railway infrastructure available for marketing has been a significant factor in depressing food prices.

Inputs

The timely availability of inputs, such as fertilizer, equipment and water, permits the proper and efficient production of crops. The agency in Cameroon which carried on research on farm equipment has been closed, and not much is now being done to improve the rudimentary equipment used by farmers. In 1990, less than 2 per cent of Cameroon farmers own or use machinery such as tractors, ploughs and sprayers, though the use is more common in the northern provinces. The small size of farms in the southern provinces, to some extent, limits the use of machinery. While the majority of the farms in the western province use more fertilizers, the other regions hardly use them at all.

Research and Extension

Research and extension services, which should ensure the availability to farmers of the necessary and appropriate technology are lacking. There is very little applicability of research findings, and the link between the research institutions and small-scale farmers is weak. This leads to stagnant technology. There is also reduced investment in research investment and extension services. During the economic crisis, for example, funding of research institutions fell significantly. Most government extension services were also reduced. With the SAP, and the efforts being made to reduce government fiscal deficits, such services may further be affected.

Other problems include the poor marketing system for agricultural products, especially for food crops, unattractive prices and the unavailability of credits from the formal sectors. Most farmers have had to rely on the informal sector for credit at very high interest rates.

Chapter 3: The structural adjustment programme and policies influencing deforestation in Cameroon

3.1 Introduction

This chapter reviews the nature of the Structural Adjustment Programme (SAP), its purpose and the form it took in Cameroon. It also reviews the policies undertaken under the SAP, with specific reference to the agricultural and timber sectors. The chapter also examines specific policies that have affected deforestation in Cameroon and those addressing the deforestation problem.

3.2 An overview of Cameroon=s Structural Adjustment Programme

The first part of this section present a short review of the nature of Structural Adjustment Programmes. The second part then looks at the specific form it took in Cameroon.

3.2.1 Structural Adjustment Programmes

The Structural Adjustment Programme (SAP) is one key component of the macroeconomic adjustment programmes that countries, especially developing countries, have been undertaking to move out from sustained periods of economic decline, or what is generally termed as >economic crisis=. The other component of macroeconomic adjustment programmes is the Economic Recovery Programme (ERP). The main difference is that the ERP, or stabilization policies are short term in nature while the SAP is more long term. In recent times, however, it has become more difficult to differentiate the two, since invariably both have been undertaken simultaneously to achieve the same long-term goal of sustained economic growth. In the discussion that follows, we do not distinguish between the ERP and SAP, and in some cases the term macroeconomic adjustment will be used to refer to both Programmes.

3.2.2 Why the need for/nature of macroeconomic adjustment

According to Khan and Knight (1981) the essence of macroeconomic adjustment programmes is to eliminate supply-demand imbalances which have caused serious distortions and exhaustion of external financial resources. The source of these distortions is thought to have been caused mainly by uneconomic prices and overvalued currencies, which have encouraged trading and speculation in developing economies at the expense of productive activities such as agriculture and manufacturing. The main policies needed to correct such distortions include:

! Demand management policies to influence domestic absorption.

! Exchange rate policies to influence the composition of domestic absorption and the production of tradeable and non-tradeables.

! External financing policies to influence capital flows.

! Structural policies to influence current and potential output.

Demand management policies are mainly policies to restrain domestic demand. The two main tools used are fiscal and monetary policies (Dell, 1982 and Diaz-Alejandro, 1984). Fiscal policies are mainly restrictive in nature, and include curtailing public spending at the same time as raising revenues. This is to help reduce domestic demand in order to eliminate supply-demand imbalances (Barro, 1974; Khan, 1987). The main tool used under monetary policy is the interest rate. This is based on the assumption that interest rates are the transmission mechanisms between monetary policies and aggregate demand (Frenklen and Johnson, 1976). Therefore, by manipulating interest rates supply-demand imbalances can be reduced.

The objectives of exchange rate policies are to improve upon the international competitiveness of a country and to redirect the economy's productive activities from non-tradeables to tradeables. The main tool use is devaluation. The policy is simultaneously expenditure-reducing and expenditure-switching (Johnson, 1958). The demand and supply effects of devaluation work to reduce excess demand and the current account deficits. However, among other things, this depends on the relative price elasticities of imports and exports, on the shares of tradeables and non-tradeables in total production, and on complementary policies being adopted at the same time. Obtaining the correct long-run real exchange rate level is also very important.

The basis of external financing polices is the belief that, because developing countries= face scarcity of capital, they should be net foreign borrowers. The main lesson of this "growth with debt" literature is that a country can and should borrow abroad as long as the capital produces a return to cover the cost of borrowing. Under such circumstances, the borrower will be increasing capacity and expanding with the aid of net foreign savings. The general Arule of thumb≅ is that a country should depend on an external loan if the real interest rate on new loans is less than or equal to the expected growth in the volume of exports.

As compared to demand management, structural policies put emphasis on growth rather than control of domestic demand and immediate improvement in the current account. Moreover, such policies may take a long time to show results since they usually require a significant rise in investment in the more efficient sectors combined with the release of capital and labour from the weak sectors to the strong sectors. Structural policies can be put into two main categories:

! policies to improve efficiency and resource allocation; and

! policies to expand productive capacity of the economy.

Improving economic efficiency includes measures to reduce distortions that cause a differential between price and marginal cost. Such distortions arise from price controls, imperfect competition, taxes, subsidies and trade restrictions. Removing these distortions are however rife with certain practical difficulties. These include any constraints on the mobility of capital and labour between sectors, which may result in unemployment. Due consideration also has to be given to the political implications of removing significant distortions, and to the reasons for government control of certain sectors in the first instance.

Productive capacity may be defined as the maximum amount of output that a country is physically capable of producing given the fullest and the most efficient use of its available resources, both human and natural. The rate at which an economy's capacity can be expanded depends among other things on:

! the allocation of income between consumption and investment; and

! the nature and quality of the capital stock being added.

both of which will help increase supply and reduce the supply-demand imbalances in the economy.

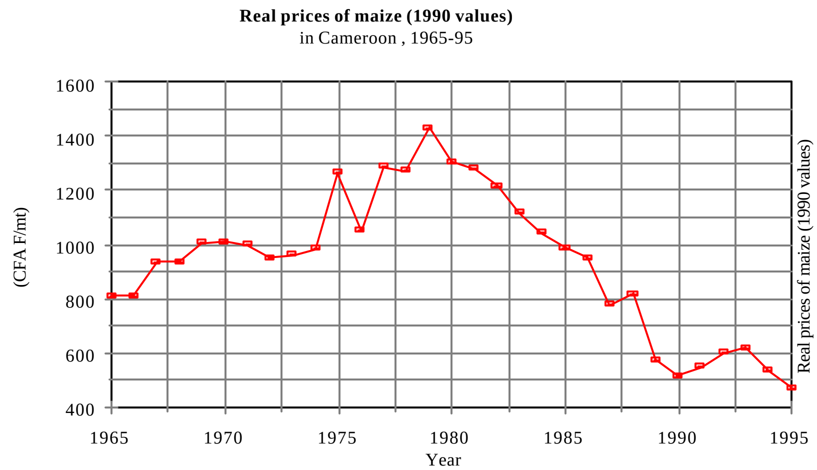
Beginning in the 1980s, the above macroeconomic adjustment policies have mainly been prescribed for developing countries by the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (IBRD - World Bank).

3.2.3 Why Cameroon needed a reform

Any analysis of long-term economic trends in the economy of Cameroon should not lose sight of the four or five very distinct and different economic eras: the pre-oil boom (1960 - 1977), the oil boom (1978-1986), the economic crisis (1987 -1988) and the SAP and devaluation periods (1989 - 1993 and 1994 to present).

From independence up to 1977, agriculture was the backbone of the economy of Cameroon. All the development plans implemented during this period placed emphasis on the sector. During the pre-oil boom stage, GDP grew annually at 4.8 per cent in real terms (Tambi, 1984; Ntangsi, 1991; Ndoye, 1997). The average share of agriculture in GDP and in total exports before the oil-boom was 30 per cent and 80 per cent respectively (World Bank, 1988). Private and public consumption and Gross Domestic Investment were all positive. Real income per capita increased from 47,749 CFA F in 1971 to 103,080 CFA F in 1977 (Amin, 1996) (see Appendix 3.1).

Given that the objective of the government was to raise revenue for development, crop prices were fixed



lower than the FOB price during the pre-oil boom period. Cocoa producers on average over the period received about 51 per cent of the FOB price and coffee farmers around 64 per cent of the FOB price. Real prices for cash crops, on the average fell in this period (see Figures 3.1 and 3.2). As was explained in Chapter 2, these producer price trends had a significant impact on replanting

Figure 3.1

Figure 3.2

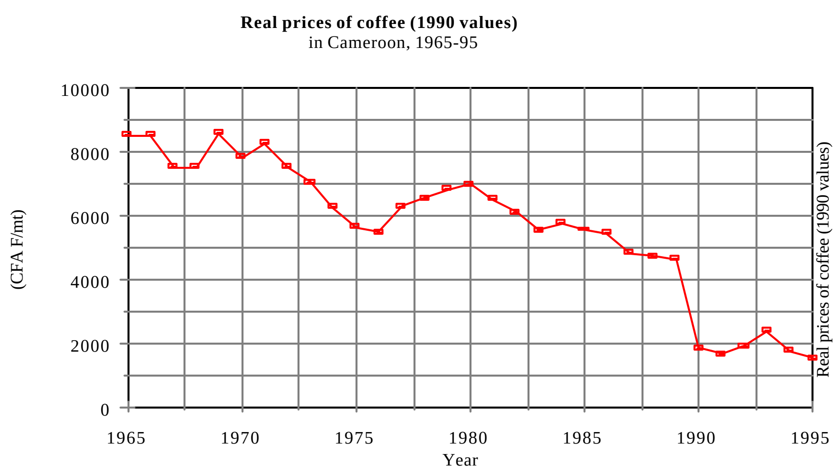


Figure 3.3

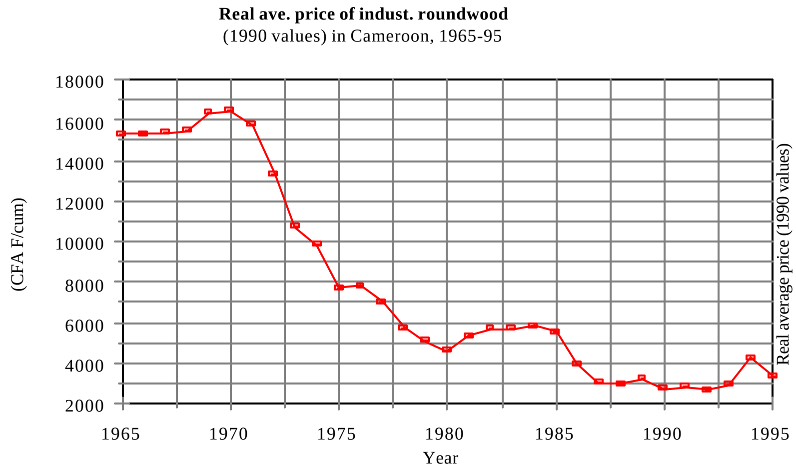
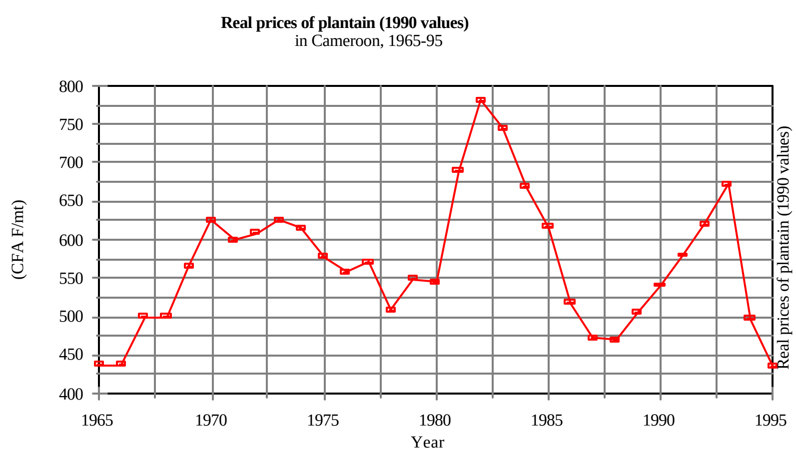


Figure 3.4

Figure 3.5



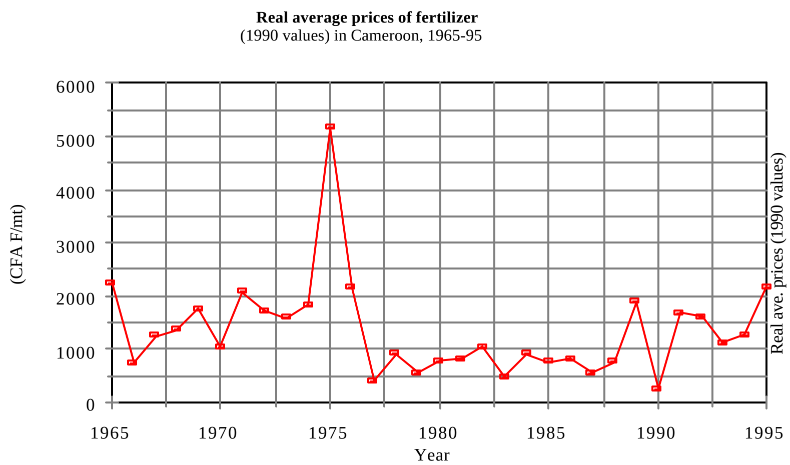


Figure 3.6

>existing= cocoa lands. For example between 1957-1966 when prices were high, 46 per cent of cocoa plantations were renewed, while only 16 per cent were renewed in 1967-76 when farmers received only 40 per cent of the FOB price. Food prices were controlled through the MIDEVIV (Mission de development des Cultures Vivrieres) created in 1975 to stabilize prices. On the average, real prices of food crops did not experience much increase (see Figures 3.3 and 3.4). The objective of such controlled prices for food crops was also to attain food sufficiency (Ndoye, 1997). Farmers also tended to divert to food crop production when prices of cash crops were relatively less attractive. For example, In 1971-76 when there were high taxes on cocoa, the area cultivated of food crops increased from 21,263 hectares to 24,680

hectares in the Lekie Department (North of Younde, Centre Province) while cocoa production declined from 24,659 to 11,853 tons (Egger, 1978; Ndoye, 1997). Similar observations were made in other parts of the country with respect to the area cultivated for coffee (Tchoungui et al., 1995).
Real average prices of timber, on the average also experienced a steeply downward trend throughout the pre-oil boom era (Figure 3.5). Not surprisingly, this also resulted in corresponding low production and exports (see Table 2.2 and Appendix 2.3).

Prices of agricultural inputs in the pre-oil boom period were subsidized. This helped to maintain the prices of fertilizer, for example as relatively low levels in the pre-oil boom period (Figure 3.6). Agricultural credits were provided by the National Agricultural Credit Bank which was created as part of the Cameroon Development Bank in the second development plan, and by FONADER (Fond National de Development Rural) created in the third development plan. Such credits were, however, short term in nature, and were not appropriate for cash crops investments. Moreover, only a small proportion of credits were used for agricultural improvement. Such credits were therefore not very useful to farmers, who depended more on credit unions. Any research and development expenditures were mainly geared towards export crops like cocoa which had very little impact on agriculture generally. Increases in agricultural production during the pre-oil boom period were more attributable to land expansion, (Tambi, 1984) and the pressure on the forest land from agriculture was therefore relatively high.

Through the mid 1980's, Cameroon was considered to be something of an African success story. With two rulers and only one attempted coups in the first quarter century of independence, Cameroon stood as a politically stable contrast to her neighbours. The discovery of oil also boosted the economy.

High prices on the world market for the primary commodities such as cocoa, coffee and cotton, combined with significant revenues from oil exports (oil revenues increased from 16.2 billion CFA F in 1980 to 382 billion CFA F in 1985/86) enabled the country to maintain a very large public sector workforce (and thus low in unemployment). By the end of the oil boom in 1986, the economy was growing strongly at 8.2 per cent per annum (Ntangsi, 1991; IMF, 1990). Per capita income increased from 121,200 CFA F in 1977/78 to 382,900 CFA F in 1985/86 (see Appendix 3.1) and inflation declined from 16.7 per cent in 1983 to 8.2 per cent in 1986. Private and public consumption and Gross Domestic Investment (GDI) were all positive. Agriculture, however, became less important. Its contribution to GDP and to exports declined. The contribution of agriculture to GDP and exports declined to 22 per cent and 51 per cent respectively (Ntangsi, 1991). One reason for this was the high rate of rural-urban migration.

Though crop price were still controlled during the oil boom, the producer prices of cash crops increased significantly, especially for cocoa (Figures 3.1 and 3.2). Cocoa farmers received a higher percentage of the FOB prices. This led to the intensification of production. Food price policy continued under the MIDEVIV, although some food prices like maize and plantain also experienced some increase in the oil boom period (Figures 3.3 and 3.4). This control of food prices was not effective, and therefore did not favour food production nor land clearance, with the exception of rice production. The objective was to

reduce imports and increase domestic production of rice from 40,000 tons in 1980 to 153,000 tons in 1986 under the Fifth Development Plan (1981-986). Prices were made to be attractive to encourage increased production of rice (Ndoye, 1997).
Real prices of timber also experienced a modest increase during the oil boom period (Figure 3.5). However, as noted in Chapter 2, although production of timber increased the growth in exports, on the average, was negative (see Table 2.2 and Appendix 2.3).

During the oil boom, the use of fertilizer, pesticides and fungicides were encouraged. The delivery system was, however, unreliable and relatively expensive. Fertilizer use was subsidised by as much as 60 per cent. This was reflected in the average prices of fertilizer which showed a drastic fall and was consistently low in the oil boom period (Figure 3.6). Pesticides use for cocoa and coffee were entirely subsidised and sprayers for fungicides were also subsidized. In some instances, SODECAO (the government parastatal in charge of cocoa development in the forest zone), applied insecticides with mechanical sprayers free of charge to farmers. Fertilizer use thus increased from 85,692 tons in 1980/81 to 105,056 tons in 1984/85 (Wyeth, 1994).

There was an increase in credit to the agricultural sector for both food and cash crops. Credits were in the form of farm inputs, equipment to control pest and disease, high yielding seeds and cash (Jilly, 1992). FONADER was converted to a bank, which directed credits to farmers= cooperatives to increase efficiency. FONADER=s share of total agricultural credit increased from 38 per cent in 1983 to 45 per cent in 1987.

The Institute of Agronomic Research (IRA) was created in 1979 with increased funding to research into crop improvement, agronomy and forestry to increase agriculture and forestry production. The IRA was mainly to research into seed multiplication and other planting materials and disseminate such information to farmers (Baker and Ayu-Takem, 1991). Given these trends in the agriculture sector, the pressure on the forest in this period was relatively low.

The period 1987-1988 changed significantly the structure of the Cameroon economy (Ndoye, 1997). The economy saw a sharp decline. All the economic pointers showed a downward trend. There were both external and internal causes of the economic crisis (Amin, 1996, Ntangsi, 1991). The external causes were the over valuation of the CFA Franc, the decline in the prices of oil and cocoa and coffee in the world market and the depreciation of the US dollar[6]. The internal causes were largely due to public

[6] The depreciation of the US dollar against the French Franc, by 40 per cent, increased the degree of overvaluation of the CFA Franc because of its fixed parity with the Freanch Franc. Furthermore, since the prices of oil, cocoa and coffee are quoted in dollars, the decline in their prices in the world market worsened the economic situation of Cameroon which exports these

mismanagement. This was characterised by an overexpansion of the public sector, heavy subsidies to parastatals, increased corruption and massive capital flight to France (Jua, 1991 and 1993). Other internal causes were the dwindling oil reserves and revenue.

Revenues from oil declined from 382 billion CFA F in 1985/86 to 207 billion CFA F in 1988. GDP growth averaged a negative 10.6 per cent over 1987/88. For the first time since independence in 1960, the budget deficit reached 508 billion CFA F in 1987, representing about 12 per cent of GDP (Ndoye, 1997). This deficit was due to the decline of government revenues by 40 per cent while public expenditures remained at previous levels. Private, public consumption and GDI were all negative. Inflation was also very high (Roubaud, 1994; Ntangsi, 1991).

The falling world commodity prices of cocoa and coffee led to 50 per cent deterioration in the terms of trade for Cameroon. Investment and imports also fell by 50 per cent and 40 per cent respectively. Private consumption also declined by at least 25 percent in the late 1980s. In 1987, about 30 per cent of export revenue was used for debt service, and with further declining commodity prices, this percentage increased significantly (Horta, 1991).

The producer prices for cocoa and coffee also declined (Figures 3.1 and 3.2). Though the FOB price for cocoa was high, the domestic value was low because of the overvaluation of the CFA F. Given that the price of cocoa export was quoted in dollars and the dollar was devalued to the French Franc, it meant farmers received lower returns for their exports. Food prices were also not attractive, as they experienced a sharp decline in real terms (Figures 3.3 and 3.4) in the economic crisis period in the late 1980s. This led more and more farmers to disengage from the market economy. Coffee and cocoa prices fell so low that even the poorest farmers did not bother bringing in any cash crop harvest. Average prices of timber also experienced a steep decline during the economic crisis period (Figure 3.5). This was also attributable to the overvalued CFA F.

Fertilizer and other inputs were still subsidised during the economic crisis, but their consumption declined because the government was not able to supply them. There was a fall in the use of pesticides, fungicides and insecticides for the same reason (Ndoye, 1997). This accounted for the decline in the yield of cocoa and other crops during the crisis years (see Chapter 2).

Agricultural credit provision was also badly affected. In 1987, FONADER was dissolved because it could no longer be financed by the National Produce Marketing Board (NPMB). This was because of the falling

---

commodities. (Ndoye, 1997).

prices of cocoa and coffee, plus the overvaluation of the CFA F. Research funding for the Institute of Agronomic Research (IRA) was also reduced. Given this scenario, the main source of increased agricultural production during this period was mainly due to land expansion.

The economic decline had the cumulative impact of effectively cutting in half the income of the average Cameroonian. Real per capita income fell sharply after 1986 (Appendix 3.1). Unemployment and underemployment substantially increased, with public employees (including security forces) going months without being paid. Public employees also faced a cumulative 75 per cent pay cut in the last 9 months of 1993. Government agencies had an effective hiring freeze. Public sector employees often stayed away from their respective offices, preferring (of necessity) to work in small gardens near their homes for foodstuffs, and even going back to their villages of origin (Areturn migration≅) to plant food crops and avoid the necessity of paying rent for their urban homes (Green and Brown, 1994).

3.2.4 The economic reform strategy and devaluation in Cameroon

Cameroon initiated its stabilisation programme through negotiations with the IMF in 1988. In 1989, Cameroon embarked on a Structural Adjustment Programme (SAP) with the World Bank and the IMF to overcome both the internal and external causes of the economic crisis. Since then, series of reforms have been implemented through agreement with the two international lending agencies.

The Cameroon SAP was supported by a World Bank structural adjustment loan (SAL) of US$ 150 million approved in July 1989 and disbursed in three tranches. The SAL was also preceded by a 18-month stand-by arrangement with the IMF, approved in September 1988, equivalent to SDR 69.5 million and a purchase of SDR 46.4 million under the compensatory financing facility. In addition to the IMF and the World Bank, the SAP was also supported by other donors, notably the African Development Bank (ADB) and by France through the CCCE (Caisse Centrale de Coopération Economique).

The macroeconomic adjustment policies embarked upon, sought to realign relative prices, liberalise markets, introduce fiscal discipline. These were aimed at removing deficits in the budget and the current account as well as reducing the country=s external debts. The policy also sought to rehabilitate the country=s social and economic infrastructure. These macroeconomic measures were supplemented by sectoral and institutional reforms aimed at encouraging savings and investment and introducing efficiency and equity. The programme which consists of three interrelated components (Ntangsi, 1991) is discussed below. They include;

! price, market and trade reform;

! public enterprise and banking reform; and

! reform of the institutional, legal and regulatory frameworks and the redefinition of the relative roles of the public and private sectors.

These programmes are being implemented simultaneously and at the same time supported by two other World Bank projects - the Economic Management Project (PAGE) and the Social Dimensions of Adjustment Project (SDA). The PAGE supports the SAP by providing additional finance for undertaking important specific tasks to be carried out under the programme, such as studies on civil service reform, public investment programmes, public enterprise rehabilitation, etc. In contrast, the SDA projects aim at mitigating the social hardships that result from adjustment, through promoting employment, small enterprises, community development, basic health and education.

3.2.4.1 Price, market and trade reform

This component of the programme was aimed essentially at liberalising prices and wages, and replacing quantitative restrictions with tariff protection, to encourage competition and efficiency. The main objective was to lower production costs and prices, and therefore greater competitiveness in the international market. With respect to external trade, quantitative restrictions (QRs) were removed on more than 140 products. Only 16 strategic, mostly agricultural products (for example rice, sugar, vegetable oils and flour) remain subject to quantitative restrictions (Ntangsi, 1991). Imports licences were abolished for all products not subject to QRs. Similarly, price controls were relaxed in January 1989 for all except 35 products and 10 categories of services. During the second phase in June 1989 only 26 products and 7 categories of services were subject to price controls and by January 1991 the number of controlled products was reduced to 16.

The reform also provided greater incentives for industrialization and export. A new investment code was adopted in November 1990, with the elimination of duty exemption in favour of fiscal advantages. The incorporation of the one-step window (*guichet unique*) in the code ensures the simplification of procedures for creating new businesses and for access to the benefits of the code. Export taxes have been eliminated for all exports except timber. A new labour code aimed at deregulating wages, reducing the cost of labour and facilitating its mobility and productivity was also finalized with Bank assistance (Ntangsi, 1991).

3.2.4.2 Public enterprise and banking sector reform

As discussed previously, the policy framework in Cameroon, before adjustment was characterised by significant direct state intervention in the production and distribution of goods and services. Such interventions were considered to be necessary for, and indeed synonymous with, rapid development. Between 1960 and 1990, a total of about 200 Public Enterprises (PEs) were created in the non-financial and financial sectors. However, their performance has been largely unsatisfactory. The PEs also contributed to the crisis in public finance through requiring large operating and investment subsidies, the servicing of external guaranteed debt by the government, and the default in payment of taxes. For example, by 1988/89 the total indebtedness of PEs to banks and suppliers stood at CFA F 1,030 billion.

Under the Structural Adjustment Programme, efforts to reduce direct state intervention have therefore centred on reform of the PEs and financial sector rehabilitation. In the case of the non-financial sector, PEs without any strategic importance have either been privatized or liquidated. By 1990, of the 67 PEs on which decisions were taken 28 were maintained in the public sector=s portfolio to be restructured, 21 were liquidated and 18 privatized. Similarly, out of 14 financial institutions (commercial banks and specialized development institutions) four were liquidated, one was transformed, and two have been merged. Furthermore, the government has withdrawn as the majority shareholder from the largest four commercial banks (Ntangsi, 1991).

3.2.4.3 Institutional reform and the role of the state

This component of the programme aimed to reform of the institutional, legal and regulatory frameworks and to rationalize the role of the state. The overall objective is a reduced role for the public sector and greater reliance on the private sector, and in particular, disengaging the state from the direct production and distribution of goods and services that are non-strategic or do not have public utility.

Under this component of the programme, the reforms that were instigated included a new investment code and a new law governing commercial activity. Other reforms included, a new labour law, a new general statute for public enterprises, a new forestry law, a new cooperative law and civil service reform (Ntangsi, 1991).

3.2.4.4 Exchange rate adjustments

In spite of the SAP undertaken in 1989, the Cameroonian economy continued to decline in the early 1990s. As a result GDP fell on average by 3.8 per cent over 1990-1993 (Ndoye, 1997) (real per capita GDP correspondingly continued to decline (Appendix 3.1)), and the current account remained chronically in deficit. Government consumption as a percentage of GDP increased from 10.9 per cent in 1989 to 11.7 per cent in 1993. Private consumption stagnated at 73.4 per cent of GDP over 1989-93. Compared to an average of 25.6 per cent during the oil boom, GDI as a percentage of GDP fell from 16.3 per cent in 1989 to 14.5 per cent in 1993 (World Bank, 1996). These problems arose because the adjustment policies implemented over 1989-93 aimed at addressing only the internal imbalances of the economy. An important external cause, the overvaluation of the CFA was completely ignored by the SAP. For example, the overvaluation of the CFA was estimated to vary between 75 per cent and 77 per cent in 1989 and 1992. This proved to be very significant, given the importance of cash crops to the economy and the increasing dependence on imports of rice and wheat.

However, there are two main reasons why the early SAP reforms in Cameroon had to be implemented without devaluing the currency. First, the decision for Cameroon to devalue its currency could not be taken unilaterally but depended on the mutual agreement of the countries under the CFA F and France[7]. Second, there were different levels of overvaluation among the CFA countries, which in turn required different rates of devaluation for each country to be negotiated. In order to maintain parity among countries under the single CFA, a single currency rate was needed. In January 1994, the CFA was devalued by 50 percent for all the African countries in the CFA zone (Ndoye, 1997).

3.3 Agricultural reforms under the Structural Adjustment Programme

In agriculture, the SAP has involved: (a) the disengagement of the state from agricultural activities, and (b) the elimination of distortions in macroeconomic, legal and regulatory environment that bears on agriculture. In addition, there have been specific reforms targeted at the agricultural sector.

3.3.1 Disengagement of the State from agricultural activities

Since 1989 the government has progressively been withdrawing or has withdrawn from many agricultural activities in favour of the private sector, which is expected to result in greater efficiency. Many of the functions in export crop and agricultural input marketing are being progressively transferred to the private sector, and the state has completely withdrawn from the food crop market. Not only were these various forms of state intervention considered costly, inefficient and ineffective, but also the public institutions which absorbed the bulk of public investment in agriculture created a bias against the smallholder sub-sector. For example, during the period 1971-80, 60 per cent of public investment resources in agriculture were concentrated in the large holding sectors which produced only 10 per cent of the agricultural output (Ministry of Agriculture, 1980).

[7] The Communuate Financiere Africaine (CFA) countries belong to a monetary cooperation agreement with France. In this arrangement the CFA franc is pegged to the French franc. The whole zone pools its foreign exchange reserves together, with an operational account with the French Treasury that guarantees the convertibility of the CFA franc. They have a common exchange control system. In the Banque des Etats de l=Afrique Centrale (BEAC) zone, Cameroon=s economy accounts for about half the aggregate GDP of the total currency area. (Amin, 1996)

3.3.2 The elimination of distortions

The removal of distortions from the macroeconomic, legal and regulatory environment is anticipated to eventually result in greater competition and efficiency in agriculture and a reduction of this sector=s overall cost structure. This should also improve upon the competitiveness of Cameroon=s export crops in the international market. This should work in the long run to the benefit of agriculture and agro-forestry for which Cameroon is likely to have comparative advantage. Moreover, new markets could result in economies of scale and increases in productivity in agriculture (Amin, 1995; Ntangsi, 1991).

3.3.3 Specific agricultural reforms under the SAP

A few specific policy reforms were targeted at the agricultural sector under the SAP. These reforms related to extension services, marketing and pricing of agricultural inputs and outputs, and agricultural credits. The long run objectives aim to improve upon agricultural productivity, reduce the risk and uncertainty associated with production and post-harvest activities, and enhance production incentives in order to increase production.

3.3.3.1 Extension services

There has been a general disengagement of the state from intensive agricultural extension institutions and integrated rural development projects. Although very costly, these interventions have contributed very little to agricultural development in Cameroon during the pre-adjustment era. In addition, the proliferation of extension institutions in many regions of the country, which were superimposed on the existing extension system of the Ministry Agriculture, resulted in two parallel, overlapping systems and in a waste of resources. Thus, an important agricultural sector reform has been the massive liquidation of many of these institutions.

Another important reform has been targeted at agricultural cooperatives. These were run largely by civil servants and had become highly ineffective. Most of the cooperatives had become bankrupt and were criticized for no longer representing the interests of farmers (Ntangsi, 1991). A new cooperative law was enacted in February 1993, allowing cooperatives to become autonomous so that farmers could manage their own affairs as well as control production and marketing. The reforms would also make it possible for farmers to reduce their administrative costs of production, and grant them greater power in negotiating for the purchase of inputs and the sale of outputs (Amin, 1995).

3.3.3.2 Marketing and pricing

The inefficiency of state marketing during the pre-adjustment era is evident in that its marketing costs of foodstuffs and agricultural inputs have been chronically higher than for private dealers. In the case of state-supplied inputs, farmers have had to face the additional problem of late delivery and periodic shortages of some inputs. As a result, MIDEVIV largely abandoned food marketing in 1986, even before the decision was formerly taken to eliminate the policy in 1989. MIDEVIV has also privatised its seed multiplication operations, and since 1987,USAID has been assisting the government in establishing a private marketing system for fertilizers. In 1990, FONADER, the State agency which had been in charge of input acquisition and distribution, as well as input subsidies, was also liquidated (Amin, 1995; Ntangsi, 1991). The result of these reforms is that the private sector is now expected to assume the main role in providing agricultural inputs.

State marketing of cocoa and coffee through the National Produce Marketing Board (NPMB) was costly, inefficient and inadequate during the pre-adjustment period. Firstly, the NPMB operating costs increased from CFA 6 billion francs in 1978.79 to CFA 11billion in 1986/87 without any increase in the volume of purchase handled (AGRER, 1988). Second, the granting of monopoly to private buyers of cocoa and coffee in their zone of purchase and their remuneration on the basis of the *bareme*, i.e. administratively determined marketing costs and profit margins, resulted in gross inefficiencies. Third, the rigidity of the stabilisation system proved to be ill-adapted to high international price stability and contributed to the large financial burden of the cocoa and coffee industries. Fourth, the existence of large stabilization reserves for NPMB=s transactions often resulted in the misuse of these funds and corruption.

Under the SAP internal and external marketing of cocoa and coffee have been liberalized and the NPMB has been restructured. Now called the National Cocoa and Coffee Board (NCCB), its labour force have been reduced from 3,800 to less than 500, and is expected to fall further to 150. The aim of the restructuring is to reduce marketing costs, export taxes, price distortions, and to increase producer prices for cocoa and coffee. However, the producer prices have not been liberalized and are still officially set for cash crops.

Although the marketing of cocoa, coffee and other export crops has been partially liberalised, the transition has not been a smooth one. In 1989, as part of the SAP, the official purchasing prices of cocoa, coffee and cotton were reduced by 50 per cent. This not only helped to reduce the fiscal deficit by eliminating the losses sustained by the official marketing board but also increased the competitiveness of these basic exports. However, in practice, this reform has led to producers reducing output and failing to maintain existing plantations, and in some cases, cutting down trees or converting marginal lands to plant food crops (Tchoungui et al., 1995).

In 1991, fixed guaranteed prices for export crops were replaced by minimum guaranteed prices by the NPMB. These prices served as reference price points below which prices were not to fall. In addition, although cash crop farmers have started to receive a higher percentage of FOB prices (e.g. cocoa farmers now receive 57 per cent of the FOB price), up to 1994 producer prices continued to decline (Figures 3.1 and 3.2) due to the fall in world market prices and the overvalued currency (Ndoye, 1997). The recent devaluation of the currency is expected eventually to have a positive impact on producer prices, on productivity and production, and may also have a significant impact on reducing the dependence on converted forest land for increasing production

3.3. 3.3 Input prices

As a result of the SAP, input prices have been liberalised. In 1989/90 the level of fertilizer subsidies decreased to 30 per cent (from 36 per cent in 1988/89) to 20 per cent in1990/91, and was completely eliminated in 1991/92. There has also been a planned reduction of subsidies on fungicides by 50 per cent beginning in 1989. This have led to increased input prices (see for example fertilizer prices in Figure 3.6).

The removal of fertilizer subsidies appears, at least in the short term, to have lowered the profitability of cash and food crop production. This impact was predicted even before the SAP was implemented. A 1987 study carried out by USAID (cited by the World Bank, 1989) found benefit-cost (BC) ratios of 8.76 for arabica coffee with the subsidy and 3.26 without subsidies. For maize, the study found BC ratios ranging from 4.15 to 8.31 with subsidies and from 1.7 to 3.5 without subsidies. Similar results were found for other crops. This has led to conclusions that, without subsidies, the price of fertilizer would be too high and cannot be afforded by farmers, especially if the producer prices remain very low (Ndoye, 1997). It has been observed that after the liberalization of the fertilizer market, the price of a 50kg bag of fertilizer in the Southwest of Cameroon, increased from 3,250 CFA F in 1992 to 6,000 CFA F in 1993 (Ndoye, 1997; Grangeret-Owona, 1995). The consequences were dramatic in Western Cameroon, where 46 per cent of households stopped using fertilizer in 1992. Similar drops in the use of insecticides and fungicides in coffee production in other regions of Cameroon.

In 1993, fertilizer imports were 58,000 tons, approximately 50 per cent of fertilizer consumption in 1986 (FAO, 1995). In fact, fertilizer consumption was 58,000 tons in 1969-70 (Minot, 1989), suggesting that in 1993 Cameroon was back to the same level of fertilizer consumption as in the late 1960's and early 1970's.

3.3.3.4 Agricultural credit

Under the restructuring of financial institutions, the Cameroon Development Bank, FONADER (the farmers= bank), the Cameroon Bank, and other state credit institutions were dismantled and liquidated (Amin, 1995). This led to increased demand by farmers for loans from the informal financial market, resulting in higher interest rates. This gap in financial and credit provision was partially offset by the establishment of FIMAC (Fonds d=Investissement de Micro-Realisations Agricoles) in 1991. FIMAC aims to provide credit to associations and groups of farmers who were required to put 20 per cent as a down payment to obtain a loan. However, FIMAC imposes strict conditions in the selection of associations and groups that qualify for credit. In the short term, most viable sources of credit to many small farmers will continued to be the semi-informal and informal financial institutions operating in rural areas.

3.4 Forestry policy reforms under the Structural Adjustment Programme

Forestry policy reforms in the SAP focused on two main areas. One is a reduced role of the state, and the other, a new Forestry Code, in the form of the Tropical Forestry Action Plan (TFAP). Other specific measures include reform of forest taxation.

During the pre-adjustment era, the operating costs of ONADEF and CENADEFOR had become unbearably large for the forestry sector, and government revenue from the sector has been below potential. In addition the rapid pace of forestry exploitation without adequate regeneration threatened the country=s forests. As a result of the SAP, ONADEF and CENADEFOR have been liquidated, the role of the Department of Forestry is being strengthened, and the establishment of inventories and regeneration activities is planned to be handled by the private sector on the basis of large-scale concessions. Only the general strategic and regulatory roles are retained by the Forestry Department (Tchoungui et al., 1995).

The Forestry Code, which came into effect in 1994, aims at improving incentives for concessionaires to manage Cameroon=s tropical forest sustainably. However, the Code was significantly watered down when it emerged from the debate in the National Assembly. Both the World Bank and the French Government were in opposition. Their main concern is that the Code too weak, and they are working to restore it to the form in which it was originally presented to the Assembly. There are two crucial issues. One is attribution (i.e. transparency and accountability), i.e. the terms of concession should be specified, so that companies can bid knowing what is expected of them, and their performance can be monitored against clearly set criteria. The second issue, is the scale and length of concessions. Originally, in the Code they were for areas of at least 500,000 hectares for a minimum of 25 years. This was considered as offering concessionaires an incentive to use their area sustainably. These limits were reduced in the Assembly to 200,000 ha and 12 years respectively. The Code also contains a proposal to create an Office National du Bois to act as a parastatal for selling logs.

The new structure of forestry taxation in the Code is intended to serve several purposes. The area tax is aimed at making concessionaires use all their area. The stumpage tax varies according to species, sizes, etc, in order to improve utilisation of different species and wood types. The export tax is intended to act as an incentive to domestic processing. Any remaining natural >rent= will, in theory, be captured in the fee during the bidding process. Case study evidence, however, shows that little of the revenue due from logging concessions is being collected, and logging practices are not being properly monitored. Hence the >rent= from forests is not being collected by the government, and this, together with the absence of controls on logging practices, increases the incentive for unsustainable rates of extraction (Tchoungui et al., 1995).

The 1994 devaluation is expected to increase the return in local currency for exporters of timber and timber products (see Figure 3.5). If earnings increase, both the log export and processing export market might be revived. Another advantage of increased earnings is that it will improve the availability of imported inputs, leading to improved efficiency in extraction and processing and reduced forest loss. One disadvantage, however, is that it may encourage more exports of logs rather than of domestic processed products (as is evidenced in Appendix 2.3), since it is easier and cheaper to export logs under the current structure of the forestry industry in Cameroon.

3.5 Policies affecting deforestation and forest degradation

As stated previously, forest loss is caused by the interaction of very different, complex proximate and underlying factors. The proximate factors of deforestation were discussed in Chapter 2. This section focus further on the underlying factors in the form of specific forestry and agricultural policies, some of which have unintended effects on the forest in Cameroon. Other important factors are increased migration to the rural areas and the land tenure system.

High rates of population growth (about 2.8 per cent in 1990 and 1995 (FAO, 1998)) are an important cause of forest loss in Cameroon. Increasing population growth has a positive impact on increasing demand for food. With the objective of food sufficiency but the lack of modern technology in agriculture, this demand can be met only by expansion in land area. What is even important in terms of population trends, is the return migration to rural areas, especially after the oil boom, which may have led to increased demand for land. Given also that, in principle all forest land is government owned but rights to land are established through the *mise en valeur* (i.e. the forests must be cleared for agricultural production before legal title may be granted) of the forest, there is the tendency to clear more forest for agricultural production in order to obtain such legal titles. All these forces have worked over the period to increase pressures on the forest.

Existing tenure arrangements and institutions may also contribute to deforestation. Farmers in forest frontier areas have few rights to the timber trees found on the land they work, save the right to use some for individual >domestic= purposes. Farmers have no right to sell timber trees on their land, although in some places such >sales= do take place. They also do not receive any portion of timber royalties earned from harvesting on their lands and have no legal rights to be informed of or to refuse felling of trees by timber concession holders. Furthermore, destruction to tree crops and farms is often sustained when timber trees are felled, with little or no compensation generally received. Farmers are therefore keen to remove such trees because they feel their crops will do better without them, given the negative effects of maintaining the trees. Thus there is a net disincentive to plant, protect and nurture timber trees in that the costs to the farmer may include not only the >bad= qualities of pest harbouring and competition with crops, but also the eventual damage to crops from felling. These may far outweigh the benefits from tree products, >good= qualities of shade, soil and microclimatic functions.

Government legislation and controls on logging operations in the forests are weak or nonexistent in Cameroon. There are still few legislative mechanisms or economic incentives to ensure that logging is carried out in a careful manner or to protect concessions once logging has ended (Horta, 1991). Current logging regulations also appear to influence the rate of deforestation. On publicly owned, for example, where most logging occurs, there is no requirement for management. Although there are a range of different options and regulations controlling exploitation, this tend to be minutely detailed and ineffective. The requirements of the reporting system and the system of log measurements are demanding, but in the forest such controls are poorly enforced. A further problem on national land is the concessions licence system, which allows local logging of small areas of forest for a three-year period. Concessions are granted without approval from any form of technical committees, and there is little or no field supervision of the operations. There is no obligation for the licence holder to construct a sawmill or a wood processing unit, and the wood is often sold to existing (expatriates) mills. Some expatriates= companies rely solely on this source to provide sufficient wood to operate their mills (Sayer et al., 1995).

The Tropical Forestry Action Plan (TFAP) for Cameroon may also have some negative implications for the forest. A 600-km road is to be constructed to open up 14 million hectares of pristine, forest in the Southeast of the country. The World Bank and bilateral aid agencies have also provided over US$230 million for logging operations, mainly for improving road infrastructures. Exports are to be facilitated further by the building of a deep-water port at Grand Batanga (Horta, 1991). These will increase access to the forest land, and if not controlled, may lead to increased forest loss. There have been efforts at conservation, with the World Bank given US$25 million for the protection of biodiversity. There is, however, skepticism about achieving that objective (Horta, 1991).

As discussed previously, during the pre-adjustment era, government interventions in the agricultural markets have also adversely influenced the use of forest land. In the first place the exchange rate was overvalued, and relatively low prices were received by cash crop farmers. It is possible then that many smallholder farmers turned to farming more lands in order to maintain their level of income.

In the pre-adjustment era, the government also tried to increase self sufficiency in food production by setting export crop prices at low levels. A shift in production from export crops to food crops was then induced through the resulting relative increase of the price of food crops. This shift to food crop production may also have led to higher rates of deforestation, as compared to some important cash crops, such as cocoa and coffee that require forested surrounding from trees and shrubs to provide continuous canopy cover, food crops do better under completely cleared land. Thus, the encouragement of food crop production, due to relative higher prices, may have led to increased deforestation (Amelung and Diehl, 1992).

Other problems in the agricultural sector are largely structural. Smallholder farmers, do not have easy access to research results or credits for inputs and marketing. Particularly during the pre-adjustment period, credit was tied to the promotion of specific crops such as coffee and cotton, and this benefited only a small number of farmers. Such constraints hamper the adoption of new and more efficient production methods, and the use of fertilizers and insecticides (Lele, 1989).

As noted previously in this chapter, agricultural policies in Cameroon have undergone significant changes and reform since the implementation of SAP in 1989. The next two chapters will examine more clearly the likely implication of the SAP on deforestation.

Government policy has also influenced market conditions in the forestry sector. As noted previously, much of government intervention, has led to inefficient exploitation. In general, prices of all natural resources have been kept artificially low in Cameroon because the government has wanted to stimulate industrialisation. In the forestry sector, timber has been sold at prices which do not reflect the environmental value of the forest: stumpage fees and their collection rates have been maintained at very low levels (Grut, 1990). Moreover, logging activities have been highly inefficient because investment in costly sustainable management practices.

A further problem has been the lack of regional differentiation in the rate of stumpage fees. The fee has remained the same, independent of the quality of the concession area and independent of the distance to the markets or ports. The result has been over exploitation of the forests nearest to ports and markets (Grut, 1990).

The prices at which forest products are sold have also been maintained at low levels. Up to 1994, this was caused partly by the overvalued exchange rate, which made competitive imports relatively cheap. The government also monopolized the marketing of certain species, thus suppressing producer prices. The effect of low prices was to reduce long-term investment in more efficient logging techniques or more sustainable forest management. The existence of government monopolies also led to over exploitation of a few species. In the Cameroon forests, about 300 tree species have commercial value of which about 30 are actually being exploited, and only 15 species make up 86 per cent of the aggregate timber harvested (Ndoye, 1997). Under the SAP, the profitability of logging has increased due to the 1994 devaluation. This may lead to increased unsustainable exploitation of the forest resource unless other measures are put in place to reduce the rate of exploitation or encourage loggers to invest in more efficient technology.

Prices of processed wood have also been artificially depressed. The government has decided to stimulate local processing by prohibiting all exports of raw logs in the year 2000. But prices of processed timber products are not very high because of the fierce competition from other developing countries. Banning log exports may further depress producer prices in Cameroon of timber used in processing, which is a disincentive to increasing efficiency in logging and processing. This is the experience found elsewhere in West Africa from the imposition of log export bans (Barbier et al., 1994).

According to Jolivald (1992), another problem affecting deforestation in Cameroon is that large logging firms are owned by foreigners, who may have less incentives to preserve the forest than local inhabitants, whose future depends largely on the forests. As the present value of the profit rates from non-sustainble production are much higher than if forests are exploited sustainably in expectation of a higher relative price in the future, this may give an incentive to logging firms to increase production now (Horta, 1991). The idea of foreign firms being more prone to unsustainable forest management may, however, be a conjecture since there is no established relationship between the type of ownership and the rate of sustainable management.

3.6 Policies addressing deforestation and degradation

Since the SAP, forestry and agricultural policies have been implemented to address specific deforestation in Cameroon. Other policies are unintended, but may have an indirect effect on reducing forest loss. The key forestry policy has been the attempt to implement the Tropical Action Plan (TFAP). With respect to agriculture, policies such as provision of credit facilities, increased supply of fertilizer and increased output prices, may have unintended and indirect effect on deforestation. There are also other conservation initiatives that may impact on the forest.

3.6.1 Forestry policies

The most high profile effort on the part of the Cameroonian government, has been the development of a new Forestry Code, modelled on the Tropical Forestry Action Plan (TFAP), to replace the outdated 1981 version. The Code contained strong sustainable forestry elements, including recognising customary land tenure, compensation to local people for deforestation and regional development plans. However, as noted above, several key components of the Code were altered, the most important being the length of time a concession could be held. The Code originally recommended a twenty-five year concession period, which was considered the minimum time allowing forestry companies to benefit from sustainable forestry practices they may implement at the beginning of their lease. However, Cameroon=s National Assembly shortened the maximum lease period to 12 years in the Code, a time period significantly shorter than the growth period of any of the valuable trees (Green and Brown, 1994).

In the timber industry, the devaluation of the currency should eventually increase the returns for the forestry sector. This could improve efficiency in the industry and therefore conserve the use of the forest resource. However, as argued previously, this effect will also depend on the other forestry policies and regulations adopted for the industry and timber management. To date, Cameroon=s record in improving forestry policy and regulation is not encouraging.

3.6.2 Agricultural policies

In the agricultural sector, the provisions of credit facilities, improved seedlings, research and extension services, increased market prices, and the devaluation could possibly make the sector less reliant on forest land conversion for increased production. For example, the provision of credit improves the farmers= ability to purchase inputs and boost the productivity of existing agricultural land. Improved research and extension services and seedlings will also increase productivity. The 1994 devaluation, which should eventually increase the producer prices of cash crops, may enable farmers to purchase and adopt environmentally friendly inputs and reduce their demand for converting forest land.

3.6.3 Conservation initiatives

The Forest Stewardship Council (FSC) has been exploring the possibility of developing accredited certification programs for forest products that are sustainably harvested and processed from Cameroon=s forests. Other recent efforts include a study written through the Biodiversity Support Programme on the role of Cameroon and its Central African neighbours in global climate change, as well as a USAID-funded analysis on non-governmental organization (NGO) participation in forestry policy making (Green and Brown, 1994).

Other conservation initiatives have been launched and supported by the WWF and various international NGOs. In 1990 a WWF office opened in Cameroon. One of the first actions of the country office was to appoint a national coordinator to develop a programme for environmental education. The WWF Korup Project, for example, integrates environmental protection and community development. The project has received support from several multilateral and bilateral development studies. The WWF Mount Kilum Project (on Mt Oku) is designed to protect the highly endangered montane forest. To reduce pressure on the forest, it encourages local communities to produce honey and support farmers= cooperatives (Sayer et al., 1995).

A scheme to develop the Dja Faunal Reserve as a national park on broadly similar lines to the Kilum and Korup projects was recently initiated by the European Development Fund of the European Union (EU). This scheme aims at protecting an exceptionally important forest in the Cameroon-Congolese forest zone. An EU-funded buffer zone project also aims at promoting agroforestry around the Dja Biosphere Reserve (Sayer et al., 1995).

Other specific conservation projects also aim at improving the management of the forest resources. The British-funded ODA ONADEF Forest Management and Regeneration Project in Mbalmayo (south of Yaoundé) is involved in forest management and conservation research, socioeconomic work and training in and around the Mbalmayo Forest Reserve. The Cooperation Française AProjet d=Aménagement Intégré de Dimako≅ is another example. This project, carried out in cooperation with the largest timber operation in the country and the French-based multinational SFID, aims to study long term forest growth performance, the management and silviculture in old growth forest, and the needs and participation potential of local people. The Dutch-funded Tropenbos programme is working on developing sustainable forestry methods and strategies in natural growth forest. They are currently working with a Dutch owned company on the coast south of Douala, near the port of Kiribi. The CIDA funded (and staffed) Forest Management pilot project, is a major effort to provide systematic inventories for the forests, thematic maps, socioeconomic studies, the development of forest management contracts, and how to involve local populations in forestry planning and administration. Canadian-funded personnel have been seconded to the Department of Forests, and have provided GIS expertise in plotting out how the forests are to be allocated (Green and Wood, 1994).

3.7 Conclusions

This chapter has reviewed the Structural Adjustment Programme undertaken in Cameroon over 1989 and 1995, and some specific agricultural and forestry policies undertaken under the programme which may have some implications for forest loss in the country. Among the specific agricultural and forestry policies identified are the more liberalized markets for cash and food crops, and agricultural inputs. The more liberalized markets have led to higher prices for food and cash crops. The devaluation has also led to increased domestic prices for cash crops and timber products. The removal of subsidies has also led to higher prices of agricultural inputs. The review showed that these higher prices of both outputs and input prices may increase pressures on the forest in the adjustment period. However, other conservation initiatives undertaken over the period may help reduce the implications of higher output and input prices on the forest. In the next two chapters we develop a model which we use to empirically investigate the impacts of these prices and other policy changes on the demand for cash crop and food crop land and timber production and therefore on the forest in Cameroon over the Structural Adjustment period.

Chapter 4: A theoretical and empirical model of tropical land use for forestry and agriculture

4.1 Introduction

The previous chapter reviewed the impacts of the Structural Adjustment Programme on the forestry and agricultural sectors of Cameroon and the likely implications for deforestation trends. In this chapter and in the remainder of the report, we develop an analytical approach to investigate formally the links between changes in Cameroon=s agricultural and forestry policies and deforestataion. This chapter has two main objectives, the development of a theoretical model of tropical forest land use and the derivation of empirically estimable equations for the demand for forest land conversion. In the next section, a dynamic optimal control problem approach is used to derive the optimal use of forest land for cash crops and food crops and timber production in a tropical country. In the subsequent section, the first order conditions of the analytical model are used to derive a relationship for forest land conversion, which is related to the demand for the stock of forest land as an input in the production of cash, and food crops, as well for timber production.

4.2 The theoretical model

The following model assumes three sectors: cash crop production, food crop production and timber extraction. The production function for each sector is assumed to be a single-valued continuous function with continuous first and second order partial derivatives, and also increasing and strictly concave.

The production functions for the cash and food crops and timber sectors are defined respectively as

Install Equation Editor and double-click here to view equation.

$C(t)$ is the output of cash crops in each time period, t, $L^c(t)$ is the total land input use in cash crop production,

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

measured in hectares and $X^c(t)$ represent other inputs= use in cash crop production. $M(t)$ is the output of food crops in number of bags in each time period, t, $L^m(t)$ is the total land input use in food crop production and $X^m(t)$ represents other inputs= use in food crop production. The production of timber, $H(t)$, is assumed to depend on the stock of forest land, $F(t)$, and other inputs used in timber extraction, $X^h(t)$.

The net benefits from cash crops, food crops and timber production, in each time t, are defined respectively by the difference between the total revenue and the total cost:

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

where $P^i(t)$, $i=c, m, h$ is the per unit output price for each respective sector, and $W^i(t)$, $i=c, m, h$ is the per unit input price. The output and input prices are assumed to be exogenously determined.

Install Equa tion Editor and double - click here t o view equat ion.

The net benefits in each of the three sectors are the incentives to use more of the stock of forest land. As the net benefits increases, either through output price increasing and/or input price falling, it becomes more profitable to use more of the stock of forest land for the three activities.

One important observation can be made from these simplified net benefit functions for the three sectors. The cost of the stock forest land, either in terms of conversion to cash or food crop land, or exploited for timber is not considered in the output decisions of the three sectors. This is because the market is not able to capture these costs due to market and policy failures. Later, we introduce these costs through >shadow prices= for converted and existing forested land. It may be argued that in some cases a cash crop of food crop farmer may make some payments to the owner of the land in the form of either crop or money. But it must be noted that these payments are not payments for the stock of forest land converted to agricultural land but for the right to farm the land. Where the land belongs to the farmer, such payments are not accounted for in markets. In general, therefore, there is no market price for land as suc h, and any existing price is not an adequate reflection of the costs of this input.

It is further assumed that the stock of forest land provides other environmental benefits, $B(F(t))$, apart from its use for timber production. These include maintaining lo cal climates, watershed protection, non-timber products and the preservation of natural habitats:

Install Equa tion Editor and double - click here t o view equat ion.

However, the total stock of forest land, F, is not static but is linked to agricultural land expansion and timber production. Changes or increase in land under cash crop production Install Equa tion Editor and double - click here t o view equat ion. and food crop production Install Equa tion Editor and double - click here t o view equat ion. are due to the conversion of forest land to cash crop land, $P^c(t)$ and to food crop land, $P^m(t)$, respectively:

Install Equation Editor and double-click here to view equation.
Install Equation Editor and double-click here to view equation.

Equations (8) and (9), imply that changes in the stock of forest land over time are a result of the conversion of the stock of forest land to cash crop land (P^c) and food crop land (P^m). Such conversion of forest land is assumed to be irreversible.

It is also assumed that timber extraction leads to a fixed amount of stock of forest land loss, given by a timber-related conversion factor, α. However, forest land extracted for timber can be regenerated by an amount given by k. Therefore extraction of timber in any time t leads to the stock of forest land changing by $-(k-\alpha)H(F(t), X^h(t))$. The change in the stock forest land, Install Equation Editor and double-click here to view equation., or the amount of deforestation, D, is defined by

Install Equation Editor and double-click here to view equation.

4.2.1 Maximisation problem

Given these assumptions, the objective of the society is to maximise the stream of net benefits (4)-(7) from the

Install Equation Editor and double-click here to view equation.

uses of the stock of forest land, subject to (8), (9) and (10). That is

The control variables in the model are X^c, X^m, X^h, P^c, and P^m. The state variables are F, L^c, and L^m.

4.2.2 Optimality conditions

Install Equation Editor and double-click here to view equation.
Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.
Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

The current value Hamiltonian for the above optimal control problem is[8]

Install Equation Editor and double-click here to view equation.

where λ, is the costate variable or shadow price of the forest, and ψ and μ, are also the costate variable for forest land converted to cash crop and food crop land respectively. The current value Hamiltonian (17) can be interpreted as the total increase in the value of the stock of forest land. The group in the first term, $[B(F) + (P^c C(L^c, X^c) - W^c X^c) + (P^m M(L^m, X^m) - W^m X^m) + (P^h H(F, X^h) - W^h X^h)]$ is the flow of net returns at instant t. The second term, $\lambda((\alpha - k)H(X^h, F) - P^c - P^m)$, is the increase in the value of the stock of the forest land at instant t. The third term, ψP^c, is the increase in the value of cash crop land, whilst the fourth term, μP^m, is the increase in the value of food crop land.

Assuming an interior solution, the first order conditions for maximizing (17) are equations (8), (9) and (10) plus

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

[8] From this point onwards notation is simplified by omitting the argument of time-dependent variables and partial derivatives are represented by subscripts.

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

Equations (18) and (19) indicate that, at any point along the optimal path, the value of marginal products of

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

inputs used in cash crop and food crop productions are equal to their respective input prices. However, equation (20) is a little bit different. For timber, on the optimal path, the sum of the private cost of production, W^h, and the social cost of timber related deforestation, $\lambda(\alpha - k)H_x(X^h, F)$, should be equal to the value of the marginal product of input, $P^h H_x(X^h, F)$.

It can be inferred from (20) tha t

Install Equa tion Editor and double - click here t o view equat ion.

Equation (20N) has an interesting interpretation: on the optimal path, the shadow price of forest land, λ, must equal the ratio of the net marginal returns of timber operation to net timber-related deforestation. Alternatively, the c ost of the net timber-related deforestation, $\lambda(\alpha - k)H_x(X^h, F)$, must equal the net marginal returns to timber operations, $P^h H_x(X^h, F) - W^h$.

Equations (21) and (22) govern the optimal state of the stock of forest land conversion to cash and food crops. In each case the marginal value of the stock forest land converted, ψ and μ, should be equal to the cost or >shadow price= of forest land, λ.

Equation (23) indicates that the stock of forest land should be employed in timber production and other environmental purposes up to the point where the benefits are equal to its social cost. The left-hand side of the equation represents the benefits. It has three parts: the direct value of the stock of forest in terms of environmental benefits, $B_F(F)$, the value of the stock of forest land as in timber extracted, $P^h H_F(F, X^h)$, and a capital gains term, Install Equa tion Editor and double - click here t o view equat ion. . The right-hand side are the costs. It includes the social cost of the net timber related deforestation, $\lambda((\alpha - k)H_F(F, X^h))$, and an interest charge, $\delta\lambda$, for the use of the forest as a capital.

Similarly, equation (24) implies that the land under cash crop production, which is the stock of forest land converted into cash crop land, should be employed up to the point where benefits from the converted forest land are equal to its social cost. The left-hand side of the equation is the benefits. It includes the value of the marginal product of the converted stock of forest, Install Equa tion Editor and double - click here t o view equat ion. and a capital gains term, Install Equa tion Editor and double - click here t o view equat ion. . The right-hand side is similar to equation (23). It measures the cost of employing the services of per unit stock forest land, $\delta\psi$.

Equation (25) also indicates that the stock of forest land should be converted to food crop land for food crop production up to the point where the benefits also equal to its social costs. The left-hand side are the benefits which include the value of the marginal product of converted forest land, Install Equa tion Editor and double - click here t o view equat ion. and a capital gains term, Install Equa tion Editor and double - click here t o view equat ion. . The right-hand side also measures the cost of employing the services of per unit stock forest land as maize land, $\delta\mu$.

Finally, equations (26) to (28) are the transversality conditions.

From equations (21) and (22)

Install Equa tion Editor and double -
click here t o view equat ion.

which implies that, along the optimal path, the shadow price of forest land must be equal across all uses. The implication is that the forest land has the same opportunity cost in any use to which it is part. It follows also from equation (29) that the following equation holds.

Install Equa tion Editor and double -
click here t o view equat ion.

Combining equations (29), (30), (23), (24), and (25), we have

Install Equa tion Editor and double -
click here t o view equat ion.

Equation (31) indicates that along the optimal path, the stock of forest land should be allocated up to the point where the marginal returns are equal across all uses - forest land, cash crop land and food crop land.

4.3 The empirical model of tropical land use and deforestation

Equation (31) is similar to a result obtained by Barbier and Burgess (1997). Following the latter=s approach, a useful interpretation of (31) is that the opportunity cost, or >price= of using the stock of forest land for one land use is the forgone benefits of other uses. Thus each land use has a >price=, which can be denoted by $V^i(t)$, $i = h, c, m$.

Through utilizing $V(t)$ for each land use in (31), and substituting for λ, we obtain

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

In equation (32) the opportunity cost or >price= of maintaining an additional stock of forest land for environmental benefits plus timber production is forgoing other marginal benefits from converting the stock of forest land to either cash crop land or food crop land. As this >price=, $V^h(t)$, increases (which means it will be more beneficial to convert to eithe r of these two uses than maintaining it), less and less stock of forest land is maintained. This implies that there is a negative relationship between this opportunity and maintaining more stock of forest land. In (33), the opportunity cost or>price= of converting an additional stock of forest land to cash crop land is, either the forgone benefits from maintaining the given stock of forest land or conversion to food crop land. Similarly, as this >price=,$V^c(t)$, increases the quantity demanded for cash crop land converted from the stock of forest land falls. In the same vein, in equation (34), the opportunity cost or >price= of converting an additional stock of forest land to food crop land, is the forgone benefit from either maintaining the given forest stock or converting it to cash crop land. As this>price=,$V^m(t)$ increases, less stock of forest land will be converted to food crop land (Barbier and Burgess, 1997).

These three equations (32 - 34) therefore form the optimal demand for the stock of forest land for timber production, for cash crop land and food crop land. However, some of the key arguments of the equations are endogenous. For example, from (18) to (20), it follows that X^c and L^c are a function of P^c and W^c; X^m and L^m are a function of P^m and W^m; and X^h , and F are a function of P^h,W^h and λ. Recall also that $\lambda(t)$, which is the marginal value of forest land, is essentially endogenous, and depends on the optimal solution of the value function, $\Pi(t)$. That is, at any time t,

Install Equa tion Editor and double - click here t o view equat ion.

It follows that $\lambda(t)$ = M$\Pi(t)$/MF is a function o f X^h and F, and in turn, from (20) the latter are both a function of P^h and W^h respectively (see also equation (20')).

Consequently, substituting for the endogenous terms in (32) - (34) and utilizing the fact that $V^h = V^c = V^m$, then the optimal stock of timber production, cash crop land and food crop land in the model is determined by the

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

following reduced form system of equations, which are determined by the price parameters of the model. The final equation in our system is equation (10) determining an optimal forest loss or deforestation. Using discrete notation Install Equa tion Editor and double - click here t o view equat ion. , we write this equation as

Install Equa tion Editor and double - click here t o view equat ion.

An important inference from equations (18) - (20) and (31) - (34) is that, on the optimal path of forest of land allocation the most important determinants for the use and non-use, or the allocations of the forest stock are the net benefits from the various uses of the forest stock. These net benefits are in turn determined by prices (as shown in our first order conditions). These prices are in turn influenced by macroeconomic policies as undertaken under the SAP (for example, price, subsidy and exchange rate policies). This is the basis for our empirical model in equations (36) - (39).

4.4 Conclusions

In this chapter we have developed a dynamic model of forest land use in a tropical country. We concluded that, along the optimal path, the value of marginal products of inputs used in cash and food crop productions should be equal to their respective input prices. For timber production, however, the sum of the private cost of production and the social cost of timber related deforestation should be equal to the value of the marginal product of input used. Along the optimal path also, the stock of forest land should be allocated up to the point where the marginal returns are equal across all uses. We have also used the theoretical model to derive demand equations for optimal timber harvesting, food crop land and cash crop land that are functions of the price parameters of the model (equations (36) to (38)). As deforestation in the model is a function of the change in land use and timber production, equation (39) will also by definition be a function of the price parameters of the model.

In the next two chapters, we attempt to estimate the reduced form demand equations (36) to (38) and deforestation equation (39) for Cameroon. These estimated equations are then used to explain the influence of the structural adjustment on these relationships.

Chapter 5: Discussion of empirical estimates

5.1 Introduction

The following chapter empirically applies the model of tropical forest land use developed in the previous chapter to Cameroon over the 1965-95 period. The objective of the analysis is to test the two key hypotheses that were identified in Chapter 1. First, if increasing cash crop and food crop land expansion and greater timber extraction have been the principal proximate causes of deforestation in Cameroon, then, prices and other economic factors determining the expansion of these activities are the underlying causes of deforestation. Second, by affecting the prices and economic factors determining the expansion of cash crop and food crop land, as well as timber production, the introduction of the Structural Adjustment Programme (SAP) in 1989 may have also influenced deforestation significantly.

The hypothesized relationship between deforestation in Cameroon and its proximate and underlying causes are examined through estimating the demand relationships derived from the theoretical model of the previous chapter. The possible influence of the SAP on these relationships is analysed through employing piecewise linear and switching regression approaches to distinguish the influences of the post from the pre-adjustment period[9]. These approaches are applied over the period 1965-95 in Cameroon.

For the purpose of our analysis, the pre-adjustment period in Cameroon should be separated into two distinct economic eras. These are the pre-oil boom era, 1965-1977, and the post-oil boom era, 1978-1988. For example as discussed in Chapter 2, during the post-oil boom period there were increased subsidies on agricultural inputs and rural-urban migration. Both factors may have influenced the rate of crop land expansion and therefore forest land conversion during this period. The extent of the impact of this economic era on the forest in Cameroon is also investigated through employing the piecewise linear or switching regression approaches.

The theoretical model of chapter 4 distinguished the tropical economy into 3 sectors: cash crop, food crop and timber production. Corresponding to these sectors is a system of equations ((36) - (38)), and an overall deforestation equation (39). However, to apply equations (36)- (39) to Cameroon economy they must be modified to five equations. This is done for two main reasons.
First, the Cameroon agricultural economy is heterogenous and regionally distinct (see Chapter 2). Using a single proxy for cash crops equation (37) and food crops equation (38), will not best describe the economy of Cameroon. Instead, there are two principal cash crops, cocoa and coffee, and two food crops, maize and plantain. The respective demands for land by the cash crop (equation (37)) and by

[9] The piecewise linear regression assumes that the true model being estimated is continuous, with a structural break. The switching regression also assumes that the true model has a structural break, but the regression relationship is not continuous (see Pindyck and Rubinfeld, 1991, p117-120).

the food crop (equation (38)) are therefore modified to a set of four equations, with each determined by similar exogenous input and output price variables.

Second, time series data on forest cover over the period, 1965-1995, are not available so the forest loss equation (39) cannot be estimated. However, based on the theoretical model in Chapter 4, increases in cashcrop land and food crop land, and timber extraction, lead to increasing levels of forest land loss. It follows that, any changes in the exogenous price variables in equations (36) - (38) that affect either the demand for land converted to cash or food crop production, or timber extraction, will also affect forest cover through the forest loss equation. Although we cannot estimate the latter equation explicitly, we assume that equation (39) is still implicitly valid for Cameroon. For example, if from the estimated food crop equation (38), increases in maize prices lead to increases in land converted to maize cultivation then based on the reasonable assumption that expansion in food crop land is due to forest conversion, the inference will be that increases in maize prices will lead to more forest cover loss. Our six equations therefore reduce to five without losing the essence of what is being investigated.

The following section discusses the estimation procedure undertaken for the five equation model for Cameroon. The results of the estimated equations for timber production, cocoa land, coffee land, maize land and plantain land, are discussed in the subsequent sections, and distinguished in terms of pre-adjustment and post-adjustment effects.

5.2 Estimation procedure

Equations (40) - (44) below are the modified versions of (36) - (38) derived in Chapter 4 that are to be estimated empirically for Cameroon over the 1965-95 period. From the empirical literature on statistical analysis of tropical deforestation, we also assume that there are two additional exogenous variables that influence these relationships: income (per capita GDP, Y_p) and population (population density, $popd$)[10]. Thus, the equations to be estimated are:

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

[10] See for example, Angelsen et al (1996), Barbier and Burgess (1997); Burgess (1993); Capistrano (1994); Holden (1996); Reis and Margulis (1991); Sankhayan (1996) and Southgate et al (1991).

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

In the above equations, the variables Install Equa tion Editor and double - click here t o view equat ion. , represent the demand for cocoa land (*c*), coffee land (*f*), maize land (*m*), and plantain land (*p*), measured in hectares of land under cocoa production, coffee production, maize production and plantain production respectively at time *t*; and H_t is the demand for the stock of forest land for timber production measured by total production of industrial roundwood in time *t*. Install Equa tion Editor and double - click here t o view equat ion. are the prices of timber (*h*), cocoa (*c*), coffee (*f*), maize (*m*) and plantain (*p*). Install Equa tion Editor and double - click here t o view equat ion. is the current years= average price of industrial roundwood; Install Equa tion Editor and double - click here t o view equat ion. , is the current years= producer prices of cocoa; Install Equa tion Editor and double - click here t o view equat ion. is the current years= producer price of coffee; Install Equa tion Editor and double - click here t o view equat ion. is the price of maize; and Install Equa tion Editor and double - click here t o view equat ion. is the price of plantain. Install Equa tion Editor and double - click here t o view equat ion. are the input prices of the corresponding crops, and Install Equa tion Editor and double - click here t o view equat ion. is the cost of logging[11].

Secondary data were used for the estimation of equations (40)-(44). These were collected mainly from the UN Food and Agriculture Organization (FAO). Other sources were the International Monetary Fund (IMF), the World Bank and the literature (A complete list of data sources is presented Appendix 5.1).

Given that all the explanatory variables are exogenous, the model is recursive, and ordinary least squares is therefore a reasonable procedure for the time series analysis. Where autocorrelation was detected, a Cochrane-Orcutt iterative approach was adopted for the estimation. The first step in the estimation procedure was to determine whether there is any significant difference in the functional forms (linear and log-log) of the estimated equations. This was done by the use of the Mackinon, White and Davidson (MWD) test (Gujarati, 1995).

The next step was to determine whether the piecewise linear (PW) or the switch (SW) regression approaches allowing for the influence of the three economic eras (pre-oil boom, post-oil boom and SAP periods) are preferred to the continuous regression of the entire 1965-95 period.

This latter analysis was conducted in the following manner. First, the data were separated into pre-adjustment (1965-88) and post-adjustment (1989-95) periods. Estimations were done for the two

[11] In our analysis, input prices are represented by the average price of total imported fertilizer less the rate of subsidies (see Appendix 5.1 for variable definitions). The best input price to use in the maize equation would have been ammonium sulphate; however, the data are not available for Cameroon. The prices of insecticides would also have been the most relevant input prices for cocoa, but these data were also not available. Following Amin (1995), total fertilizer prices (incorporating the rate of subsidies), were used as a proxy for input prices for all the crops in the analysis.

separate periods and a Chow test was applied to determine whether the two regressions are significantly different. Where the Chow test showed a significant difference, the appropriate structural adjustment dummy variables (*DS* for the PW and *D1* for the SW) were included in the model for the estimation of the piecewise linear or the switching regression. The same approach was used to determine whether the pre-adjustment period (1965-1988), was also influenced by the oil boom, or whether a continuous regression is preferred for the entire period. Thus the data for the pre-adjustment period were also divided into a pre-oil boom (1965-77) and post-oil (1978-88) phases. Where the Chow test performed on separate regressions for the two periods was significant, appropriate oil boom dummy variables (*DO* for the PW and *D2* for the SW) were also included in the model for the estimation of the piecewise linear or the switching regression[12].

The final step was to determine whether the piecewise linear or the switching regression is the best approach for capturing any influences of the oil boom and the structural adjustment >breaks= in the estimated relationships This was done in three ways: First, by comparing the adjusted R-squares of the two types of regressions; second, by comparing the level of significance of the coefficients of the dummy explanatory variables in the respective regressions; and third, by comparing the joint significance of their dummy explanatory variables using the F-test (Gujarati, 1995).

Implementing the above procedures led to the following results for the overall model of Cameroon: First, the MWD test showed that the linear functional form was preferred to the log-log functional form in all the five equations. In addition, the piecewise linear regression allowing for the influence of both the oil boom and the SAP was preferred for the estimated equation for the demand for land by coffee

[12]Where the Chow test indicated a significant difference between the pre-adjustment and the post-adjustment periods on one hand and the pre-oil boom and the post-oil boom periods on the other, the correct procedure is to include all the relevant dummy variables. However, even if the Chow test is significant it is possible in multivariate equations such as (40)-(44) that not all the variables may have been influenced by the structural change. Including the period dummies for all the explanatory variables in some estimations, may not explain the relationship very well. In fact, in some cases they may reduce the level of significance of the entire regression, in which case the appropriate procedure is to drop the irrelevant dummy variables from the estimation.

production, while the switching regression was preferred in the equation for maize land. In the cocoa and plantain land equations, the piecewise regressions allowing only for the influence of the oil boom were preferred. However, in the cocoa land equation the inclusion of the SAP dummy price variable improved upon the results. For the timber equation, the switching regression allowing for the influence of both the oil boom and the SAP was preferred to the piecewise linear approach. In all the estimations, the Cochrane-Orcutt interactive procedure was used to correct for the presence of autocorrelation.

The following section discusses in more detail the regression results for each of the five estimated equations (40-44).

5.3 Cocoa land results

The estimated piecewise model for the cocoa land equation is indicated in equation (45) below. The price of plantain (P^p) was use as the competing crop price. As noted in Chapter 2, plantain is an important crop in the Southern part of the country where cocoa is also grown (see also Ndoye, 1997; Amin, 1995 and Tambi, 1984). Other crop prices were not relevant in explaining cocoa farmers= behaviour in Cameroon and therefore were dropped. The per capita GDP variable (Y_p) was excluded as it did not improve upon the results. The Chow test confirmed a significant difference between the regressions of the pre and post-oil boom periods, but not between the pre and post-adjustment period regressions. The oil boom period dummies were introduced in the piecewise linear regression to capture this difference. However, most of the oil boom dummies were dropped because they did not improve upon the results. Moreover, even though the Chow test did not show any significant difference between the pre and post-adjustment periods, the SAP cocoa price dummy was very significant and its inclusion in the equation also improved upon the results. It is possible that the Chow test for the pre and post adjustment was not significant

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

where:

Table 5.1 Ordinary Least squares estimation of Cocoa land equation (L^c)

Variable	Estimated results		Pre-Adjustment				Post-Adjustment	
			Pre-oil boom		Post-oil boom			
	Coefficients	t-values	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]
Constant	β_{02} 376425***	4.2	β_{02} 376425		β_{02} 376425		β_{02} 376425	
P^c	β_{12} 5.7	0.625	β_{12} 5.7	0.065	$\beta_{12}+\beta_{52}$ 22.08	0.27	$\beta_{12}+\beta_{52}+\beta_{72}$ 97.93	0.53
W^c	β_{22} 8.05	1.59	β_{22} 8.05	0.038	$\beta_{22}+\beta_{62}$ -44.36	-0.08	$\beta_{22}+\beta_{62}$ -44.36	-0.18
P^p	β_{32} -155.4*	-1.86	β_{32} -155.4	-0.23	β_{32} -155.4	-0.22	β_{32} -155.4	-0.23
popd	β_{42} 391.5	1.36	β_{42} 391.5	0.15	β_{42} 391.5	0.19	β_{42} 391.5	0.28
$(P^{c1})DO$	β_{52} 16.38	1.003						
$(W^{c1})DO$	β_{62} -52.41	-1.58						
$(P^{c2})DS$	β_{72} 75.85*	2.0						
R-square = 0.3994		Adjusted R-square = 0.1706			DW statistic = 1.729		No. of observation = 31	

[1]Elasticities were calculated by using the means in the respective period.

***Coefficient statistically significant at 1% level **Coefficient statistically significant at 5% level

*Coefficient statistically significant at 10% level because our model did not include all relevant variables, the influence of which may be captured by the SAP cocoa price dummy. The estimated piecewise regression results and the computed marginal values and elasticities of the pre-adjustment (pre-oil boom period and post-oil boom period) and the post-adjustment periods are presented in Table 5.1.

Table 5.1 shows that in Cameroon, the output price of cocoa (P^c) and the price of plantain (P^p) are the most important factors determining the rate of cocoa land expansion between 1965-95. The output price impact is, however, greater in the post-adjustment period than in the pre-adjustment period.

In the pre-adjustment period (pre and post-oil boom periods), the relationship between the price of cocoa and cocoa land expansion is positive but not significant. In the post-adjustment period, there is also a positive relationship between the price of cocoa and cocoa land, and the significance of the dummy variable, Install Equation Editor and double-click here to view equation., suggests that this greater price impact is an important effect during this period. A one per cent increase in the price of cocoa will lead to about a 0.5% increase in cocoa land. Following the assumption that cocoa land expansion is due to forest land conversion, it can be inferred that cocoa price increases in the post-adjustment period may lead to greater forest loss in Cameroon. However, as Figure 3.1 shows real cocoa prices generally were falling during this period up to 1995.

The input price variable (W^c), the average price of fertilizer, is not very significant in all the periods under investigation. As stated earlier, it is possible that the price of insecticides is a better proxy for input prices for cocoa. Although not fully significant the negative coefficient of the post-oil boom input price dummy ($(W^{c1})DO$), may have an important economic interpretation. During the oil boom period, subsidies on fertilizers were as high as 60% and even higher on insecticides (see Chapter 2). Subsidies on inputs during this period may have played a major role in reducing the rate of cocoa land expansion and therefore reducing forest land conversion and the rate of deforestation in Cameroon.

The coefficient of the alternative crop price, plantain (P^p), is negative and significant. That is, from the cocoa farmers= point of view, plantain and cocoa compete in land use decision making in Cameroon. During the post-adjustment era, a rise in plantain prices encourages cocoa farmers to switch to plantain production.

The population variable ($popd$), has a positive impact on cocoa land expansion but is not significant. It is possible that population growth did not play a significant role in increasing forest loss through cocoa land expansion in Cameroon.

The above regression results provide some tentative evidence that price changes in the post-adjustment period in Cameroon may have led to increased forest loss through cocoa land expansion. Of particular concern is the total removal of subsidies on inputs, as the rates of increases in input prices were far greater under the SAP than the rates of increases in cocoa prices (see Chapter 3). This increased the relative cost of using these inputs in cocoa production and left forest land as the cheaper input for expanding cocoa production during the adjustment period. On the other hand, the liberalization of food crop markets under the SAP increased the real producer price of plantain, at least in the early stages of the post-adjustment period over 1989-94 (see Figure 3.4). According to Table 5.1, this could have reduced the demand for cocoa land expansion, especially in Southern Cameroon where cocoa and plantain are competing crops.

5.4 Coffee land results

The estimated piecewise model for the coffee land equation is as shown in equation (46). The price of maize (P^m) was use as the competing crop price. As noted in Chapter 2, coffee is produced mainly in the Northwestern and Western provinces of Cameroon where maize is also an important food crop (see also Ndoye, 1997; Amin, 1995 and Tambi, 1984). Other crop prices were not relevant in explaining coffee farmers= behaviour in Cameroon and therefore were dropped. The real per capita (Y_p) was also eliminated in this model. The Chow test showed a significant difference between the regressions of the pre and post adjustment period. Dummies for the Structural Adjustment period were therefore introduced into the model. The Chow test also confirmed a significant difference between the pre and post-oil boom period, and thus the oil boom period dummies were also introduced in the piecewise linear regression. Even though most of the dummy variables were not significant, their inclusion improved upon the overall significance of the estimation. The estimated results and the computed marginal values and elasticities of the pre-adjustment (pre-oil boom period and post-oil boom period) and the post-adjustment periods are presented in Table 5.2.

In Table 5.2, the output price of coffee (P^f), the price of maize (P^m), and population density ($popd$) are the most important variables determining coffee land expansion between 1965 and 1995 in Cameroon. These variables had the greater impact in the pre-oil boom period, except for population density ($popd$) which was more important in the SAP period

In the pre-oil boom period, the price of coffee (P^f) has a significant negative impact on coffee land expansion. A one percent fall in coffee prices leads to a 0.6% increase in coffee land expansion. As noted in Chapter 2, coffee prices in that period were very low and falling. Given that farmers may have wanted to maintain their income levels during the pre-oil boom era, and the cost of land was minimal, the only way to achieve this was for farmers to expand their land under cultivation. This behaviour may explain the negative relationship between coffee prices and coffee land expansion during the pre-oil boom period. In contrast, during the post-oil boom and post-adjustment periods, the output price impacts on coffee land expansion are positive and larger in magnitude, although they are not significant. The inference from this result is that in the pre-oil boom period, lower prices of coffee had a significant impact on forest land conversion to coffee land. It therefore played a major role in the rate of forest loss. In the post-oil boom and post-adjustment period, price increases may have influenced increasing forest land conversion due to coffee land expansion, though this impact may not have been very significant. Also, as Figure 3.1 indicates, real coffee prices generally fell over 1989-95.

Although the impacts of the average price of fertilizer (W^f) on coffee land expansion vary in sign across the different periods, none of the coefficients are significant. The conclusion is that, over the period of analysis, the price of fertilizer has a less significant impact on coffee land expansion

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

where:

Table 5.2 Ordinary Le ast squares estimation of Coffee land equation (L^f)

Variable	Estimated results		Pre-Adjustment: Pre-oil boom		Pre-Adjustment: Post-oil boom		Post-Adjustment	
	Coefficients	t-values	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]
Constant	β_{04} 96324	0.636	β_{03} 96324		β_{03} 96324		β_{04} 96324	
P^f	β_{13} -20.08*	-1.83	β_{13} -20.08	-0.56	$\beta_{13}+\beta_{53}$ 20.22	0.34	$\beta_{13}+\beta_{53}+\beta_{93}$ 45.77	0.36
W^f	β_{23} -10.18	-1.58	β_{23} -10.18	-0.07	$\beta_{23}+\beta_{63}$ 34.04	0.075	$\beta_{23}+\beta_{63}+\beta_{103}$ 48.29	0.24
P^m	β_{33} 199.2***	4.72	β_{33} 199.2	0.77	$\beta_{33}+\beta_{73}$ 37.25	0.12	$\beta_{33}+\beta_{73}+\beta_{113}$ -269.5	-0.52
popd	β_{43} 878.7**	2.18	β_{43} 878.7	0.49	$\beta_{43}+\beta_{83}$ 279.2	0.17	$\beta_{44}+\beta_{83}+\beta_{123}$ -1758	-1.62
$(P^{f1})DO$	β_{53} 40.28	0.93						
$(W^{f1})DO$	β_{63} 44.22	0.996						
$(P^{m1})DO$	β_{73} -161.9	-0.999						
$(pop1)DO$	β_{83} -599.5	-0.445						
$(P^{f2})DS$	β_{93} 25.55	1.532						
$(W^{f2})DS$	β_{103} 14.25	0.721						
$(P^{m2})DS$	β_{113} -306.7	-1.343						
$(pop2)DS$	β_{123} -2037*	-1.746						
R-square = 0.8321	Adjusted R-square = 0.6957		DW statistic = 2.035		No. of observation = 31			

[1]Elasticities were calculated by using the means in the respective period.

***Coefficient statistically significant at 1% level **Coefficient statistically significant at 5% level

*Coefficient statistically significant at 10% level in Cameroon. This result suggests that other inputs, such as insecticides or pesticides, may be more relevant to coffee production than fertilizer.

The coefficient for the price of maize, is not significant in the post-oil boom and post-adjustment periods. It is, however, positively significant in the pre-oil boom period. This means that in the pre-oil boom period maize was a complementary crop to coffee. In the post-oil boom and the post-adjustment periods the coefficient is not significant, but it is negative in the latter period. That is in the post-adjustment period, as the price of maize increases the demand for coffee land falls. In the post-adjustment period therefore maize and coffee are more of substitutes than complements, although the relationship is not significant. Figure 3.3 indicate that the real price of maize first increased and then declined slightly over 1989-95, which would suggest some switching between maize and coffee production during the post-adjustment era.

The coefficient of the population variable ($popd$) is significant in the pre-oil boom and post-adjustment periods but not in the post-oil boom period. This means that the rural-urban migration during the post-oil boom period appears not to have significantly influenced coffee land expansion. In the pre-oil boom period, a one per cent increase in population density led to about 0.5% increase in coffee land expansion. As noted in Chapter 2 after independence in 1960, both land expansion and labour force were relied upon to increase production of cash crops, such as coffee. As coffee is mainly grown in converted forest areas, the increased rural population growth may have led to more forest conversion to coffee land in the pre-oil boom period. In contrast, during the post-adjustment period, the impact of population density on coffee land expansion turned negative. A one per cent increase in population density leads to a 1.6% fall in coffee land expansion (Table 5.2). Despite the high return migration (urban-rural) during this period, it appears that in the post-adjustment period the impact of population growth on forest loss through coffee land expansion has been reduced.

In conclusion, there is some evidence that increases in the producer price of coffee in the post-adjustment period may have led to increased forest conversion to coffee land but this result is not fully significant. The removal of subsidies on inputs in the period may also have increased coffee land expansion, but this was difficult to assess in our analysis due to data limitations. The impact of the return migrants during the post-adjustment period on coffee land expansion may, however, have been minimal. Finally, our results provide some evidence that higher maize prices may negatively influence coffee land expansion during the post-adjustment era. As maize prices were liberalized as a consequence of the SAP, especially in Northwestern and Western Cameroon, farmers may have responded to rising prices by switching land from coffee to maize production.

5.5 Maize land results

The estimated switching regression model for the maize equation is as shown in equation (47). The price of coffee (P^f) was used as the competing crop price. The reason for this was explained earlier in the coffee analysis. Other crop prices were not relevant in explaining maize farmers= behaviour in Cameroon and therefore were dropped. The real per capita GDP (Y_p), did not also improve upon the model and was excluded. The Chow test showed a significant difference

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

where:

Table 5.3 Ordinary Least squares estimation of Maize land equation (L^m)

Variable	Estimated results		Pre- Adjustment				Post- Adjustment	
			Pre-oil boom		Post-oil boom			
	Coefficient	t-values	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]
Constant	β_{04} 298407	1.068	β_{04} 298407		$\beta_{04}+\beta_{54}$ 5110365		$\beta_{04}+\beta_{54}+\beta_{104}$ 4190094	
P^m	β_{14} -76.5	-0.514	β_{14} -76.5	-0.16	$\beta_{14}+\beta_{64}$ 510.7	1.58	$\beta_{14}+\beta_{64}+\beta_{114}$ 903.4	1.68
W^m	β_{24} 2.6	0.212	β_{24} 2.6	0.009	$\beta_{24}+\beta_{74}$ -87.1	-0.18	$\beta_{24}+\beta_{74}+\beta_{124}$ -132.4	-0.64
P^f	β_{34} -13.9	-0.744	β_{34} -13.9	-0.21	$\beta_{34}+\beta_{84}$ -186.4	-3.06	$\beta_{34}+\beta_{84}+\beta_{134}$ -189.8	-1.43
popd	β_{44} 2437*	1.877	β_{44} 2437	0.73	$\beta_{44}+\beta_{94}$ -8528	-4.89	$\beta_{44}+\beta_{94}+\beta_{144}$ -7748.2	-6.63
D1	β_{54} 2405979	2.693						
$(P^m)D1$	β_{64} 587.2*	1.858						
$(W^m)D1$	β_{74} -89.7	-1.089						
$(P^f)D1$	β_{84} -173**	-2.274						
(*popd*)*D1*	β_{94} -10965***	-3.891						
D2	β_{104} -920270	-1.55						
$(P^m)D2$	β_{114} 392.7	0.953						
$(W^m)D2$	β_{124} -45.3	-1.252						
$(P^f)D2$	β_{134} -3.4	-0.117						
(*popd*)*D2*	β_{144} 779.8	0.358						
R-square = 0.9393		Adjusted R-square = 0.8742			DW statistic = 1.876		No. of observation = 31	

[1]Elasticities were calculated by using the means in the respective period.
**Coefficient statistically significant 1% level **Coefficient statistically significant 5% level
*Coefficient statistically significant 10% level

between the regressions of the pre and post adjustment period. Dummies for the latter period were therefore introduced into the model. The Chow test also confirmed a significant difference in the pre and post-oil boom period. Oil boom dummies were also introduced in the switching regression. The estimated results and the computed marginal values and elasticities of the three periods are presented in Table 5.3.

From Table 5.3, the important variables that influence the demand for maize land are the population density ($popd$), the price of maize (P^m), and to a lesser extent the average price of fertilizer (W^m). The post-oil boom period had a more significant impact on explanatory variables influencing the demand for maize land, especially with respect to population density ($popd$), the price of maize (P^m) and input prices (W^m). The post-adjustment period has had very little impact on the explanatory variables affecting maize land expansion, given that none of the SAP dummies were significant.

In the pre-oil boom period, the (negative) coefficient of the price of maize (P^m) was not significant. During that era maize prices were controlled at very low levels and so they were unlikely to have much impact on the demand for maize land. In the post-oil boom period, price changes appear to have had a significant and positive impact on forest loss through maize land expansion. A one per cent increase in the price of maize led to a 1.6% increase in the demand for maize land. The relationship between the price of maize and maize land in the post-adjustment period is also positive, but not significantly different from the pre-adjustment era. In the adjustment period, therefore, any rise in maize prices could have influenced forest loss through maize land expansion, but it may be erroneous to infer that the SAP increased this impact significantly. As Figure 3.3 shows, over 1989-95 the real price of maize rose initially but then fell from 1993 onwards.

Fertilizer prices (W^m) had a positive impact on maize land in the pre-oil boom period but a negative impact in the post-oil boom and the post-adjustment period. The relationships are, however, not very significant. The negative relationship suggests a complementarity between fertilizer use and maize land, which is not surprising given the poor quality of converted forest land for maize production in Africa. The conclusion is that the higher fertilizer prices as a result of the SAP, and given the complementarity between fertilizer and maize land, may have actually helped to reduce the reliance on land and therefore help reduced the rate of forest loss in Cameroon.

The coefficient of the price of coffee (P^f) is negative, but generally not significant. However, there appears to be a significant (and negative) break in the regression during the post-oil boom period. Corresponding to this period was a rise in coffee prices, which may have encouraged farmers to switch to planting more coffee rather than maize. Note as well that, during the post-adjustment period, producer prices for coffee fell over 1989-95 (Figure 3.2), which would suggest that farmers switched back to maize production and possibly converted more land for this purpose.

Population density ($popd$) had a positive impact on maize land expansion in the pre-oil boom period but a negative impact in the post-oil boom period. The negative impact may have increased as a result of the SAP, although this effect is not statistically significant. During the pre-oil boom period, a one percent increase in population density led to a 0.7% increase in the demand for maize land, reflecting the importance of maize as a food crop in Cameroon. Thus, in the pre-oil boom period, population pressures appear to have had a significant impact on forest loss through maize land expansion. In the post-oil boom period, however, a one percent increase in the population density led to about 4.9% fall in the demand for maize land. In the post-oil boom period rural migration to urban centres for jobs created by the oil boom reduced the dependence of the population on agriculture for employment and on converting forest land for maize production. This result is very important, as it indicates that in an economy where there are alternative means of non-agricultural livelihoods, population growth may not be a significant factor in crop land expansion and forest cover loss. The return migration, in the post-adjustment period was expected to put pressure on the forest land through increased demand for maize land. This is not, however, confirmed in the analysis. By reviewing non-agricultural sectors, the SAP may have actually increased employment in these sectors and reduced the pressure on forest conversion for maize production.

The analysis of maize has shown a significant difference between the pre-oil boom period and the post-oil boom impact on maize land expansion and therefore on forest loss. The difference between the pre and post-adjustment periods for most price effects are, however, not very significant. This may be because the SAP policies have yet to significantly influence the behaviour of maize farmers in Cameroon. The price of maize on demand for land was not relevant in the pre-oil boom period, but had a positive impact on maize land expansion in the post-oil boom and the post-adjustment periods, especially over 1989-93 (see Figure 3.3). Fertilizer use and maize land cultivation appear to be complements. Thus, the high fertilizer prices as a result of the SAP may reduce the dependence on forest land conversion for maize production, although this result may not be highly significant. Similarly, the lower coffee prices during the post-adjustment period may have encouraged maize land expansion and forest conversion. Though population may have been a significant factor in agriculture land expansion and therefore forest loss, during the pre-oil boom period, where there are significant alternative job opportunities, the impact of population growth on forest loss will decline. This was shown by the negative impact of the variable on maize land in the post-oil-boom period, which appears to have continued in the post-adjustment era.

5.6 Plantain land results

The estimated piecewise linear model for the plantain land equation is as shown in equation (48). The price of cocoa (P^c) was use as the competing crop price, following the explanation given in the cocoa analysis. Other crop prices were not relevant in explaining plantain farmers= behaviour in Cameroon and therefore were dropped. Including real per capita GDP (Y_p) improved upon the model. The Chow test confirmed a significant difference in the pre and post-oil boom period, but there was no significant difference between the regressions of the pre and post- adjustment periods. Oil boom period dummies were therefore introduced in the piecewise linear regression, which was preferred to the switching regression. The estimated results and the computed marginal values and elasticities of the pre-adjustment (pre-oil boom period and post-oil boom period) and the post-adjustment periods are presented in Table 5.4.

Install Equa tion Editor and double - click here t o view equat ion.

Install Equa tion Editor and double - click here t o view equat ion.

where:

Table 5.4 Ordinary Least squares estimation of Plantain land equation (L^p)

Variable	Estimated results		Pre- Adjustment				Post- Adjustment	
			Pre-oil boom		Post-oil boom			
	Coefficients	t-values	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]
Constant	β_{05} 2910866	2.238	β_{05} 2910866		β_{05} 2910866		β_{05} 2910866	
P^p	β_{15} -56.3	-0.097	β_{15} -56.3	-0.11	$\beta_{15}+\beta_{65}$ -921.5	-1.37	$\beta_{15}+\beta_{65}$ -921.5	-2.44
W^p	β_{25} 56.0**	2.521	β_{25} 56.0	0.36	$\beta_{25}+\beta_{75}$ -238	-0.45	$\beta_{25}+\beta_{75}$ -238	-1.64
P^c	β_{35} -11.4	-0.170	β_{35} -11.4	-0.18	$\beta_{35}+\beta_{85}$ -13.3	-0.17	$\beta_{35}+\beta_{85}$ -13.3	-0.12
popd	β_{45} -10760**	-2.16	β_{45} -10760	-5.6	$\beta_{45}+\beta_{95}$ -14872	-7.58	$\beta_{45}+\beta_{95}$ -14872	-18.8
Y_p	β_{55} 882407	0.923	β_{55} 882407	0.064	β_{55} 882407	0.48	β_{55} 882407	1.23
$(P^{p1})DO$	β_{65} -865.2	-1.111						
$(W^{p1})DO$	β_{75} -294**	-2.117						
$(P^{c1})DO$	β_{85} -1.9	-0.168						
$(pop1)DO$	β_{95} -4111.9	-1.011						
R-square = 0.4721		Adjusted R-square = 0.1942			DW statistic = 1.22		No. of observation = 31	

[1]Elasticities were calculated by using the means in the respective period.
**Coefficient statistically significant 5% level *Coefficient statistically significant 10% level

From the estimates (Table 5.4), the important variables determining plantain land expansion in Cameroon between 1965-1995 are the average price of fertilizer (W^p) and the population density ($popd$). The price of plantain (P^p) and the per capita GDP (Y_p) appears to have only a minimal influence on plantain land expansion. The impacts of input prices (W^p) and population density ($popd$) on plantain land expansion also increased significantly in the post-oil boom and SAP periods.

The price of plantain (P^p) is negative but insignificant throughout the analysis. In the pre-oil boom period, this is similar to the maize results. Because food prices were controlled and low, they appear not to have been important in food crop land decision making. In general, however, the results suggest that output prices do not explain plantain land expansion in Cameroon.

The estimated coefficient of the alternative crop price (P^c) is negative, which shows that cocoa and plantain compete in land decision making in Cameroon. However, the relationship is not very significant. One reason may be that it is not easy to convert plantain land to cocoa land. Cocoa may therefore not be a potential alternative crop for plantain farmers, but as the cocoa analysis indicated, plantain may be a potential alternative crop to cocoa farmers. If this is the case, then the fall in real cocoa prices over 1989-95 may have stimulated plantain land expansion (see Figure 3.1).

The average price of fertilizer (W^p) is very significant in the pre-oil boom period and the post-oil boom period, but the impacts in these two periods are different. In the pre-oil boom period, a one per cent increase in the average price of fertilizer led to a 0.4% increase in plantain land expansion. This means that land and fertilizer use were substitutes in plantain production. In the post-oil boom period, a one per cent increase in fertilizer prices led to a 1.64% fall in plantain land expansion, indicating that fertilizer use and land were complements in plantain production. This result is similar to the maize land analysis. An important inference is that, during the SAP in Cameroon the removal of fertilizer subsidies, and the subsequent rise in prices may have played a significant role in reducing the rate of forest loss due to food crop land expansion.

The impact of population density ($popd$) on plantain land expansion in the pre-oil boom is negative. Although an unexpected result, given the heterogeneity of the agriculture sector in Cameroon, population pressures on the demand for crop land in the pre-oil boom may have been felt in other sectors such as cocoa, coffee and maize crops. Although the negative impact of population growth on plantain land expansion was still negative in the post-oil boom and SAP periods, any additional effects during these latter periods do not appear to be statistically significant. This was similar to the maize results, and again suggests that the creation of non-agricultural opportunities may reduce the pressure of rising populations on forest conversion for food crop production.

It can be concluded from the plantain land analysis that the SAP did not appear to alter the key price effects on the demand for land. However, the two explanatory variables that had the largest impact on the demand for land in plantain production - fertilizer prices and population density - exhibited similar effects as in the maize land analysis. This suggests that the higher fertilizer prices as a result of the SAP may have reduced conversion of forests for both maize and plantain production in Cameroon. Similarly, to the extent that the post-adjustment period created more non-agricultural opportunities outside of rural areas this is reflected in overall population density and reduced demand for land for food crops. Finally, there is tentative evidence to suggest that the fall in real cocoa prices during the post-adjustment period may have encouraged some farmers to switch to plantain production thus encouraging more land to be used for this food crop.

5.7 Timber production results

As indicated in equation (40) an important explanatory variable for timber production is the cost of logging. However, it is only recently that attention has been paid to the timber industry in Cameroon, and very little time series data on logging costs are therefore available. As timber extractors do not consider other forest land uses (e.g. cash and food crops) as alternative forest land uses, the price variables for these crops are omitted from the analysis of timber production.

The Chow tests confirmed a significant difference in the regressions of the pre and post-oil boom periods on one hand and the pre and post-adjustment periods on the other. Oil boom and SAP period dummies were introduced in the regression to reflect these >breaks= in the regression. The switching regression approach was found to be the better approach explaining timber production relationships than the piecewise regression. The estimated equation is presented in equation (49). The computed marginal values and elasticities of the pre-adjustment (pre-oil boom period and post-oil boom period) and the post-adjustment periods are indicated in Table 5.5.

Table 5.5 shows that in Cameroon, the price of timber (P^h), population density ($popd$) and per capita income (Y_p) are important in determining the amount of timber production. There are also significant differences in the impacts of these variables across the three periods of the analysis.

Population density ($popd$) had a positive impact on timber production in the pre-oil boom period. A one per cent increase in population led to a 3.7% increase in timber production. In that period, therefore, pressure on the forest through population growth was high. This result is difficult to explain since very few studies have established any relationship between timber production and population growth. It is possible that population growth was stimulating domestic demand in the early stages of development of the forestry industry in Cameroon. In the post-oil boom period, however, a one per cent increase in population led to about a 0.16% fall in timber production, and in the post-adjustment period, a 0.3% fall.

Real per capita income has had a positive influence on timber production in Cameroon. In the post-adjustment period, a one per cent increase in per capita income led to a 0.22% increase in timber production. Increasing levels of real income put pressures on the forest through increased demand for timber products. As argued in Chapter 2, timber-related deforestation in Cameroon is likely to increase unless more sustainable management of the forestry industry and timber exploitation is implemented.

There is a significant difference between the impact of timber prices on timber production between the pre-adjustment period and the post-adjustment period (Table 5.5.). In the pre-adjustment

Install Equation Editor and double-click here to view equation.

Install Equation Editor and double-click here to view equation.

where:

Table 5.5 Ordinary Least squares estimation of the timber production equation (H)

Variable	Estimated results		Pre- Adjustment				Post- Adjustment	
			Pre-oil boom		Post-oil boom			
	Coefficients	t-values	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]	Marginal values	Est. elast.[1]
Constant	β_{01} 597546	1.46	β_{01} 597546		$\beta_{01}+\beta_{41}$ 2532947		$\beta_{01}+\beta_{41}+\beta_{71}$ 3756689	
P^h	β_{11} -35664***	-3.57	β_{11} -35664	-0.35	$\beta_{11}+\beta_{51}$ -29834.2	-0.06	$\beta_{11}+\beta_{51}+\beta_{81}$ 109841	0.11
popd	β_{21} 7682***	3.718	β_{21} 7682	0.86	$\beta_{21}+\beta_{61}$ -2004	-0.16	$\beta_{21}+\beta_{61}+\beta_{91}$ -4596	-0.39
Y_p	β_{31} 2305234***	3.844	β_{31} 2305234	0.036	β_{31} 2305234	0.21	β_{31} 2305234	0.22
D1	β_{41} 1935401	2.099						
$(P^{h1})D1$	β_{51} 5829.8	0.171						
(*popd*)*D1*	β_{61} -9686**	-2.18						
D2	β_{71} 1223742	1.614						
$(P^{h1})D2$	β_{81} 139675*	1.759						
(*popd*)*D2*	β_{91} -6600*	-1.808						
R-square = 0.997		Adjusted R-square = 0.9907			DW statistic = 2.11		No. of observation = 31	

[1]Elasticities were calculated by using the means in the respective period.
***Coefficient statistically significant 1% level **Coefficient statistically significant 5% level
*Coefficient statistically significant 10% level

period there is a negative relationship between the price of timber and timber production. A one per cent increase in the price of timber in the pre-oil boom period led to a 0.35% decrease in timber production. During this era emphasis on timber production was very minimal and producers may have responded to falling prices by expanding harvesting operations in order to maintain revenues. In the post-adjustment period, however, the relationship became positive. A one per cent increase in the price of timber leads to about 0.11% increase in timber production. With oil becoming less important in the economy of Cameroon, attention has been directed to revenues from timber extraction. The number of logging companies has increased, and with very limited harvesting restrictions, the price of timber has become very important in determining the amount of timber produced. The inference is that increases in timber price, due both to higher world market prices and the recent devaluation in the post-adjustment period, may lead in the post-adjustment period to increasing deforestation in Cameroon through stimulating timber production. As shown in Figure 3.5, the average real price for timber has increased since 1989, although it dipped in 1995 in the immediate after effects of the devaluation.

Chapter 6:
Summary, conclusions and policy implications

This study has employed a theoretical and empirical model to investigate the impacts on the forest of the Structural Adjustment Programme (SAP) introduced in Cameroon in 1989. The analysis examined these impacts through the influences of the SAP on output and input prices on cash crops, food crops and timber production. The role of the oil boom between 1978 and 1988 was also investigated.

In the theoretical model, a dynamic control problem approach was used to derive the optimal conversion and exploitation of the stock of forest land for cash crops and food crops production, and timber extraction. The conclusion was that, along the optimal path of forest land allocation the output and input prices of the various uses of the forest stock are the main determinants of the forest land uses. This formed the basis of the empirical model.

The empirical model depicted relationships for forest land conversion to cash crop land, food crop land, and the exploitation of timber, i.e. the demand for the stock of forest land as an input for the production of cash crops, food crops and timber, with output and input prices as the explanatory variables. Per capita gross domestic product and population density were also included in the model as explanatory variables.

Given the heterogeneity of the agriculture sector in Cameroon, five empirical demand equations were estimated, for cocoa land, coffee land, maize land, plantain land and timber production. The forest loss equation could not be estimated because of the unavailability of time series data on forest cover in Cameroon for the entire 1965-95 period. However, the review of agricultural and forestry sectors of Cameroon suggest that expansion of agricultural land and timber production will lead to forest loss.

Three main economic eras in Cameroon were also identified for investigation: the pre-oil boom period (1965-1977), the post-oil boom period (1978-1988) and the post-adjustment period (1989-95). Piecewise linear and switching regression approaches were used to investigate the influences of these economic eras on the analyses of cocoa land, coffee land, maize land, plantain land and timber extraction.

Over the period of 1965-1995, economic changes and trends, in particular the oil boom and more importantly the policies under the SAP, have affected the various uses of the forest resource in different ways. The impact on forest loss, or deforestation was therefore not the same during each of these eras. The impact of the specific land use, depends on how the policies of each era have affected the underlying causes of output and input prices, as well as population and changes in income over the period.

The overall results indicate that in the pre-oil boom period the pressure on the forest was high. In the post-oil boom period this pressure was reduced, but in the post-adjustment period, the pressure on the forest is likely to increase again. Our findings also show the important role of relative output prices and population movements in influencing forest loss through crop land expansion. The availability of alternative jobs to farming may also reduce pressures on the forest in Cameroon, whereas higher income levels may contribute to deforestation through the increase demand for timber production

A summary of our estimated impacts of price changes during the post-Structural Adjustment period on agricultural land conversion and timber production are presented in Table 6.1. From the table, there is some evidence that higher output prices in the post-adjustment period may lead to higher forest loss through the expansion in crop land and increased timber production. With the exception of plantain, increases in the price of each crop (cocoa, coffee and maize) will lead to land expansion for crop production. A rise in timber prices will also cause an increase in timber production. The output prices of cocoa and timber are especially high and significant. A 10 per cent increase in the price of cocoa and timber will lead, respectively, to a 5.3 per cent increase in cocoa land and a 1.1 per cent increase in timber production. It follows that in the post-adjustment period, higher prices for agricultural crops, especially for cocoa and timber products, may generally result in increased forest loss, through the increased demand for the forest land for agricultural and timber production.

Although our estimates indicate that rising real crop and timber prices are likely to lead to greater deforestation in Cameroon during the post-adjustment period, Figures 3.1 to 3.5 in Chapter 3 indicated that in the 1989-95 period, most real producer prices actually fell in Cameroon. The exceptions are maize prices, which first increased before declining slightly (Figure 3.3), and timber prices, which rose modestly during the post-adjustment period before dipping in 1995 (Figure 3.5). This suggests that the immediate aftermath of Structural Adjustment may have been less pressure on the forests. However, our results also indicate that as the economy recovers and real producer prices increase, the pressures on deforestation should also increase in Cameroon.

There is, however, no strong evidence that the removal of subsidies during the Structural Adjustment period which have led to higher prices of inputs such as fertilizer may lead an increased demand for crop land and therefore an increase in forest loss. Rather, as Table 6.1 shows, although the elasticities are not significant, higher prices of inputs in general may have led to a fall in the demand for food crop land. The effect of input prices on the demand for cash crop land were difficult to determine because data limitations prevented us from employing the relevant input variable (i.e. the price of insecticides rather than the price of fertilizers).

Our results also provide evidence that, in the post-adjustment period, cash and food crops compete for land in production. Relative crop prices appear to be important in land decision making in Cameroon, and there are regional differences in the choice of crops. The price of plantain, for example, has a negative and significant impact on cocoa land. A 10 per cent increase in the price of plantain leads to about a 2.3 per cent fall in cocoa land in the post-adjustment period (Table 6.1). Similarly, a 10 per cent increase in cocoa prices causes a 1.2 per cent fall in plantain land. Thus cocoa and plantain appear to be competing for land in Cameroon, particularly in the Southern part of the country where both crops are grown. Table 6.1 also indicates that maize and coffee compete for land, although the results for this relationship are less significant. This competition is likely to be strongest in Western and Northwestern Cameroon, where coffee is the main cash crop and maize the principal food crop.

Table 6.1 Average changes in agricultural land and timber production as a result of a 10 per cent increase in prices in the Structural Adjustment Period (1989-95)[1]

Prices (10% change)	Agricultural land (% changes)				Timber production (% changes)
	Cocoa land	Coffee land	Maize land	Plantain land	
P^c	5.3*			-1.2	
P^f		3.6	-1.43		
P^m		-5.2	16.8		
P^p	-2.3*			-2.44	
P^h					1.1*
W^c	-1.8				
W^f		2.4			
W^m			-6.4		
W^p				-16.4	

[1]Values calculated from Tables 5.1 - 5.5
***Values statistically significant at 1% level **Values statistically significant at 5% level
*Values statistically significant at 10% level

In conclusion, our study provides some tentative evidence that, as the economy recovers in the post-adjustment period, rising producer prices could lead to increased forest loss through agricultural land expansion, especially for cocoa land, and through increased but poorly managed timber production. An additional concern that we could not analyze specifically is that, in the agricultural sector, although the total removal of subsidies in itself may not lead to forest loss, the rates of increases in input prices are far greater than the rates of increases in output prices. The total effect of this difference will be an increase in the demand for the cheaper input, which is forest land for agricultural production. For timber production, the concern is that improved prices with very limited control over methods of timber extraction will lead to pressures on the forest through excessive timber >mining=.

Another important result from our study is that the availability of alternative job opportunities may reduce population pressures on the forest. For example, in the oil boom period (1978-88), greater rural-urban migration appears to have reduced the population pressures for increased demand for crop production, especially for food crop production such as maize and plantain. Any return migration in the post-adjustment period could therefore increase pressures on the forest through greater demand for food crop land, although there is only anecdotal evidence in our study to support this latter finding.

There are two important policy implications resulting from the conclusions of this study. First, in the post-adjustment period, policy makers need to be aware that rising real crop prices could increase the incentive for forest conversion. Relative cash-food crop prices could also influence the pattern of deforestation particularly in specific regions of the country. As farm income rise in real terms, policy makers should ensure that farmers invest this additional income in improving existing crop land rather than in opening up of forested lands through conversion. Thus complementary public investments are necessary, especially in research and extension aimed at rehabilitating and replanting existing coffee and cocoa lands as well as in providing affordable credit for fertilizers, other inputs and land improving investment for farmers cultivating maize and plantain.

Second, rising timber prices could also lead to increased timber-related deforestation, due to the lack of enforcement of sustainable timber management policies (see Chapter 3). Further forestry policy reforms are required to improve concession policy, the efficiency of processing industries and overall sustainable harvesting practices. Such reforms are necessary, if rising timber prices are to be an incentive for sustainable exploitation of timber from the remaining production forest of Cameroon rather than an incentive for timber mining and unnecessary deforestation.

Finally, an important, probably long-term option to reduce crop expansion on forest loss in Cameroon may be to provide alternative jobs outside of agriculture for the rural population. This could reduce the dependence of the population on the expansion of food crop production and deforestation for their economic livelihoods.

References

AGRER (1988), Secteur Agricole: Rapport Final, Mission de Rehabilitation des Enterprises du Secteur Public et Para-public, MCM/PS.

Alexandre, D.Y. (1978), >*Le* rôle disseminateur des éléphants en forêt de Taï, Côte d=Ivoire=, La Terre at la Vie 32:47-72.

Amelung, T. and M. Diehl (1992), Deforestation of Tropical Rain Forests: Economic causes and impact on development, Tubingen: J.C.B. Mohr.

Amin, A.A. (1996), >The effects of exchange rate policy on Cameroon=s agricultural competitiveness=, African Economic Research Consortium (AERC), Research Paper 42.

Baker, D. and J. Ayu-Takem (1991), >Agricultural research policy in Cameroon: Implications of economic crisis and structural adjustment=, Paper presented at the International symposium on Agricultural Policy Analysis in Sub-Saharan Africa, Dschang University Center, November 3-6.

Barbier, E.B. et al. (1991), >The economics of tropical deforestation=, Ambio 20:55-58.

Barbier, E.B. et al. (1994),>The linkages between timber trade and tropical deforestation=, Indonesia World Economy 18(3): 411-442.

Barbier, E.B. et al. (1995), Paradise Lost? The Ecological Economics of Biodiversity, London: Earthscan.

Barbier, E.B. and J.C Burgess (1997), >The economics of tropical forest land use options=, Land Economics 73(2): 174-95.

Barro, R.J. (1974), >Are government bonds net wealth?= Journal of Political Economy, December, 1095-1117.

Brown, K. and D. Pearce (eds.) (1994), The Causes of Tropical Deforestation, London: University College London Press.

Bulte, E.H. and D.P. van Soest (1996), >Tropical deforestation, timber concessions and slash-and-burn agriculture: why encroachment may promote conservation of primary forests=, Journal of Forest Economics 2: 55-66.

Burgess, P.F. (1971), >The effect of logging on hill depterocarp forest=, Malaysia Nature Journal 24:231-237.

Dell, S. (1982), >Stabilization: The political economy of overkill=, World Development, August, 597-

61, Washington, D.C.: World Bank.

Diaz-Alejandro, C. (1984), >IMF Conditionality: What Kind?=, PIDE Tidings.

Egger, (1978), >Projet de Développment agricole de Lekie-Mban, Etude sur I=amélioration des techniques cultures et du contrôle de I=erosion, délivrée au Gouvernement de la Republique Unie du Cameroun, Université de Heidelberg, Allemagne, May.

Fairhead, J. and M. Leach (1998), Reframing deforestation: Global analysis and local realities, studies in West Africa, London: Routledge.

FAO (1981), Forest Resources of Tropical Africa, Part I and II (Country Briefs), Tropical forest resources assessment project, Rome: FAO

FAO (1990), Tropical Forestry Action Plan: Joint Interagency Planning and Review Mission for the Forestry Sector, Cameroon,

FAO (1995), >Etude de I=Impact de la Dévaluation du Franc CFA sur la Production Agricole et la Sécurité Alimentaire au Cameroun=, Rapport de Synthèse, Juillet.

FAO (1999), FAOSTAT data base, CD-ROM, Rome: FAO.

Foteu, K.R. (1995), >Impact de la Dévaluation sur le Secteur Forestier du Cameroun=, Unpublished report, Juin.

Frenklen, J.A. and H.G. Johnson (1976), >The monetary approach to the balance of payments=, Journal of International Economics, February, 65-74.

Gartlan, S. (1989), *La Conservation des Ecosystèmes Forestiers du Cameroon*, Cambridge, IUCN.

Gartlan, S. (1990), >Practical constraints on sustainable logging in Cameroon=, Paper presented at the Abidjan conference on forest conservation in West and Central Africa, November.

Glowka, L. et al. (1994), >A guide to the convention on biological diversity=, Environmental and Policy Paper No. 30, IUCN.

Grangeret-Owona, I. (1995), >De la Crise à la Dévaluation du Franc CFA: Les Evolutions Technologiques et Sociales de L=Agriculture Intensive familiale Bamiléké=, Cahiers Agricultures, 4(1):45-51.

Green, J.L. and K.M. Brown (1994), Forest certification program prospects, Cameroon, Central Africa. A consultation report for the government of Cameroon

Grut, M. (1990), >Resource and concession policy for the timber forests of West Africa=, Paper presented at the Seminar of the International Tropical Timber Organization, Bali, Indonesia, May.

Hall, J.B. and M.D. Swaine (1981), >Distribution and ecology of vascular plants in tropical rainforest. Forest vegetation in Ghana=, Geobotany 1, The Hague.

Horta, K. (1991), >The last big rush for the green gold: The plundering of Cameroon=s rainforest=, The Ecologist 21(3): 142-147.

IIED (1987), *Le Territoire Forestier Camerounais: Les Ressources, les Intervenants, les Politiques d=Utilisation*, London, IIED.

Jacobs, M. (1988), The Tropical Rain Forest: A First Encounte,. London, Springer-Verlag.

Jilly, N.M. (1992), >The state and agricultural policies in Cameroon: The social and economic outcome of agricultural policies=, PhD Dissertation, Department of Sociology, University of Missouri, Columbia.

Johnson, H.G. (1958), >Towards a general theory of the balance of payments=, In: International Trade and Economic Growth, London: Allen and Unwin.

Jolivald, F. (1992), Forêts à la Recherche d=une Nouvelle Stratégie de Mise en Valeur=, Marchés Tropicaux, 2457:3336-3338

Jua, N. (1991), >Cameroon: Jump-starting an economic crisis=, Africa Insight, 21:3.

Jua, N. (1993), >State, oil and accumulation= in Pathways to Accumulate in Cameroon, ASC-KARTHALA.

Kaimowitz, D. and A. Angelsen (1997), A users guide to economic models of deforestation. Draft, Center for International Forestry Research (CIFOR), Indonesia.

Khan, M.S. and M.D. Knight (1981), >Stabilization programmes in developing countries: A formal framework=, Staff apers, 28: 1-53, Washington, D.C.: International Monetary Fund.

Khan, M. S. (1987), >Macroeconomic Adjustment in Developing Countries: A Policy Perspective=, The World Bank Research Observer, 2(1):23-42.

Kingdom, J.S. (1990), Island Africa, London: Collins.

Lanly, J.P. (1982), ALa regressionde la forêt dense in Côte d=Ivoire≅, BFT 127:45-59.

Lele, U. (1989), >Agricultural growth, domestic policies, the external environment, and assistance to

Africa: Lessons of quarter century=, MADIA Discussion paper 1, Washington DC: World Bank.

Mackinnon, J. and K. Mackinnon (1986), Review of the Protected Areas System in the Afrotropical Realm, Gland, IUCN/UNEP.

Martin, C. (1991), The Rainforests of West Africa, Accra: Elsevier Publishers.

MINAGRI. (1990), Politique Agricole du Cameroon, Agricultural Projects Division, Ministry of Agriculture, Youndé.

Ministry of Agriculture (1980), Bilan Diagnostique du Secteur Agricole (1960/1980) Direction Etudes et Projects. Ministry of Agriculture, Cameroon.

Minot, N. (1989), >Patterns of fertilizer use in Cameroon: A review of the literature=, AMIS Project. Abt Associated and University of Idaho, Prepared for fetilizer sub-sector reform program, Government of cameroon-USAID/Yaounde, August.

Myers, N. (1988), >Threatened biotas: >hot spots= in tropical forests=, The Environmentalist 8(3):187-208.

Ndoye, O. (1997), >The impact of macroeconomic and agricultural policies on forest conditions in Cameroon=, Paper prepared for the Centre for International Forestry Research (CIFOR).

Ndoye, O. (1995), >The markets for non-timber forest products in the humid forest zone of Cameroon and its borders: Structurem conduct, performance and policy implications=, Centre for International Forestry Research (CIFOR), Bogor.

Ntangsi, J. (1991), Structural adjustment in Cameroon and implications for agriculture, Paper presented at the International Symposium on Agriculture Policy Analysis in Sub-Saharan Africa, Dschang University Center.

ONADEF (1993), >Development of national guidelines for the sustainable management of natural tropical forests in Cameroon, ITTO Project Proposa PD20/93, Yaoundé: Office National de Développement des Forêts.

Rouband, F. (1994), >Le Modéle de développement Camerounias 1965-1990: De la croissance Equilibrée á la crise structurelle=, In Le Village Camerounais á I=Heure de Iajustement, KARTHALA, Paris.

Sayer, J.A. et al. (1995), The Conservation of tropical Forests:Africa, London: The World Conservation Union (IUCN).

Stuart, S.N.(ed.) (1986), Conservation of Cameroon Montane Forests, Cambridge, ICBP.

Stuart, S.N. et al. (1990), >Biodiversity in Sub-Saharan Africa and its Islands: Conservation Management and Sustainables use=, Occasional Papers of the IUCN Species Survivial Commission No. 6, Gland, IUCN.

Tambi, E.N. 1984, >Agricultural development policy and performance in Cameroon, 1960-1980', PhD thesis, University of Pittsburgh.

Tchoungui, R. et al. (1995), Structural Adjustment and Sustainable Development in Cameroon, A World Wide Fund for Nature Study, Working Paper 83, London: ODA.

Temple, L. (1994), >La dynamique d=Approvisinnement en Bananes Plantain Essai d=une Démarche pour une Recherche en Economic du Changement Technique=, CIRAD/FLHOR.

Thiele, R. and M. Wiebett (1993), >Modelling deforestation in computable general equilibrium (CGE) model=, Kiel working Paper 555, Kiel institute of World Economics, Kiel.

UNEP (1995), Global Biodiversity Assessment, London: `Cambridge University Press.

van Dorp, M. (1995), >Shaking the tree: an economic geographical analysis of the foreign impact on forestry in Cameroon=, Masters Thesis, Economic Geographic Institute, Faculty of Economics and Econometrics, University of Amsterdam, The Netherlands.

van Soest, D.P. (1996), >Tropical rainforest degradation in Cameroon=, Department of Economics, University of Groningen.

White, F. (1983), The Vegetation of Africa: A Descriptive Memoir to Accompany the UNESCO/AETFAT/UNSO Vegetation map of Africa, Paris, UNESCO.

World Bank. (1989), Cameroon Agricultural Sector Report, Report No. 7486-Cam, Washington, DC: World Bank.

World Bank (1998), World development indicators 1998, CD-ROM, Washington, D.C., World Bank.

World Resources Institute. (1990), World Resources 1990-1991, Oxford: Oxford University. Press

Wyeth, P. (1994), >Policies affecting production incentives at the farm level in Cameroon=s humid forest zone: Implications for shifting vs. Stationery cultivation=, Report, ASB.

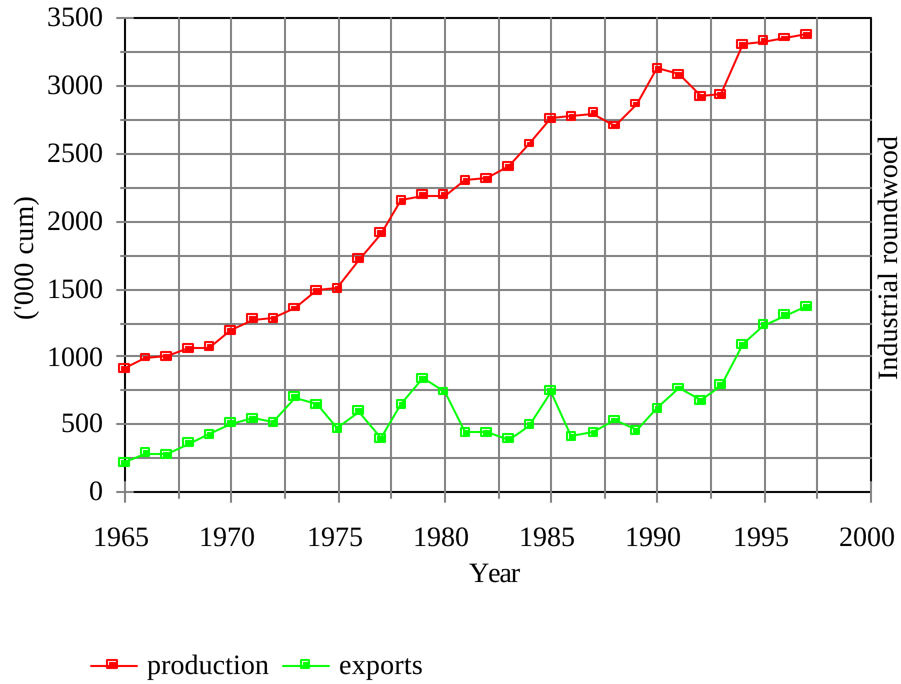
List of Appendices

Appendix 2.1: Administrative map of Cameroon

Source: Tchoungui, R. et al. (1995), Structural Adjustment and Sustainable Development in Cameroon, A World Wide Fund for Nature study, Working Paper 83.

Appendix 2.2: Major vegetation types of Cameroon

Production and exports of industrial roundwood in Cameroon (1965-1997)

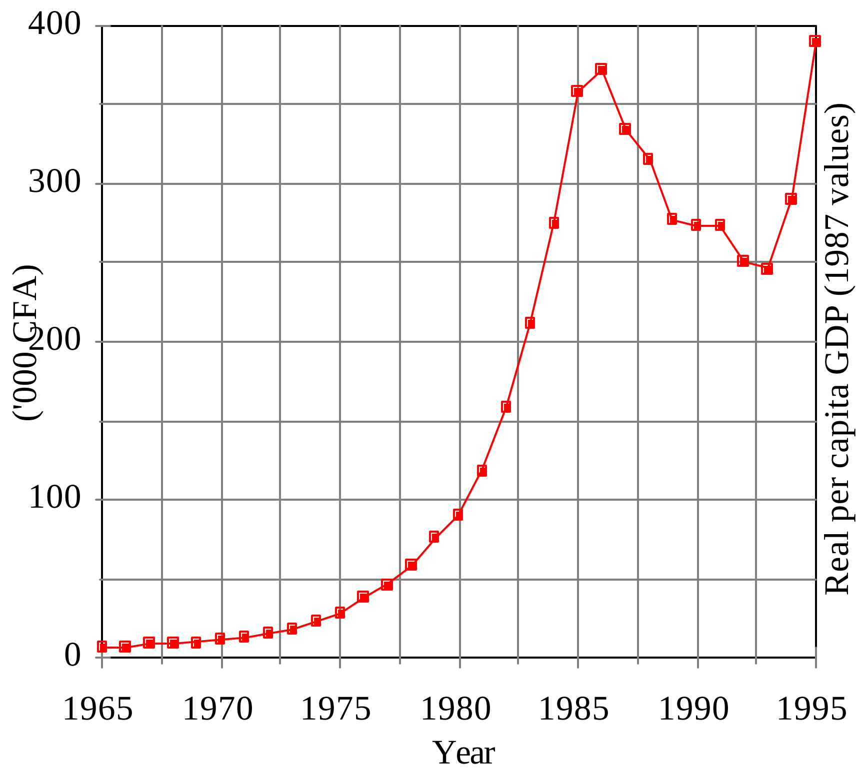


Source: Tchoungui, R. et al. (1995), Structural Adjustment and Sustainable Development in Cameroon, A World Wide Fund for Nature study, Working Paper 83.

Appendix 2.3

Appendix 3.1

Real per capita GDP (1987 values)
in Cameroon, 1965-95 ('000 CFA)



Appendix 5.1: Definitions of variables and data sources

Variable	Definition and data sources
L^c	Cocoa land area harvested (national level, >000 ha). Data from: FAO (1999), FAOSTAT database, CD-ROM, Ndoye (1997) and Tambi (1984).
L^f	Coffee land area harvested (national level, >000 ha). Data from: FAO (1999), FAOSTAT database, CD-ROM, Ndoye (1997) and Tambi (1984).

Variable	Definition and data sources
L^m	Maize land area harvested (national level, >000 ha). Data from: FAO (1999), FAOSTAT database, CD-ROM, Ndoye (1997) and Tambi (1984).
L^p	Plantain land area harvested (national level, >000 ha). Data from: FAO (1999), FAOSTAT database, CD-ROM, Ndoye (1997) and Tambi (1984).
H	Industrial roundwood production (national level, >000 CUM). Data from: FAO (1999), FAOSTAT database, CD-ROM, and Ndoye (1997).
P^c	Real producer price of cocoa (national level, constant 1990 prices, >000 CFA F/mt). Producer price of cocoa data from the FAO (1999), FAOSTAT database, CD-ROM.
P^f	Real producer price of coffee (national level, constant 1990 prices, >000 CFA F/mt). Producer price of coffee data from the FAO (1999), FAOSTAT database, CD-ROM.
P^m	Real average price of maize (national level, constant 1990 prices, >000 CFA F/mt). Data from the FAO (1999), FAOSTAT database, CD-ROM.
P^m	Real average price of plantain (national level, constant 1990 prices, >000 CFA F/mt). Data from the FAO (1999), FAOSTAT database, CD-ROM.
P^h	Real average price of exported industrial roundwood (constant 1990 prices, >000 CFA F/cum). Average price of exported industrial roundwood data from the FAO (1999), FAOSTAT database, CD-ROM.
W^c	Real average price of fertilizer (constant 1990 values, >000 CFA/mt). The average prices of fertilizer were estimated by first dividing total imports of fertilizer by the total value of fertilizer imports. Second, the different levels of subsidies over 1965-95 (1965-77 (40 per cent), 1978-86 (60 per cent), 1987-88 (36 per cent), 1988-90 (30 per cent), 1990-91 (20 per cent), and 1992-95 (no subsidy)) were then deducted. Total imports and total value of imports data were from FAO (1999), FAOSTAT database, CD-ROM.
W^f	Same as W^c
W^m	Same as W^c
W^p	Same as W^c
Y_p	Real per capita GDP (national level, GDP in constant 1987 values/population). Real GDP values from the World Bank (1998), World Development Indicators, and population (millions) data derived from the IMF=s International Financial Statistics and FAO (1999), FAOSTAT database, CD-ROM.
Popd	Population density (national level, population/total land area (>000 ha)). Total land area data from FAO (1999), FAOSTAT database, CD-ROM.

Note:
1. The consumer price index (CPI) for 1990 was used to estimate the real prices.
2. The 1987 GDP deflator was used to deflate the current GDP values to arrive at the real values.