Chapter 3

Tropical Deforestation in Cameroon: A Case Study

3.1 Introduction

In the previous chapter, the main characteristics of the typical deforestation process have been described. However, as has become clear in section 2.5, the underlying causes generally differ substantially for different countries. Indeed, in the literature the importance of analysing the deforestation process in a particular country is emphasised (see for example Kaimowitz and Angelsen, 1997, pp. 60-61; Kummer and Sham, 1994, p. 158). Therefore, in this chapter attention shifts to the deforestation process in one single country, Cameroon. This Central African country is of approximately the same size as Spain. It is often referred to as ‘Africa in miniature’ as the continent’s main vegetation types are represented in the country: the north is covered by Sudano-Sahelian savanna, the centre by high altitude moist savanna, and the south by tropical rainforests (Horta, 1991, p. 142; Tchoungui et al., 1995, pp. 22-23).

The choice of Cameroon is based on the consideration that its forest area is highly valuable: it probably supports the richest flora and fauna in continental tropical Africa with high levels of endemism while large areas of forests are still undisturbed (Alpert, 1993, p. 44; Myers, 1988, p. 201; Rietbergen, 1989, p. 45; Tchoungui et al., 1995, p. 13). Unfortunately, it is increasingly threatened by unsustainable land use. Concerning the country’s rate of deforestation, the 1980s have shown an acceleration of the deforestation process: over the first half of the decade the rate was 0.4% (Panayotou and Ashton, 1992, p. 23) while at the end of the decade the rate is reported to be 0.9% (Rietbergen, 1989, p. 45); the average rate of
deforestation over the 1980s was 0.6% (FAO, 1993, annex 1, table 4a).\(^1\) However, the most recent estimates suggest that the rate of deforestation is decreasing slightly: according to FAO (1997, p. 186), the average rate of deforestation over the first half of the 1990s was 0.6%.

In this chapter, the Cameroonian deforestation process is analysed. In section 3.2, an overview is given of the direct causes of deforestation in this country. In general, agricultural conversion is found to be the main cause of forest loss. In section 3.3, attention shifts to the underlying causes of deforestation: attempts are made to explain the settlement pattern of the rural population and to assess the importance of tenure rights. Although the results should be interpreted with care, some evidence is found that in the early 1980s both regional population pressure and uncertainty of tenure rights can be identified as factors that are closely related to deforestation in Cameroon.

From the deforestation figures presented above, it is clear that in the second half of the 1980s forest loss accelerated. This coincides with the economy’s transition from a situation of economic boom into a deep recession in 1986/87. Since this transition is widely considered to have affected the deforestation rates, an economic analysis of this period is called for. In terms of pressure on the forests, both the level of economic activities and the intensity with which these activities are carried out are important: the first factor determines the extent of forest degradation, the second the degree in which economic activity is carried out sustainably. In section 3.4, an analysis is provided of the relationship between the economic crisis and (changes in) the level of economic activity: first, the developments in Cameroon’s economic situation are described, and next their consequences in terms of the extent of forest exploitation are analysed. Section 3.5 discusses the changes in the intensity with which economic activities are undertaken. Finally, in section 3.6 the main conclusions are summarised, paying special attention to the roles played by the various actors.

\(^1\)On the basis of his wider definition of deforestation, Myers (1994, p. 30) states that at the end of the 1980s, the deforestation rate may already be as high as 1.4% (see also the discussion about definitions of deforestation in section 2.4.1).
3.2 The direct causes of deforestation in Cameroon

Compared to other countries, a large proportion of the Cameroonian rainforests is still primary: it is estimated that by the end of the 1980s about half of the forests had not yet been subject to economic activity (Lewis, 1989, p. 2008; Tropenbos Foundation, 1992). The only activity that has penetrated the tropical forests to a large extent is the harvesting of trees. Indeed, the forestry sector is generally indicated to be the main source of forest degradation in Cameroon. According to Amelung and Diehl (1992, p. 120), 98% of the primary forests that are degraded into secondary forests, have been first exploited by the forestry sector. In terms of biomass the damage inflicted by the forestry sector is quite limited: this sector is responsible for about 10% of the annual loss of biomass (Amelung and Diehl, 1992, p. 120). The reason is that logging is extremely selective, mainly because transportation is very expensive: only trees with the highest market value are extracted, which means that on average only one tree per hectare is logged. Although there are about 300 species with commercial potential in Cameroon, about 30 are actually exploited while just 15 make up 86% of the timber harvested (Business International, 1990; Jepma and Kamphuis, 1994, p. 6).

However, the reduction in vegetation quantity caused by the forestry sector is only temporary: regrowth is generally sufficient, at least in terms of biomass. The sector that is responsible for the actual deforestation in Cameroon is the agricultural sector, in particular small-scale agriculture: according to Amelung and Diehl (1992, p. 118), shifting cultivators are responsible for about 79% to 95% of deforestation2, while the agricultural sector as a whole is responsible for all deforestation in the 1980s.

On the basis of these figures, it can be deduced that other types of economic activity play a minor role in the Cameroonian deforestation process. Indeed, cattle ranching for example does not take place on a considerably large scale: although no exact figures are available, Lele and Stone (1989, annex 1, table 8, p. 43) indicate that cattle ranching in the Cameroonian rainforest area is negligible in comparison to other parts of the country.

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2Following Amelung and Diehl’s (1992) references, the lower figure is derived from various issues of the FAO Production Yearbooks, and the higher figure is reported by FAO/UNEP in Tropical Forest Resources Assessment Project, Technical Report 1-3, 1981.
Tropical deforestation in Cameroon

Locational factors, such as diseases, prevent the expansion of livestock production into the tropical forests. Another activity which may have affected the Cameroonian forest area is the construction of dams in order to utilise the hydropower capacity of the rainforests. Only one dam is located in the forest area, which was built in 1953. Hence, dam construction has not been an important economic activity in the forests in the recent past (Amelung and Diehl, 1992, pp. 110-112).

Furthermore, industrial activity is not likely to take place in forests because of the distance to the commercial centres, except if there is some important resource located in the area. Apart from timber, mineral resources are also present in the forest area of Cameroon. However, they have not been exploited on a considerable scale yet because it is not profitable to do so. Mining in forest areas is expensive because of topological conditions and lack of infrastructure; therefore, the Cameroonian government preferred to develop the mineral reserves outside the forest area (Amelung and Diehl, 1992, pp. 99-100). Thus, mining is not likely to be an important threat to the forests unless mineral prices will rise substantially.

As a conclusion it can be stated that forestry and agriculture are the key sectors in the Cameroonian deforestation process. Logging activities are the most important cause of forest degradation as the forestry sector is usually the first to exploit primary forests. The main direct cause of deforestation is agricultural activity carried out by shifting cultivators; forestry activities do not result in actual forest loss (at least not directly), while the role of mining and livestock keeping is negligible. Grut (1990), Horta (1991) and Jolivald (1992) come to the same conclusions.

3.3 The underlying causes of deforestation: An analysis of the role of the agricultural sector

One of the most important underlying determinants of deforestation is the intensity of land use in rainforests. This means that the spatial component is important in the deforestation process: it is not so much the overall level of activity in the rainforest area that determines deforestation, but rather
the intensity of land use of a particular parcel of forest land. In this section, the spatial distribution of deforestation in Cameroon is analysed. Given the fact that agricultural activities are the main cause of tropical deforestation in this country, the focus will be on determining which factors cause high levels of land use intensity in the agricultural sector. The analysis is severely hampered by the limited availability of data. Therefore, most attention will be paid to the causes of deforestation for which data are available: population density and the tenure right system. Furthermore, as the only information on forest cover available is for 1985, the analysis focuses on that year.

Increases in the level of population pressure on forest land decreases sustainability of shifting cultivation simply because there are more mouths to be fed: the present demand for food crops increases. Given the fact that in 1985 the average rural population density in the Cameroonian rainforest area was about 8 inhabitants per square kilometre\(^3\), there was no real necessity for fallow cycles to shorten: there is no evidence of land shortage (yet) that may have necessitated a reduction in fallow periods since population densities of up to 20 persons per km\(^2\) are estimated to be sustainable.\(^4\) However, the population was not distributed evenly over the forest area; some areas were densely populated, whereas other areas were (practically) uninhabited. Therefore, although aggregate population pressure on the forest lands in Cameroon was not very high, local population pressure was: increased rural population pressure in certain parts of the Cameroonian forest area led to a decrease in fallow periods and thus to a gradual loss of forest cover (Quan and Foy, 1994, p. 4; Tonye et al., 1994, p. 269).

The tenure system is also an important potential factor determining deforestation: both the type of contracts under which land is cultivated and their security are important because sustainable use of forested land can be seen as an investment. Less intensive use of forest soils implies that

\(^3\)Calculated on the basis of figures presented by Lele and Stone (1989, p. 41) and Toornstra et al. (1994, p. 3).

\(^4\)According to Quan and Foy (1994, p. 4), an average family of shifting cultivators in Cameroon (consisting of five persons) needs about 6.2 hectares of forest land in a ten year fallow regime. This means that five persons need about 25 hectares in a forty year fallow cycle.
current agricultural yields are forgone in order to secure higher revenues in the future (Barrett, 1991a). Therefore, the larger the share of land cultivated under temporary contracts rather than under permanent land rights, the more deforestation one would expect. Furthermore, the degree in which land rights are respected affects land use sustainability. In this respect, it can be hypothesised that there is a difference in enforceability between formal land rights and customary land rights. Customary land rights can be very secure, at least as long as the social situation is stable. However, in immigration areas customary land rights can become uncertain: migrants are not familiar with the distribution of land and hence land disputes may arise (Southgate and Pearce, 1987, p. 4). As can easily be conceived, it is easier to defend claims on land under cultivation than on land lying fallow (Lawry and Stienbarger, 1991, p. 24; Southgate et al., 1991; Westphal et al., 1981, p. 53). Thus, if ownership rights are not likely to be respected, the cultivation period will probably be increased at the expense of the length of the fallow period; in other words, land use intensity is likely to increase. Assuming that in case social pressures arise formal land rights are more likely to be enforceable than customary land rights, the share of land cultivated under formal land rights (as opposed to customary land rights) can be used as an explanatory variable of deforestation (see Southgate et al., 1991).

If local rural population density is found to be important, it is interesting to analyse which factors influence the settlement pattern of the rural population in the rainforest area. Taking into account the regional data available, several types of variables may be tested in order to determine their relationship with the settlement pattern. An obvious variable is potential agricultural income: generally, the agricultural population is likely to settle where rural income is expected to be high.

Another determinant which is often included in econometric analyses is distance to local and national markets. The main reason for this is that the presence of a large city in the area increases potential agricultural income. However, according to Kummer and Sham (1994, p. 154), it can also be interpreted as a measure of the lack of control over the forest area: the larger the distance to the major urban areas, the weaker legal enforcement and therefore the shorter the fallow period is likely to be.
A third type of variable often mentioned is the density of road and river networks. A dense network of roads and rivers increases the attractiveness of an area of forest land in several ways. First, a dense network of roads and rivers increases the accessibility of the forest area: it facilitates travelling into the rainforests. Second, it increases potential agricultural rents because products can be transported at lower cost to regional, national and international markets (Barbier et al., 1992a, p. 19; Horta, 1991; Lamprecht, 1992, p. 214). Third, the presence of roads may stimulate settlement because of the following reasoning. Road networks are built mainly by the forestry sector: the roads are used to transport the logs to mills, markets and ports. The fact that these roads are located within concession areas facilitates conversion of forested lands into agricultural lands: because the forestry sector has already removed some of the largest trees, the peasants’ costs of converting forest land into agricultural land are decreased (Panayotou and Sungsuwan, 1994, p. 198).

It is obvious that these three types of factors which may determine the settlement pattern of the rural population are not likely to be entirely independent. All three types will reflect the influence of (expected) income on the settlement pattern. But the road density variable and the distance to urban areas are probably correlated as well: the greater the distance to the big cities, the lower the road density is likely to be. Therefore, it should be checked whether or not these exogenous variables are independent.

Hence, in this section the deforestation pattern in Cameroon is analysed, using (predominantly) 1985 data. Basically, the regression analysis is undertaken in two steps. First, an attempt is made at explaining deforestation using both population density and the various types of land rights as explanatory variables. Next, the population settlement pattern is analysed by explaining differences in local population pressure. Before we are able to do this, the available data are described in section 3.3.1; the regression results are presented in section 3.3.2.

### 3.3.1 Description of the data

In order to test the importance of rural population density in the deforestation process in Cameroon, three data sources are used. First, geographical information is used which has been collected in a Geographical
Information System format by the World Conservation Monitoring Centre. Spatial information about remaining forest cover (defined as areas with at least 30 per cent crown cover), the road network, the rural population’s settlement pattern, the location and size of urban areas and the river network are available for the year 1985. Second, socio-economic data are presented by Lele and Stone (1989, annex 1, table 5, p. 41). In this table, agricultural income data for the year 1985 are presented on a departmental level. Total agricultural income is disaggregated into income earned with the production of cash crops and food crops. Lele and Stone also present rural population sizes per department. Finally, data on tenure rights are derived from the Agricultural Census 1984, conducted by the Department of Agricultural Statistics of Cameroon.

Given the fact that only one observation of forest cover is available for every department, the dependent variable of the regression analysis is percentage forest cover: in each department the area of forested land is divided by the total land area. This makes the analysis vulnerable to the point raised by Kummer and Sham (1994) that percentage forest cover measures cumulative deforestation rather than just recent deforestation (see the discussion in section 2.5.2). Therefore, in the present analysis those departments are included that are still fairly densely forested, of which it is quite certain that their original forest cover must have been close to 100% and in which the deforestation process is likely to have started only quite recently so that there will be reasonable correspondence between the percentage deforested and contemporary levels of explanatory variables. Unfortunately, the consequence of this selection is that only data for 13 departments can be used in the regression analysis, and hence the number of degrees of freedom is quite small. This implies that the results of the statistical tests should be interpreted cautiously.

The data derived from the Geographical Information System are summarised in table 3.1: high deforestation areas are characterised by

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5A Geographical Information System is a set of digital maps that contain spatial information. I am grateful to the World Conservation Monitoring Centre, Cambridge, for graciously putting the maps at my disposal.

6Following the reference in Lele and Stone (1989), the income data presented are obtained from the BCEOW Inventory of Feeder Roads, 1985, while the rural population sizes are calculated from the Sixth Plan.
higher levels of road density and are located in the vicinity of urban areas; river density does not seem to have a straightforward relationship with observed deforestation percentages.

Table 3.1: Geographical characteristics of areas with high, medium and low percentages of deforestation

<table>
<thead>
<tr>
<th>Classification of departments</th>
<th>Average percentage deforested</th>
<th>Average road density</th>
<th>Average river density</th>
<th>Average distance to major urban areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>High deforestation</td>
<td>54.98</td>
<td>0.111</td>
<td>0.023</td>
<td>58.0</td>
</tr>
<tr>
<td>Medium deforestation</td>
<td>29.65</td>
<td>0.090</td>
<td>0.026</td>
<td>108.0</td>
</tr>
<tr>
<td>Low deforestation</td>
<td>13.98</td>
<td>0.049</td>
<td>0.025</td>
<td>198.8</td>
</tr>
</tbody>
</table>

*Calculations based on the WCMC data; adepartments with high percentages of forest cover removed are Fako and Moungo; medium deforestation areas are Nyong et Kelle, Sanaga Maritime, Ntem, Meme, Dja et Lobo; low deforestation departments are Ocean, Manyu, Haut Nyong, Nkam, Ndian, Boumba et Ngoko; ccalculated as the area of land with less than 30% crown cover divided by total land area, per department; ddefined as the number of kilometres of paved or unpaved roads per square kilometre; edefined as the number of kilometres of rivers per square kilometre; fdefinition: smallest distance from the centre of each department to either Yaoundé or Douala, the two largest urban areas in the vicinity of the rainforest area, measured in kilometres.

3.3.2 Statistical analysis of the role of agricultural activity in the tropical deforestation process

The approach taken in this subsection is that first an attempt will be made to explain the percentage of forest cover left using population density and type of land rights as independent variables; next an attempt will be made to explain the settlement pattern of the rural population in the rainforest of Cameroon. Both equations have been estimated using ordinary least squares. Furthermore, for each equation two specifications have been tested, a regression in levels and a regression in log-linear form. As the latter performed best, only these results are presented.

In the regression equation used to explain deforestation, percentage forest cover (*perfc*) is the dependent variable while the two explanatory variables are rural population density (*pdens*) and the share of land under temporary land rights (*stlr*, as opposed to permanent land rights). The
Tropical deforestation in Cameroon

result of the regression analysis is presented below (the \( t \)-values are presented in parenthesis):

\[
\ln(\text{perfc}) = -0.2244 \ln(\text{pdens}) - 0.0533 \ln(\text{stlr}) \\
(-7.264) \quad (-2.180)
\]

\( n = 13 \quad R^2 = 0.71 \quad F \text{ statistic} = 30.026 \)

This regression equation suggests that population density and the type of land rights are correlated with loss of forest cover: the higher population pressure and the larger the share of land cultivated under temporary land rights, the more forest cover is reduced.\(^7\)

In addition to this regression, another was run to test the tenure security hypothesis. Like in the Southgate et al. (1991) study, we have tested whether there is a negative relationship between the area deforested and the area of land formally adjudicated (rather than under customary ownership), since there may be a difference in the degree in which each type is respected. Thus, in the regression equation the share of land adjudicated was included next to the population density variable. However, the share of land under formal land rights was not found to have a significant relationship with percentage forest cover. Therefore, in 1985 customary land rights seemed to have been well-respected in as far as peasant households were not induced to reduce the fallow periods for this reason.

Having found a possible relationship between remaining percentage forest cover and rural population density, it is interesting to analyse the regional dispersion pattern of the rural population. The question is which factors influence the settlement pattern of the rural population in the rainforests of Cameroon. On the basis of the regional data available, three types of

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\(^7\)The most notable feature of this equation is that no intercept is included. Running the regression which includes an intercept term, the resulting constant is not found to differ significantly from zero. A variable addition test shows that this term can safely be excluded. Exclusion of the intercept slightly worsens the performance of the land right variable: its two-tail significance drops from 0.0316 to 0.0518; therefore, this variable fails to be significant only just at the 95% confidence interval. The rural population density variable is significant even at the 99% confidence interval.
variables may be included in the regression analysis: variables that reflect the accessibility of a department (road density, \( rdens \); and river density, \( rivdens \)), least distance from the two major cities in the south of Cameroon (Yaoundé and Douala, \( dist \)), and rural per capita income variables (that is, total rural per capita income, \( tpci \), and its divisions into per capita income from production of food crops and from production of cash crops). The individual significance of these variables has been tested by regressing each of the explanatory variables on the dependent variable, rural population density. The result is that the factor river density can be safely ignored in the analysis because it proved to have no significant relationship with population density. Furthermore disaggregation of income into rural income earned by cultivation of cash crops and food crops was found to be futile: the total income variable proved to perform better.

The next step was to test the degree of interdependency between the three remaining explanatory variables: as has already been hinted in the introduction of this section, these three variables may be interrelated. Calculation of correlation coefficients will yield some insight into the interdependence of these explanatory variables, see Table 3.2:

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Correlation coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ln(rdens), \ln(dist) )</td>
<td>-0.8265</td>
</tr>
<tr>
<td>( \ln(rdens), \ln(tpci) )</td>
<td>0.2877</td>
</tr>
<tr>
<td>( \ln(dist), \ln(tpci) )</td>
<td>-0.2915</td>
</tr>
</tbody>
</table>

The conclusions that can be drawn on the basis of these correlation coefficients are that there is a fairly high correlation between the road density and distance variables, and a fairly low correlation between either of these two variables and the income variable. Therefore, the income variable should be included in the regression equation, whereas either the road density variable or the distance variable should be added.

The result of the regression analysis aimed at explaining the regional distribution of the rural population is presented in equation (3.2):
The rural population density in the rainforest area ($pdens$) is found to correlate with the density of the road network ($rdens$) and the total per capita rural income ($tpci$). The $t$-values of the coefficients are again presented in parenthesis; both coefficients prove to be significant at the 99% confidence interval.8

\[
\ln(pdens) = 1.5244 \ln(rdens) + 0.5756 \ln(tpci)
\]

\[
(5.0542) \quad (7.7369)
\]

\[
n = 13 \quad R^2 = 0.70 \quad F \text{ statistic} = 28.653
\]

3.3.3 Conclusions

The agricultural sector is generally indicated to be the main cause of deforestation in Cameroon. Whether the agricultural sector inflicts permanent damage on a particular parcel of forest land strongly depends on the intensity with which cultivation is carried out: the longer the fallow cycle and the shorter the cultivation period, the more likely it is that agriculture will be sustainable. However, it is observed that in some regions in the rainforest area agricultural activities are carried out more intensively than in other areas. To explain this, studies should be conducted at a disaggregate level.

In this section, the deforestation process in Cameroon is examined statistically. Using (predominantly) 1985 data, the deforestation analysis is done in two steps. First, remaining forest cover is examined: it is indicated that a large part of the variance in remaining forest cover is explained by the variance in rural population density and by the variance in the share of land under temporary tenure rights (rather than under permanent land

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8Again, in this specification no intercept term is included. Estimation of an extended equation which includes a constant term, the income variable and the road density variable, yields insignificant results for both the constant and the income variable. In order to be able to choose between specifications in which either the income variable or an intercept is included, a variable addition test is again applied; the result is that null hypothesis of no difference could not be rejected. Because of the fact that the specification using the income variable has a better performance, this equation is presented.
rights). Second, an analysis is presented of variables that influence the spatial distribution of the rural population; road density (which mainly reflects accessibility of the rainforest area) and total per capita agricultural income are found to correlate positively with rural population density.

Given the methodological problems arising from the limited availability of data, the results can only be indicative. The fact that only one observation of forest cover is available implies that the results are vulnerable to the criticism that if percentage forest cover is used as dependent variable, cumulative deforestation is analysed rather than current deforestation (Kummer and Sham, 1994). To reduce the likelihood that this criticism applies to the analysis presented in this section, only those departments are included in the analysis for which the deforestation process has started only recently (accepting the fact that making this selection has a cost in terms of the number of observations). Furthermore, the fact that cross section data are used implies that causality may be questionable.

3.4 Analysis of the factors determining the level of economic activity in the rainforests

The previous section indicates that deforestation is positively correlated with (regional) population pressure on the forests and the duration of the tenure rights. However, the analysis is somewhat outdated as it is based on observations around 1985. Since the rate of forest loss was lower in the first half of the 1980s than either in the period 1985-1990 or in the period 1990-1995, it is important to determine which factors have affected the level and intensity of economic activity in the rainforests after 1985.

One of the main determinants of the level of agricultural activity in rainforest areas is the size of the population living in the forests. In this respect, the first observation is that the country’s overall rate of population growth is high: comparison of the results of the two most recent population censuses (held in 1976 and 1987) reveals that the Cameroonian population grows at a rate of 2.9% annually (Statistisches Bundesamt/Eurostat, 1993, p. 32). Because of the demographic characteristics of the population, the rate of population growth is expected to remain high for a long period of time: the population size will increase from about 13
million in 1992 to a stationary size of 53 million people in about a century (Myers, 1994, pp. 36-37). However, national population growth does not result in deforestation per se; actual pressure on the forests does not necessarily increase if the economy is not dependent on the forests. This subsection explores the linkages between the Cameroonian economy and deforestation process: the main hypothesis is that the economic crisis which dominated the second half of the 1980s increased the necessity to exploit the forests. Therefore, in this subsection the recent economic developments are presented first and next their consequences are analysed in terms of the level of economic activity in the forests.

3.4.1 A description of the general socioeconomic background

In the period 1960-1980 real gross domestic product per capita grew at a rate of 2.8% per year. Until 1979 Cameroon was largely dependent on agriculture. Over the period 1975-1979 the primary sector (mainly small-holder agriculture) accounted for about 30% of GDP, the secondary sector for 18% and the tertiary sector for 52% (World Bank, 1993, pp. 160-161).

At the end of the 1970s the Cameroonian economy transitioned into a boom period mainly as a result of the almost simultaneous discovery of oil reserves and strong increases in the oil prices: oil export revenues increased at annual rates of more than 30% (Statistisches Bundesamt/Eurostat, 1993, table 17.2, p. 143). As a result, the Cameroonian economy experienced annual real growth rates of about 8.6% over the period 1979-1985 (World Bank, 1993, pp. 160-161). The oil boom caused strong shifts in the shares of the different economic sectors: the primary sector’s contribution to GDP decreased from 31.3% in 1978 to 23.2% in 1984, the share of the tertiary sector fell in the same period from 52.7% to 36.1%, whereas the contribution of the secondary sector increased from 16.0% to 40.7% (World Bank, 1993, pp. 160-161). These sectoral changes were the result of the way in which the oil revenues were spent by the Cameroonian government: they were invested in new (parastatal) companies and in the agro-industrial sector (GATT, 1995, p. 3; Lele, 1989, p. 26; Wautelet, 1991, p. 80). The industrial sector experienced the highest rates of growth: it increased by 15.5% per year (World Bank, 1993, pp. 160-161). The decrease in the contribution of the primary sector was caused by the crisis in the agricultural export markets: after a period of price increases, world prices
of cocoa and coffee plummeted in 1979 (Wautelet, 1991, pp. 78 and 80). In this period of high rates of economic growth, only the value of per capita agricultural production decreased: agricultural production grew at a rate of 2.2% per year while the population grew at 2.9% per annum (World Bank, 1993, pp. 160-161 and Statistisches Bundesamt/Eurostat, 1993, p. 32, respectively).

As can be conceived on the basis of these figures, Cameroon was Africa’s economic success story in the first half of the 1980s. Then, in 1986, the country plunged into a severe recession caused by a steep fall in the prices of its main export product, oil, while the prices of its other important export products, coffee and cocoa, were still quite low because of structural global overproduction and even suffered a substantial decrease again around 1985/86 (Wautelet, 1991, pp. 78 and 82). As a result, Cameroon’s terms of trade deteriorated by 45% between 1985 and 1987 (Business International, 1990; Horta, 1991). Furthermore, the oil reserves of Cameroon that could be recovered profitably at that time, were found to be close to depletion: it is estimated that Cameroon will become a net oil importer around the year 2000, and oil production will probably cease entirely not much later (IPD/AC/UNICEF, 1994, p. 45; Jua, 1990; O’Connor, 1992; Wautelet, 1991, p. 82).

The consequences of these adverse developments were harsh indeed: over the period 1986-1993 real GDP fell with about 23.7%; given the rate of population growth of 3% the corresponding decrease in real per capita income was 38% (DIAL/DSCN, 1994, pp. 46 and 68). The sector with the highest rate of decline was the tertiary sector which fell at a rate of 8.9% per year over the period 1986-1990 while the secondary sector contracted at a rate of 4.1% per year. In the second half of the 1980s only one sector experienced positive growth rates: the primary sector grew at a rate of 0.5% per year mainly due to increased forestry revenues (World Bank, 1993, pp. 160-161). However, in 1989 the government was forced to abandon agricultural producer price support which caused the primary sector to contract as well. In the first half of the 1990s negative growth rates persisted in Cameroon. The average rate of growth of GDP over 1990-1994 was -4.4% (Clément et al., 1996, p. 30; GATT, 1995, p. 4). The economic crisis seemed to have hit rock bottom in 1991, when the economy contracted with 7.3% in real terms.
In general, the economic crisis adversely affected the population both in urban and in rural areas. In 1993, unemployment rates in Cameroon were among the highest in Africa (Ngassam and Roubaud, 1994, p. 49). Between 1983/84 and 1993, the general observation was that Cameroonian unemployment figures in the urban areas increased rapidly. Over the period between 1988/89 and 1992/93, many urban based economic sectors experienced negative or only weakly positive profit rates (MEF, 1994 and 1995). Therefore, in the second half of the 1980s, many people were fired in the private sector while the public sector was forced to revise its expenditures on personnel in the first half of the 1990s (Ngassam and Roubaud, 1994, pp. 87-88). Unfortunately, no reliable data are available at the national level, but a detailed survey undertaken in the capital Yaoundé, is very elucidating. In this city, the number of people actually unemployed in 1993 was 68,000 while the number of people who had a job either in the formal or in the informal sector was 207,000 (DIAL/DSCN, 1994, p. 33). Hence, the 1993 unemployment rate was 24.7%, whereas the reported rates were 7.3% and 14.7% in 1983-84 and 1987 respectively (DIAL/DSCN, 1994, p. 70). These figures are even more disturbing when ‘discouraged workers’ are taken into account: these people would like to have an occupation, but have given up hope that they will find a job given the current economic situation and are therefore not actively looking for one. In 1993, the number of discouraged workers in Yaoundé totalled 166,000 (DIAL/DSCN, 1994, p. 33). Hence, if the numbers of unemployed and discouraged people are compared with the number of people who have a job, the employed are actually a minority in the Cameroonian capital. The compression in the formal sector resulted in an increase in the informal sector’s share in total employment (Ngassam and Roubaud, 1994, p. 51). To illustrate, the percentage of people receiving wages (rather than being self-employed) of the total active population dropped from 61% in 1983 to 37% in 1993 (DIAL/DSCN, 1994, pp. 70-71). Unemployment rates continued to increase in 1994 as in April of that year a lay-off
of 20,000 civil servants was announced (while the World Bank even thought that 40,000 would be more appropriate; Ngassam and Roubaud, 1994, p. 88). Since the crisis decreased the demand for the informal sector’s output, employment possibilities in the informal sector were reduced as well (DIAL/DSCN, 1994, p. 37).

Of course, these lay-offs had important financial consequences for those who lost their jobs. However, purchasing power of those still employed deteriorated substantially as well. In 1993, the salaries of civil servants were cut twice (in January and November), resulting in a nominal loss of income of about 50-65% (Ngassam and Roubaud, 1994, pp. 87-88). Furthermore, purchasing power of all citizens decreased as a result of the devaluation of the Franc CFA in January 1994: in that month the exchange rate vis-à-vis the French Franc devalued from FCFA 50 to FCFA 100 for a French Franc (Ngassam and Roubaud, 1994, p. 88; Tchoungui et al., 1995, p. 41).

The consequences for the living conditions in urban areas were that poverty increased substantially. According to the World Bank, households are defined to be poor if they are located in the lower 40% range of the country’s per capita consumption distribution. In 1983, this corresponds to an annual income of FCFA 78,000 per household member (Ngassam and Roubaud, 1994, p. 3). An elaborate survey held in 1983/84 reveals that less than 2% of households in the large urban areas had a per capita income lower than that amount. Recalculating this income threshold for 1993, the percentage of poor urban households had risen to more than 20% in Yaoundé and even more than 30% in Douala (Ngassam and Roubaud, 1994, pp. 56 and 72). Over the period 1983-1993, the per capita consumption levels of households whose head was active in the formal sector in Yaoundé decreased with 20-30%, in the informal sector with 40%, and the unemployed were hit most severely as their per capita expenditures fell with about 60% (Ngassam and Roubaud, 1994, p. 58). The median con-

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11Over the period 1989-1992, civil servants’ allowances had already been cut several times (Ngassam and Roubaud, 1994, p. 88).
The consumption level was reduced by about 33% over the time period under consideration (Ngassam and Roubaud, 1994, p. 56).\textsuperscript{12}

The rural sector was also hit by the recession. In the second half of the 1980s the international prices of cash crops such as coffee and cocoa plummeted. At first the peasant households were protected from these adverse developments by guaranteed prices which were not reduced until 1989 (GATT, 1995, p. 3). Still, life in the rural areas became more difficult as subsidisation schemes (especially for fertiliser use) and production support schemes (diffusion of new technologies) were abandoned. When after 1989 the prices of cash crops declined at rates ranging between 40% in the case of cocoa and 60% in the case of coffee robusta, the peasant households’ response was to turn to food crop production both for autoconsumption and for the local and national markets (GATT, 1995, p. 6; Statistisches Bundesamt/Eurostat, 1993, p. 73). Unfortunately, the recession in Cameroon reduced the demand for food crops considerably and hence producer prices for food crops also fell. The developments can be summarised by stating that the real value of total agricultural production decreased from FCFA 540 billion in 1984 to FCFA 354 billion in 1992/93 (measured in 1984 prices), resulting in a negative annual rate of growth of 5.2% (Ngassam and Roubaud, 1994, p. 81-85). Of course, production per capita fell even more as a result of population growth.

Thus, on the basis of these figures it can be inferred that the economic crisis hit both the urban and the rural areas. However, Eloundou-Enyegue (1992, p. 7) states that the consequences in rural areas were less harsh since the decrease in monetary income had a less severe effect on rural households than on urban households. Basically, rural households in Cameroon do not depend on monetary income for their survival: they can rely on switching to subsistence agriculture so that a decrease in monetary income results mainly in strong cuts in the funds available for various types of investments (not only in physical capital, but also in health and education). On the contrary, in the urban areas a fall in monetary income affects all expenditures including food consumption and housing.

\textsuperscript{12}Note that the choice of this time period somewhat obscures the actual consequences of the recession as the economy experienced positive growth rates up to 1985/86.
3.4.2 The consequences of the economic crisis in terms of pressure on the forests

The effects of the onset of the economic crisis on deforestation are difficult to establish due to the lack of data. For example, the latest data on regional population density are for 1987. However, on the basis of indirect and anecdotal evidence, an analysis can be provided of the importance of the economic situation in Cameroon for the deforestation process. In the period of the economic boom, the increase in the pressure on the forests arising from high rates of natural population growth seems to have been limited. As a result of the high rates of economic growth (fuelled by the oil revenues), the necessity to exploit the rainforests was reduced. The government of Cameroon used the oil revenues to invest in communication, transport, agro-industrial production, and human capital (GATT, 1995, p. 3; Lele, 1989, p. 26). Also the role of the government as an employer gained in importance: the number of civil servants doubled during the boom period (Quan and Foy, 1994, p. 20). The consequence of these developments was that the urban areas were very attractive especially to rural adolescents because of the education possibilities and of the high demand for labour, which resulted in good employment prospects and high wages. It is estimated that 140,000 new jobs were created in the modern sector (private and public) between 1976 and 1986, and real wages increased at a reasonably high rate (for example minimum wages increased by about 17.7% between 1978 and 1985 in Douala; see Lele, 1989, p. 26 and Wautelet, 1991, p. 81). Indeed, less than 1% of the inhabitants of Yaoundé were considered to be poor in 1983, while the situation was only slightly less flourishing in Douala as the percentage in this city was about 2% (Ngassam and Roubaud, 1994, pp. 56 and 72). Moreover, unemployment rates were relatively low: a little over 7% of the workforce in Yaoundé was unemployed in 1983, which is thought to be close to the natural rate of unemployment (DIAL/DSCN, 1994, p. 69). As a result, the rate of urbanisation was very high in the period 1970-1985: the urban population grew 2.1 times faster than the national population (Statistisches Bundesamt/Eurostat, 1993, table 3.6, p. 42).

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The Cameroonian government’s response to the rural exodus was to improve living conditions in the rural areas as it recognised the potential danger of unequal regional development. One of the main aims of the government was to maintain national self-sufficiency in food consumption; the efforts were concentrated on increasing the absorption capacity of the rural areas (De Jong and Harts-Broekhuis, 1997, p. 212; Sikod, 1996, p. 11; Statistisches Bundesamt/Eurostat, 1993, p. 41). Indeed, industrialisation efforts in Cameroon have been moderate compared to other countries, and a substantial share of government expenditures benefitted the rural areas, either directly or indirectly. An example of indirect stimulation is the fact that substantial investments were made in agro-industrial sectors (Lele, 1989, p. 26). More directly, the use of fertilisers by smallholder agriculture was subsidised and producer prices for cash crops were kept artificially high (GATT, 1995, p. 65). These measures were supported further by regional stimulation projects. Parastatal organisations played an important role in achieving a more equal development pattern by means of initiating projects aimed at improving agricultural production (although they were not all equally successful; Lele and Stone, 1989, p. 32; Timnou, 1993, pp. 68-69). The main tasks of these parastatal organisations were to increase the peasant households’ access to inputs (such as fertilisers, pesticides, and irrigation techniques), to disseminate information on improved agricultural techniques, and to make the external situation more stable for peasant households by setting guaranteed prices (GATT, 1995, pp. 65 and 67; Jean, 1992, pp. 35-38; Lele and Stone, 1989, pp. 31-35). The result was that the absorption capacity of the traditional rural areas was increased and also that land could be used less extensively in the rainforest areas.

However, despite these efforts, massive urbanisation occurred. The exodus from the rural areas was such that the rate of rural population growth was only 1.5% over the period 1975-1985, which is about half of the rate of national population growth (Kamdoum, 1996; Statistisches Bundesamt/Eurostat, 1993, p. 42). Emigration occurred not only from the rural areas outside the forests but also from the forest areas, thus dampening the increase in population pressure on the rainforests.

Since 1985/86, the country suffers from a deep economic crisis. The main consequence of the economic downturn was a strong decrease in the
absorption capacity of both the urban and the rural areas outside the rainforest area. Whereas over the period 1981/82 to 1984/85 the oil export revenues increased at annual rates of more than 30%, the growth rate was negative in the period 1984/85 to 1989/90: revenues declined with 19.1% each year (Statistisches Bundesamt/Eurostat, 1993, table 17.2, p. 143). As a result of the recession, the balance of government budget deteriorated in 1987 when it changed from a surplus of 0.6% of GDP to a 3.2% deficit and has worsened almost continuously, at least until 1994: in this year, the budget deficit was 9.5% (GATT, 1995, p. 4). Furthermore, government debt became a real burden. External debt reached a level of some 60% of GDP in 1992 which means that it had doubled since 1986; internal debt (mainly arrears in salaries) is estimated to have been about a third of GDP in 1992 (GATT, 1995, p. 7). Therefore, the government was forced to revise its expenditures substantially and to aim to increase its non-oil revenues.

In the previous subsection, the consequences of the decrease in government expenditures have already been outlined. The decrease in government expenditures and economic activity in the private sector resulted in salary cuts and massive lay-offs. Therefore, the urban areas became less attractive. Although net urbanisation was still positive, in the first six years of the crisis its magnitude appears to have been lower than in the previous fifteen years: the rate of growth of the urban population decreased from 6.9% over the period 1970-1985 to 5.9% in the period 1985-1991, whereas the rate of growth of the rural population increased from 1.3% to 1.7% (Statistisches Bundesamt/Eurostat, 1993, table 3.6, p. 42). Therefore, the urban population grew 2.1 times faster than the national population over the period 1975-1985, whereas in the period 1986 to 1991 the ratio fell to 1.78 (Statistisches Bundesamt/Eurostat, 1993, table 3.6, p. 42).

In terms of population pressure on the rainforests, the economic crisis has three effects. First, emigration from the rainforests is decreasing in magnitude, which implies that population pressure is increasing as the natural rate of population growth is dampened to a lesser extent.

Second, people who have migrated from the rainforests to the urban areas during the economic boom, are considering remigrating to their areas of origin. Therefore, although there is still net migration to the urban
areas (especially of young people wanting to receive higher education), remigration is slowly gaining in importance: unemployed people start to return to their villages of origin (Bergsma, 1997, p. 199; De Jong and Harts-Broekhuis, 1997, pp. 212 and 216; Gubry et al., 1996, p. 76; ONADEF, 1993, p. 4). Indeed, there are references that people remigrate to the rainforest areas to undertake agricultural activities. For example, in the department of Nyong and So‘o, the flow of young people to urban areas has slowed down and seems to be reversing (Quan and Foy, 1994, p. 22). In the Centre province, a survey reveals that the number of remigrants is even observed to be substantial (De Jong and Harts-Broekhuis, 1997, pp. 216-217).

Third, a new migration trend to the rainforests is developing, albeit slowly (Horta, 1991; Lewis, 1989, p. 2008; ONADEF, 1993, p. 4; Toornstra et al., 1994, p. 9; Verhagen and Enthoven, 1993, p. 6; Zama, 1995, p. 265). Of course, not only urbanised people originating from the rainforest region are considering to return to their villages: a remigration trend is observed to be developing towards the savannah areas as well. However, the cut-backs on the expenditures on rural development (for example, subsidisation of fertilisers) decreased the absorption capacity of those areas that were already densely populated in the period of economic boom (mainly the Western Highlands in the west of the country, and the northern region; Balépa et al., 1992). Reduction in agricultural yield (caused by decreases in productivity as fertiliser input is no longer subsidised, and by a fall in producer prices) combined with the abolition or privatisation of the parastatal organisations aiming to improve the regional situation, led to a reduction of the absorption capacity of those savannah regions in terms of the number of people that can be sustained on the land available (De Jong and Harts-Broekhuis, 1997, p. 215; Jean, 1992, p. 35; Lele, 1989, p. 35; Quan and Foy, 1994, p. 20). Indeed, Kelodjoue (1989, p. 93) states that in the Western Highlands land is no longer distributed to young people, an observation that supports the view that
land is becoming scarce. As a result, a migration flow (albeit still quite small in magnitude) is observed to develop towards the forests.  

Concerning the relative importance of these three sources of increased population pressure on the forests, the first (natural population growth combined with reduced emigration rates) is the most important one; the majority of the shifting cultivators in Cameroon’s tropical forests is still indigenous (Amelung and Diehl, 1992, p. 77). Thus, it can be concluded that the economic crisis in combination with increasing land scarcity in the densely populated areas of the country has resulted in increased pressure on the forests, mainly because the natural growth of the number of forest dwellers is dampened less and less by emigration, while (albeit to a lesser extent) both remigration of people originating from the forests and immigration of people foreign to the area also play a role.

Stating that the situation worsened in urban and rural areas outside the rainforests is not a sufficient explanation of the increase in population pressure; the situation in the rainforests may have deteriorated even more. For example, if land had become scarce in the rainforest areas as well, emigration rates would still be very high. However, the quantity of land available in the rainforests increased during the economic crisis as a result of increased forestry activities. As is already suggested in section 3.3, the forestry sector increases the attractiveness of agricultural activities by opening up closed forests, thus increasing the cultivatable land area. Indeed, in Cameroon the construction of logging roads is often followed by agricultural settlement at road sides, not only by migrants but also by the forest population itself, who needs additional land (Besong, 1992, p. 37; Gartlan, 1992, p. 142; Mission d’Orientation, 1993, p. 18; Quan and Foy, 1994, p. 48; Rietbergen 1989, p. 44; Verhagen and Enthoven, 1993, p. 3).

Since the economic crisis induced the Cameroonian government to stimulate forestry activities, the area of accessible forest land increased. In response to the fall in foreign exchange earnings caused by the decrease in oil revenues, the government of Cameroon aimed to increase exports of

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14Note that there are obstacles to migration that are probably largely responsible for the fact that the magnitude of the migration flow is still limited. For example, the presence of diseases in rainforests discourages people to migrate to those areas. Furthermore, strong cultural differences hampers migration as the forest population may be hostile to migrants.
tropical timber products (Evans, 1990, p. i; GATT, 1995, p. 74; Horta, 1991, pp. 142-143; Toornstra et al., 1994, p. 4). The volume of wood removed from the forest areas grew at a moderate rate over the 1980-1986 period: the volume of roundwood extracted in 1980 was 2.196 mln m$^3$ and 2.770 mln m$^3$ in 1986, which means an average increase in the quantity of wood removed of 3.9% per year. Over the period 1988-1990, when the oil revenues were falling rapidly, this rate increased to 9.7% resulting in a production volume of 3.276 mln m$^3$ in 1990 (Statistisches Bundesamt/Eurostat, 1993, table 7.10, p. 76; see also Foteu Kameni, 1995). Export values increased from an average US$ 45 mln between 1981 and 1986 to an average US$ 120 mln between 1986 and 1992 (GATT, 1995, p. 72). This trend is expected to continue in the future as the government has announced plans to meet falling oil revenues by increasing forestry production to 4 million m$^3$ by the year 2000 and even 5 million m$^3$ by the year 2010 (Evans, 1990, p. i; Toornstra et al., 1994, p. 4).\(^{15}\)

Thus, the forestry sector's activities increased the area of accessible land in the rainforest area so that the increased population could be accommodated. Additionally, the forestry activities also increased population pressure directly. The forestry sector provides between 35,000 and 40,000 jobs (GATT, 1995, p. 71). As the majority of these employees are not hired locally, there is an inflow of people which results in increased pressure on the forests as the forestry employees' families start undertaking agricultural activities (SNV-EP, 1993, pp. 9-10; Toornstra et al., 1994, p. 9-10; Tchoungui et al., 1995, p. 91; Van Dorp, 1994; Verhagen and Entoven, 1993, p. 6).

3.5 Analysis of the factors determining agricultural intensity in the rainforest region

The increase in the level of economic activity (both forestry and agriculture) has resulted in increased forest degradation. However, in terms of actual deforestation, the intensity with which agricultural activities are performed, is important. Shifting cultivation can be a sustainable forest

\(^{15}\)The quantity of timber extracted as fuelwood increased as well: while the rate of growth of production was 2.5% in the first half of the 1980s, it increased to an average of 4.1% in the second half (Statistisches Bundesamt/Eurostat, 1993, table 7.10, p. 76)
management system if the rotation period is long enough and if the period in which the land is cultivated is short enough, so that the soil is not totally exhausted.

As is already argued in section 3.3, factors that affect land use intensity are population density, the type of tenure rights and the degree in which these rights are respected. This section aims to determine whether these factors indeed affect sustainability of agricultural activities in the rainforest areas of Cameroon. In section 3.5.1, attention is paid to the tenure system. Section 3.5.2 analyses the degree in which this tenure system is respected. In section 3.5.3, a statistical analysis using household data is carried out in order to test whether indeed population pressure and the land right system have an impact on agricultural sustainability.

3.5.1 The system of land rights in the Cameroonian rainforests

Officially, in Cameroon law, formal land rights prevail over customary land rights while all ‘unoccupied’ land (that is, land that is not formally adjudicated) is officially government-owned since the German colonial period (Lawry and Stienbarger, 1991, p. 14; Tchoungui et al., 1995, p. 29). A prerequisite for obtaining formal land rights is the ‘mise en valeur’ of forests, that is forests must be cleared for cultivation purposes before legal land titles can be obtained (Horta, 1991, p. 144; Tchoungui et al., 1995, p. 29). In practice, land rights are predominantly customary rather than formal: in 1984 only 4% of the land was cultivated under formal land rights. The main reason for this is that formal land rights are quite costly to obtain, not only in terms of money but especially in terms of time (Horta, 1991, p. 144; Lawry and Stienbarger, 1991, pp. 14 and 16; Ngwasiri and Nje, 1995; Tchoungui et al., 1995, p. 29).

In most areas in Cameroon, customary land right systems are based on kinship relationships. The allocation of land to individual members of kinship groups is in the hands of the lineage authorities: land may be revoked and redistributed on the basis of generally recognised rules. However, kinship members’ use rights on specific land parcels are often very secure: in some instances, rights to particular parcels of land are even

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16 Calculation based on the 1984 Agricultural Census of the Cameroonian Department of Agricultural Statistics.
Tropical deforestation in Cameroon

Inheritorable. Therefore, kinship members usually enjoy more or less permanent occupation rights and have a strong discretion over how their land is used; these rights are usually referred to as primary land rights (Lawry and Stienbarger, 1991, pp. 10-11).

Of course, not all land is cultivated under primary land rights: subject to mutually agreed conditions, land can also be used by a third person who has secured agreement from a primary right holder. These land rights are referred to as secondary land rights or tenancies and are usually short-term use rights. Common forms are rental and share-cropping agreements with a limited duration, which may even be less than a year (Lawry and Stienbarger, 1991, pp. 11-12 and 15).

In practice, most land is cultivated under permanent tenure: between 1984 and 1992 the percentage has been more or less constant at 85%; the remaining land is cultivated under temporary land rights.\(^{17}\)

3.5.2 Land right security in the rainforest region

Apart from the type of contract under which land is cultivated, the actual security of land rights is important as well. In the analysis presented in section 3.3.2, a regression has been run to test whether there is a distinction in deforestation between departments with high shares of formal land rights rather than customary land rights. It was found that making this distinction did not yield statistically significant results. The explanation is that the time period of the regression analysis was characterised by a strong migration flow from the rural areas (including the rainforest area) towards the urban areas because of the economic boom. This means that actual land right uncertainty is not likely to have been important in this period: for customary land right systems to be stable, all parties involved should be familiar with the system; in areas with no immigration this condition is likely to be fulfilled.

Since the onset of the crisis, however, the frequency of land conflicts seems to be increasing. The inflow of people from outside the forest areas combined with reduced emigration results in increased competition for land. For several departments there are references that land disputes are

\(^{17}\)Calculation based on the 1984 and 1992 Agricultural Surveys of the Cameroonian Department of Agricultural Statistics.
becoming more frequent, such as in Lekié (Kelodjoue, 1989, p. 98; Lösch et al., 1991, p. 52), Moungo (Kelodjoue, 1989, p. 92; Lösch et al., 1991, p. 81) and Meme (Lösch et al., 1991, p. 70). Furthermore, there are references about departments in which immigration flows are observed to occur. Close to the urban areas, migration takes place from the already high population pressure areas (such as Lekié) and from the urban areas towards less densely populated areas such as Mbam (De Jong and Harts-Broekhuis, 1997, p. 219; Lösch et al., 1991, pp. 48 and 52), and Nyong et So’o (Bergsma, 1997, p. 199; Quan and Foy, 1994, p. 30). Indeed, in the area south of Yaoundé (in the department of Nyong et So’o, Centre province) people break decisively with the traditional ways of cultivation under pressure of the economic crisis: young urban remigrants clear land for commercial food production without authorisation of the village elderlies (Quan and Foy, 1994, p. 30). But there is also a migration flow (although still quite small) of people from outside the rainforest area towards the forests in the Centre-South provinces; sometimes these people are clearing unused or fallowed forests without consent of the customary land owners (Lösch et al., 1991, pp. 48 and 52; Quan and Foy, 1994, p. 30).

In the more remote areas, the forestry sector induces migration by facilitating access (Mission d’Orientation, 1993, pp. 7 and 12). This is especially the case in the departments of Kadey and Haut-Nyong in the East province, in which the forestry sector is active in the (primary) forests and attracts migrants (ONADEF, 1993, p. 4; SNV-EP, 1993, p. 46; Verhagen and Enthoven, 1993, p. 6). Again, some of these people are remigrants (SNV-EP, 1993, p. 46; Toornstra et al., 1994, pp. 9-10); others are foreign to the region and migrate from the west and north of the country towards the eastern part of the rainforest area (Horta, 1991, p. 144; Ngoma, 1994, pp. 73-78 and 86-87). Although the magnitude of the migration flow to the east is still fairly limited, it may gain in importance if the economic crisis continues (Quan and Foy, 1994, p. 48). Probably the main motivation is the hope to find a job in the logging industry. As the number of jobs is quite limited, many of the migrants turn to agriculture for a living (Toornstra et al., 1994, p. 9). In absolute terms, population density in the East province is quite limited: about 1 inhabitant per square kilometre. However, actual population pressure is much higher since the population tends to settle along roadsides. Not only migrants prefer to cultivate land along road
sides; the indigenous population gives up traditional shifting cultivation and occupies land along the roads (Mertens and Lambin, 1997). Hence, population pressure is much higher than suggested by the density figure presented while traditional communal ownership rights are breaking down (SNV-EP, 1993, p. 35).

3.5.3 The effects of the economic crisis on agricultural productivity
In this subsection, an attempt is made to determine whether indeed agricultural sustainability has been affected (negatively) by the developments arising from the economic crisis. The main hypothesis is that increased population pressure, higher percentages of short-term contracts and increasing insecurity of land rights induce peasant households to cultivate their land more intensively by increasing the cultivation period at the expense of the fallow period. Unfortunately, no reliable data are available on the length of the fallow cycle. Therefore, the focus will not be on the length of the fallow period compared to the length of the cultivation period, but rather on agricultural productivity. Indeed, theory predicts that if land is used unsustainably for some time, agricultural productivity is likely to fall. In order to test the hypothesis, the 1984 and 1992 agricultural surveys of the Cameroonian Department of Agricultural Statistics can be used, which contain a wide range of data at the level of individual peasant households.

Agricultural productivity is operationalised as the ‘shift parameter’ in a peasant household’s Cobb-Douglas production function:

\[ q_t = \theta_t L_t^\alpha A_t^\beta \]  \hspace{1cm} (3.3)

In this equation, \( q_t \) is output, \( L_t \) is quantity of labour used, and \( A_t \) is area of land cultivated, all in the current period. Agricultural productivity is represented by \( \theta_t \). Hence, the main hypothesis is that the \( \theta_t \) coefficient will be lower if land is cultivated under temporary rather than permanent land rights, if the land rights are likely not to be fully respected, and if population pressure is observed to be increasing.

With respect to the duration of land rights (permanent or temporary), observations are directly available: the data sets contain a dummy variable that indicates whether the parcel of land is cultivated under permanent land rights (\( Landown = 1 \)) or under temporary land rights (\( Landown = 0 \)).
Unfortunately, there are no direct observations available of the degree in which land rights are respected: the questionnaires did not contain a question on perceived tenure security in terms of land take-overs. The distinction between formal and customary land rights cannot be used either, since this distinction is not made in the 1992 data set. Therefore, we have to resort to a more indirect measure. The likelihood that traditional land right systems break down increases if land scarcity increases. This means that increased population pressure is likely to have two effects: apart from the fact that increased population pressure decreases sustainability of agricultural production since more mouths are to be fed, it may also result in disrespect of customary land rights. On the basis of the data available, it is not possible to discriminate between these two effects: neither data on land right security are available, nor recent population data at a sufficiently disaggregate level. Thus, the best we can do is to assign a dummy variable to departments in which there are signs of increasing turbulence ($Socturb = 1$) which includes areas where immigration takes place or where land conflicts are observed to occur as presented in section 3.5.1; all other departments are assigned a value 0. Controlling for the area of land used and the quantity of labour applied, one would expect output to be lower for peasants who do not have permanent (customary) land rights and who live in the turbulent areas.

Finally, agricultural productivity is likely to be influenced by other factors as well. First, not all crops require a fallow period to maintain agricultural productivity. Basically, this is the difference between perennial crops and annual crops: agricultural productivity of perennial crops does not depend on fallow cycles whereas productivity of annual crops does. Unfortunately, although the quantities produced are available for each crop, no information is available about the allocation of the production factors land and labour over these crops. Therefore, we must make a short-cut by analysing total production, correcting for the share of perennial crops in production. Second, the use of inputs such as fertilisers and pesticides is expected to have a positive effect on agricultural productivity; dummy variables are available that indicate whether or not the peasant households applied fertilisers or pesticides.
Thus, the variables used in the regression analysis are the following. To derive an index for agricultural production per household, the quantity of each crop type produced is multiplied by the average national price level for that particular crop. Hence, the dependent variable is in fact agricultural revenue \((\text{Rev})\).\(^{18}\) With respect to the production factors, the area of land cultivated \((\text{Land})\) is directly available in the data sets and the quantity of labour used is the number of people (both household members and hired workers) that have worked at least 30 days in the past year \((\text{Lab})\). Furthermore, to correct agricultural productivity for crop types that do not need a fallow cycle, the share of perennial crops in total revenue is used; this variable is labelled \(\text{Shpcrin}\). The main coefficients are of course the coefficients on the variables \(\text{Socturb}\) and \(\text{Landown}\).

Running the regression for the information available in 1992, the results are (the \(t\)-values are presented in parenthesis):

\[
\ln(\text{Rev}) = 9.402 + 0.274\ln(\text{Land}) + 0.530\ln(\text{Lab}) + 0.452\text{Shpcrin} - 0.455\text{Landown} - 0.436\text{Socturb}
\]

\[
\begin{align*}
&\quad \quad \quad \quad (24.782) \quad (5.233) \quad (10.182) \quad (2.251) \quad (3.471) \quad (-4.403) \\
&\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \QUOTEDLINE
that either the pesticide and fertiliser dummies should be included in the regression equation, or the Shpcrin variable. As the latter option performed best whereas the coefficients on the other variables in the regression analysis were not affected in qualitative terms, the specification including the share of perennial crops is presented. Regarding the variables that are the actual subject of the analysis, Socturb and Landown, it is found that their coefficients differ significantly from zero and have the expected signs. This means that indeed agricultural productivity is found to be lower in the departments in which either immigration takes place or where land disputes occur, whereas permanent land rights are positively correlated with agricultural productivity.

However, this regression is not fully convincing in terms of the effect of social turbulence: many reasons can be put forward why assigning dummy variables to these departments results in a negative sign. For example, it may be the case that soil productivity is structurally lower in these departments than in departments for which the dummy variable was assigned the value zero. Therefore, the same equation was also tested for 1984. The results are presented in equation (3.5):

\[
\ln(Rev) = 8.891 + 0.353\ln(Land) + 0.563\ln(Lab) + 1.638\text{Shpcrin}
\]

\[
+ 0.291\text{Landown} + 0.020\text{Socturb}
\]

\[
(3.623) \quad (0.275)
\]

\[\begin{align*}
R^2 & = 0.43 \\
F-value & = 180.075
\end{align*}\]

Indeed, controlling for the area of land cultivated and the quantity of labour used, the type of landownership (permanent or temporary) is still found to be a determinant of agricultural productivity but the social turbulence indicator no longer is. This implies that in the immigration areas and in the areas where land conflicts are observed to occur, agricultural productivity is indeed found to have decreased.

3.6 Conclusions

Having analysed the deforestation process in Cameroon, the roles of the various actors can be assessed. Of the actual exploiters of the rainforest
areas, agriculture and forestry were found to be the most important sectors active in the forests.

The agricultural sector is generally indicated to be responsible for the actual deforestation in Cameroon. As for the level of agricultural activities, the number of people carrying out agricultural activities seems to have increased in response to the economic crisis. While there was a strong emigration trend from the rainforest areas towards the urban areas in the boom period, net emigration has fallen since the onset of the crisis as the attractiveness of settling in urban areas decreased. Although still limited in magnitude, a (re-)migration trend is even observed to be developing towards the forest regions as a result of the worsening situation in the urban and rural areas outside the rainforests. As regards the sustainability of the agricultural techniques applied, the duration of land rights is found to be important: land under permanent land rights is more likely to be cultivated in a sustainable manner than land under temporary land rights. Furthermore, the combined effect of increased population pressure and rising insecurity of land rights (indicated by observations of immigration and land conflicts) is determined to be a threat to sustainability: agricultural productivity is found to be lower in departments in which immigration occurs and/or in which land conflicts are observed to arise.

As for actual deforestation, the forestry sector seems to play a minor role at least directly: the logging technique applied is very selective in the harvested tree species; about one tree is logged per hectare. This does not imply that the forestry sector does not cause any environmental damage: the felling of a tree and its removal inflict damage upon the standing stock, resulting in a reduction in both biomass and biodiversity. However, the reduction in biomass is only temporary as the vegetation regenerates fairly quickly. In terms of the loss of biodiversity, the role of forestry is far more important: in virtually all cases, this sector is the first to degrade Cameroon’s primary forests into secondary forests. Furthermore, the sector acts as a catalyst of subsequent deforestation as it opens up closed forest areas for agricultural settlement: people tend to settle along the roadsides.

In the analysis, the general economic situation in the country is observed to have affected the deforestation process. Since the fall in oil revenues was the main cause of the economic crisis, the government has played an important role in setting the stage for the increase in deforest-
ation. Indeed, the fall in oil revenues forced the government to reduce spending on the one hand and increase non-oil revenues on the other hand. The reduction in expenditures caused the absorption capacity of both the urban areas and the traditional rural areas to fall. During the boom period, employment possibilities in the urban areas increased (for example because the government expanded in terms of its number of civil servants and because it stimulated the agro-industrial sector), while the rural areas benefitted from government policy aiming to sustain agricultural productivity (both in terms of prices and fertiliser input) and dilution of improved technologies. When government expenditures were cut, living conditions in both areas deteriorated, inducing a reduction in the net urbanisation trend and even (albeit at a small scale) migration towards the forest areas. Government policy also resulted in increasing the attractiveness of agricultural activities in the forest area. In an attempt to dampen the fall in income resulting from the reduction in oil revenues, the government stimulated forestry activities, which resulted in an increase in the area of land accessible to small-scale peasant households.

Thus, the case of Cameroon shows that government intervention can have (unintended) consequences in terms of deforestation. Although migration into the tropical forest areas was not government-induced in the sense that the administration planned the colonisation of tropical forest areas on a large scale as it did in many other countries (see Amelung and Diehl, 1992, p. 80), government policy has resulted in increased (unsustainable) use of the country’s tropical rainforests.

On the basis of this chapter, several research questions arise. First, more attention should be paid to the response of shifting cultivators to changes in prices (which is an indirect way of affecting households’ behaviour as direct instruments are not available) and to tenure uncertainty. Second, the role of the forestry sector in the deforestation process needs to be addressed more thoroughly, especially with respect to its interaction with shifting cultivators. Finally, the local governments themselves should be subject to closer examination as ways should be found to induce them to improve forest conservation.