Economic Crisis and Forest Cover Change in Cameroon: The Roles of Migration, Crop Diversification, and Gender Division of Labor*

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I. Introduction

Rapid tropical deforestation is an urgent worldwide concern because of possible "public goods" consequences, such as global warming and loss of biological and genetic diversity, and because of more localized consequences, such as land degradation, soil erosion, watershed destruction, flooding and siltation, and loss of income from timber and nontimber forest products.[1]

Central Africa's 200 million hectares of contiguous humid tropical forest (spanning the Democratic Republic of Congo, the Popular Republic of Congo, the Central African Republic, Gabon, Equatorial Guinea, and Cameroon) constitute the second largest remaining such area in the world after the forests of the Amazon basin in Latin America.[2] The 17 million hectares of humid forest covering the southern third of Cameroon have received much research attention in recent years.[3] Among the reasons for this attention is that Cameroon's estimated annual loss of forest cover in the 1990–95 period was 129,000 hectares, or 0.6% of the total.[4]

Recent satellite imagery time-series research has shown that the rate of net deforestation in the humid forest zone of Cameroon greatly increased in the 10-year period after the 1986 onset of a devastating economic crisis as compared with the 10-year period prior to the crisis.[5] Benoît Mertens and Eric Lambin found that in a 110,000 hectares block in the region of Bertoua (East province), the average annual rate of net deforestation doubled in the period from 1986 to 1996 as compared with that of the period from 1973 to 1986.[6] Nadine Laporte found that in a 42,000 hectares block surrounding Yaoundé (the capital city), net deforestation increased by a factor of two in the period from 1987 to 1995

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as compared with that of the period from 1973 to 1988.[7] Mertens et al. found that in a 70,000 hectares block in the Ndélélé region of the Eastern province, the rate of average annual net deforestation increased by more than four times in the period from 1986 to 1996 as compared with that of the period from 1973 from 1986.[8]

This article attempts to explain how changes in population dynamics and smallholder agriculture have led to increased deforestation in the period of the crisis. These foci are justified by the fact that population growth and shifting cultivation are generally viewed, respectively, as the main cause and agent of deforestation in Central Africa in general and in Cameroon in particular.[9] Other factors contributing to deforestation and forest degradation in Cameroon are logging and the construction of transportation infrastructure.[10]

This article examines the role of agricultural smallholders in Cameroon's forest cover loss within the context of dramatic macroeconomic events in the last 20 years. Beginning in the late 1970s, Cameroon experienced a period of rapid economic growth followed by a devastating recession beginning in 1986, a weakly implemented structural adjustment program in 1989, and then a drastic currency devaluation and weak economic recovery beginning in 1994.

Between the late 1970s and 1985, Cameroon had robust economic growth based largely on oil exports. The average annual rate of real gross domestic product (GDP) growth in this period was 7%.[11] The oil boom supported rapid increases in urban employment. The population of Yaoundé grew 107%, the population of Douala (the main commercial city) grew 77% in the 1976–87 period,[12] and there was a corresponding stagnation in the rate of growth of villages in outlying regions. In this period, cocoa and coffee were the principal cash earners for farmers in the humid forest zone.[13] Many of these farmers received government subsidies for fertilizers and other inputs.[14]

In 1986, national income collapsed because of a drastic decline in world oil and agricultural prices in combination with a sharp appreciation of the CFA franc against the U.S. dollar.[15] In the period from 1985 to 1987, Cameroon's terms of trade declined 65%.[16] In 1989, the purchase prices of cocoa and coffee—the leading agricultural export earners—were cut in half by the government, greatly adding to the immiseration of the country.[17] In the same year, government subsidies for plantation crop inputs were sharply reduced.[18] Production and export of cocoa and coffee declined precipitously afterward.[19]

A 50% devaluation of the CFA franc in January 1994 made Cameroon's export commodities more competitive on the international market. The devaluation, coupled with increased world prices of cocoa and coffee, led to a modest rebound of production of these commodities in Cameroon in recent years.[20] During the crisis, the decline in urban incomes narrowed the gap between urban and rural incomes.[21] Case study research has provided preliminary evidence of massive "return" migration to the countryside as a reaction to worsening urban poverty.[22] In the period from 1987 to 1993, average annual GDP growth was negative; in the period from 1994 to 1996, average annual GDP growth was positive and in the range of 3.3%–5.0%.[23]

It stands to reason that any serious examination of the role of population and agriculture in Cameroon's forest cover change must be done within the context of macroeconomic events of the last 20 years because population movements and agricultural practices appear to have been profoundly influenced by the oil boom, the crisis, and currency devaluation. Little research has been done from this perspective. J. A. M. Hoogeveen and D. P. van Soest speculate that return migration and increased agricultural and logging activities related to the recession must have increased the rate of deforestation.[24] Ousseynou Ndoye and David Kaimowitz, drawing on large amounts of secondary data, have reached essentially the same conclusion.[25] However, none of these previous studies has had access to regionally representative empirical data. On the basis of such data, this study aims to answer important questions that remain unanswered in the literature; among them, How exactly did the crisis and devaluation affect migration patterns, cropping patterns, and household labor allocation? And how did these changes, in turn, affect forest clearing practices?

These questions are addressed in the following sequence. Section II explains the hypotheses and field research methodology. Section III presents the field research findings. Section IV discusses some implications of the findings for forest cover change. In Section V, we explain the policy implications of our findings.

II. Hypotheses and Methodology

Hypotheses

This study tests three hypotheses related to the effects of Cameroon's economic crisis on migration and agricultural decisions of rural households and on the gender division of labor. There is an underlying tenet in our approach that assumes that significant changes occurring between two reference years are at least partly attributable to a macroeconomic "event" in the intervening years. We recognize that these changes might also be explained by nonmacroeconomic phenomena (e.g., changing fertility and death rates, health care or agricultural extension improvements, weather patterns, etc.). However, the effects of the 1986 crisis and 1994 currency devaluation were so drastic and widespread that, arguably, many abrupt and significant socioeconomic changes that ensued might be traceable to these events. This issue will be taken up in greater depth in Section IV.

The three hypotheses tested are:

HYPOTHESIS 1. As a consequence of the economic crisis, rural-to-urban migration has slowed, and populations in the villages have grown, with increased forest clearing as a consequence, but there has been no net return migration from urban to rural areas. The basis for this hypothesis is the increase in urban poverty from 1% to 20% of the population between 1983 and 1993 and an explosion of unemployment from 7.3% to 24.6% in the same period.[26] It is also based on evidence of return migration to the countryside through field research in the West and North provinces.[27] We assumed that out-migration would continue to exceed

in-migration in the villages (i.e., that net out-migration would continue) because of the persistence of certain advantages in rural-urban migration.

HYPOTHESIS 2. Between the years prior to the crisis and the present, production of cocoa and coffee has stagnated, especially in terms of area increases. Farmers have compensated with increased production and marketing of food crops, especially of plantain, which is usually produced in primary forests. The basis for the second hypothesis is the literature, noted earlier, showing that production and export of cocoa and coffee declined precipitously after 1989 in response to the government cuts of producer prices and subsidies. The hypothesis is also based on case study research, such as that carried out by Georges Courade and Véronique Alary, which indicates that between 1989 and 1993 the marketing of food crops increased at one-third of sampled farms.[28] The hypothesis is also based on the observations by F. Heidhues et al. that the production of plantain had increased noticeably between 1987 and 1992 and by James Gockowski, Blaise Nkamleu, and John Wendt that the collapse of plantation crop prices induced a shift of labor into plantain and cocoyam production.[29]

HYPOTHESIS 3. The collapse of plantation crop prices has led to growing participation by men in the production of food crops. Although the gender division of labor has been strong (i.e., in the past, men produced almost exclusively cocoa and coffee, and women, food crops), it has weakened as a consequence of the urgent need to increase household income. The third hypothesis is based on information such as that reported by Heidhues et al.,[30] which shows that between 1987 and 1992, men put additional time into production of food crops in cocoa areas in southwestern Cameroon. The third hypothesis is a corollary to the second. Since most women have specialized in food crop production, it makes sense that significantly expanded production at the household level would require a notable increase in the contribution of men.

Methodology

The three hypotheses were tested through a survey of 4,078 households in the Center and South provinces of Cameroon between September and November 1997. Primary data were collected on a large scale because of an almost total lack of reliable socioeconomic data at the national level; Cameroon has been unable to complete a national census since before the beginning of the crisis. It might have been preferable to conduct our survey not only in the Center and South provinces but also in the Southwest, Littoral, and East provinces, which are also part of the humid forest zone. We restricted ourselves to the Center and South provinces because we aimed to replicate the methodology and update the findings of André Franqueville's 1974–75 field research on migration in these provinces.[31] Franqueville's field research, based on 2,479 households in 38 villages in the Center-South provinces, sought to explain the reasons for, and socioeconomic dynamics of, migration in the mid-1970s.

We chose to use the Franqueville study as our "template" for five reasons.

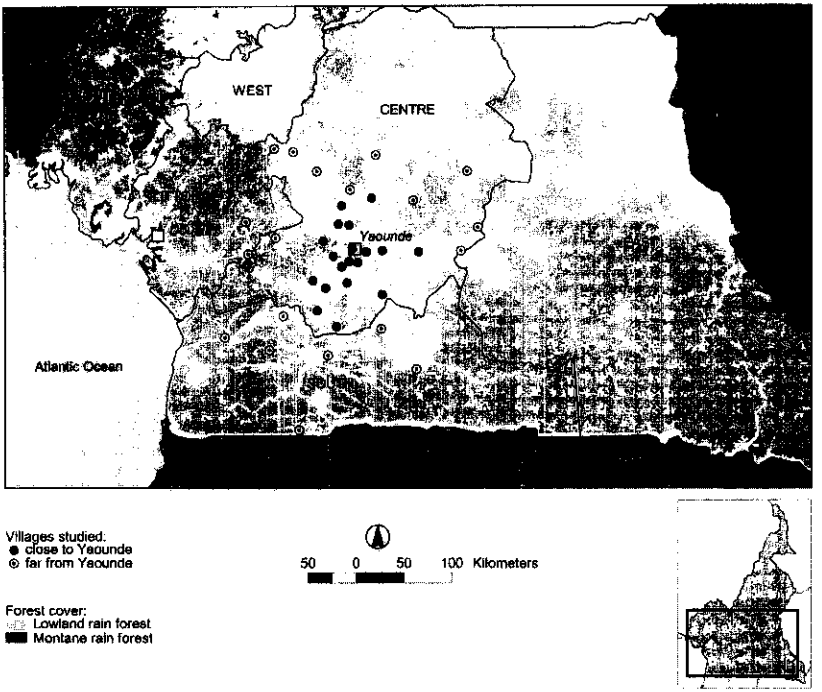


FIG. 1.—Map of the 38 study villages and dense forest cover in the Center and South provinces of Cameroon.

First, the Center and South provinces encompass a substantial portion of Cameroon's humid forest zone—about one-third of the total forest area and about 2.6 million of the estimated 4 million people living in the zone.[32] Second, as can be seen in the map of the study area (fig. 1), Franqueville's 38 villages happen to be situated both within and beyond the zone of peri-urban deforestation in the Yaoundé metropolitan area. This supported well our aim to understand the relationship of population growth and movement and rural-urban dynamics to forest cover change. Third, we wanted to understand the change of migration and livelihoods over time and therefore needed to anchor ourselves in high-quality research conducted before the onset of the crisis. Fourth, Franqueville's data were largely representative of all rural households in the Center and South provinces when the study was conducted. Fifth, Franqueville himself was available for consultation so that we could be sure to replicate his methodology correctly.

Our study replicates Franqueville's in the following ways. We surveyed all households in the same 38 villages where he surveyed all households in 1974–75. We posed certain questions with the aim of updating tables that summarized some of his key findings concerning basic population, migration, and livelihoods data. The first two of four components in the questionnaire reproduced his methodology. In the first component, we collected basic infor-

mation (place of birth, employment, education, etc.) on all members of the household. In the second component, we compiled information on the place of residence in 1977, 1982, 1987, 1992, and 1997 of all long-term migrants born in the study villages who were (1) currently members of the household or (2) the sons and daughters and "true" brothers and sisters of the head of household who did not live in the study village at the time of the survey and were still alive.[33] Our one important departure from Franqueville's methodology was to define as long-term migrants those who had lived 6 consecutive months or more outside the study village, whereas he classified as migrants those who had lived 30 consecutive days or more outside the study village. This was done to adjust for the fact that, currently, much of the migration lasting less than 6 months is temporary in nature and does not involve relocation.

The third component assessed for each household according to whether lands dedicated to cocoa, coffee, plantain, and other food crops had expanded, contracted, or stayed the same. These assessments compared area changes for particular crops between 1985 and 1993 (i.e., before and after the onset of the crisis) and between 1993 and 1997 (i.e., before and after implementation of the currency devaluation). In the fourth component, we asked respondents to provide information on whether, where, and how they had enlarged or created forest fields in 1996.[34] We sought to know if these clearings were created in primary or secondary forests and whether they were created with or without the use of a chainsaw.

Our reference years were chosen with the intent of understanding how certain macroeconomic events might have influenced socioeconomic change: 1977 is prior to the oil boom, 1982 is in the midst of the oil boom, and 1985 is directly before the onset of the crisis and toward the end of the oil boom. The year 1987 is after the oil boom and at the beginning of the economic crisis, 1992 and 1993 are still in the midst of the crisis and prior to the currency devaluation, and 1996 and 1997 are after the currency devaluation.

In addition to the household survey, we also conducted a follow-up survey with village heads in June–July of 1998. The aim of this survey was to better understand the preliminary findings of the household survey. In particular, we were interested in knowing the reasons for the apparent volatility of the land area allocated to food crops in the study villages.

III. Research Results

The research results are presented in four parts. The first three parts address each of the three hypotheses. The fourth part looks at the results of multiple regression analysis on various household-level and village-level predictors of forest cover change.

Test of Hypothesis 1

The first hypothesis states: As a consequence of the economic crisis, rural-to-urban migration has slowed, and populations in the villages have grown, with damaging consequences for forest condition, but there has been no net

return migration. The study results show that, on average, the populations of the study villages grew tremendously. However, the factors leading to this growth are not satisfactorily described by the hypothesis. Moreover, contrary to our hypothesis, there has been net return migration beginning in the 1993–97 period.

Between 1976 and 1987, the overall population of the study villages grew only 8.2% (0.75% per year), whereas in the period from 1987 to 1997, the growth was 45.5% (4.55% per year; see table 1). The village of Ngoulemakong, now accounting for one-fifth of all people in the data set, has a disproportionate influence on the recent period of growth and, in a way, distorts the finding. Ngoulemakong is now within the Yaoundé metropolitan area, and the tripling of its growth in the 1987–97 period owes much to the urbanization phenomenon. However, even if Ngoulemakong is removed from the calculation, the average rate of population growth in the remaining 37 villages in the 1987–97 period is 23.9% (2.39% per year). Note that the rate of population growth in this period is uneven and that in six of the villages the population declined. The average rate of population growth in the 1987–97 period of the 18 villages closest to Yaoundé (minus Ngoulemakong) was 29.5%; for the 19 villages far from Yaoundé, it was 19.0%. This shows there was a considerable population buildup even in the relatively forested areas away from Yaoundé.[35]

Much of the population growth in the villages results from in-migration of people not born in the villages. In 1974–75, a large proportion of all village inhabitants were born in the respective villages of the study.[36] In 1997, among the 24,565 people classified as members of the village households, 13,237 people (53.9%) were born in the villages, and 11,328 people (46.1%) were born outside the villages. The number of people born in the study villages (both household members and nonhousehold members) and enumerated in the surveys declined 5.4%, from 20,817 in 1974–75 to 19,685 in 1997.[37] (If we exclude Ngoulemakong, where the number of people born in the village and enumerated in the surveys rose 102.6% during this period, the decline is 11.3%.) A substantial portion of the inmigrants were born in the following departments close to Yaoundé: Mfoundi (17.9% of total), which is the department where Yaoundé is situated; and Lekié (11.8%), Mefou et Afamba (7.1%), and Nyong et So (4.7%), which are adjacent to Mfoundi.

The study results show that rural-to-urban migration has decreased and that migration to rural destinations has increased in recent years (fig. 2). During the period of the oil boom and growth of urban employment (mainly early to mid-1980s), we see a steep rise in migration to urban areas and a corresponding decrease in migration to rural destinations. The pattern is reversed after the onset of the crisis in 1986. Urban migration slows greatly in 1987–92 and then declines in 1992–97. The decline of migration to rural areas slows in 1987–92, and then migration to rural areas grows rapidly in 1992–97.

The study results show that there was net out-migration from the study villages in the 1978–92 period and net in-migration (return migration) in the 1993–97 period (fig. 3). It is interesting to note that the numbers of people

TABLE 1

CHANGE OF THE TOTAL POPULATION RESIDING IN THE 38 STUDY VILLAGES, 1961–97

Code	Village Name	ORSTOM 1961–67	RGPH 1976	RGPH 1987	CIFOR 1997	% Change 1976–87	% Change 1987–97
1.	Ngoulemakong	(1966) 820	959	2,024	6,170	111.1	204.8
2.	Messamendongo	(1965) 250	163	447	843	174.2	88.6
3.	Vian	(1965) 350	379	296	491	−21.9	65.9
4.	Meyo	(1965) 399	388	340	418	−12.4	22.9
5.	Ekiembié 1	(1965) 427	374	479	537	28.1	12.1
6.	Kala	(1966) 285	270	226	342	−16.3	51.3
7.	Mekoumbou I	(1966) 305	219	131	241	−40.2	84.0
8.	Ezezang Mendoum	(1967) 105	142	155	290	9.2	87.1
9.	Ekoumdouma	(1967) 502	586	886	1,210	51.2	36.6
10.	Nkolyem	(1967) 168	188	168	213	−10.6	26.8
11.	Nkolekono	(1966) 592	562*	530	470	−5.7	−11.3
12.	Adjap	(1963) 685	504	426	449	−15.5	5.4
13.	Nkoelon	(1966) 206	287	157	125	−45.3	−20.4
14.	Zamakoé	(1965) 747	699	815	803	16.6	−1.5
15.	Benebalot	(1965) 571	775	463	677	−40.3	46.2
16.	Olamndoé	(1965) 314	263	270	397	2.7	47.0
17.	Ndokoa	(1967) 87	53*	20	97	−62.3	385.0
18.	Simbane	(1967) 365	508	596	617	17.3	3.5
19.	Zengoaga	(1967) 128	192	249	283	29.7	13.7
20.	Ekok	(1961) 279	339	335	330	−1.2	−1.5
21.	Salla	(1961) 753	758	1,084	1171	43.0	8.0
22.	Akok-Maka	(1967) 431	450	476	564	5.8	18.5
23.	Kella	(1966) 424	549	806	884	46.8	9.7
24.	Assala 2	(1967) 879	1,018	1,047	1,096	2.8	4.7
25.	Poneck	(1967) 143	137	261	377	90.5	44.4
26.	Issandja	(1967) 209	503	383	719	−23.9	87.7
27.	Ndikitiek	(1967) 263	82	79	109	−3.7	38.0
28.	Mom I	(1967) 513	599	717	954	19.7	33.1
29.	Dingombi	(1967) 330	424	380	360	−10.4	−5.3
30.	Logbabem	(1967) 380	558	192	373	−65.6	94.3
31.	Nyouya	(1967) 351	345	247	266	−28.4	7.7
32.	Ekouk	(1967) 249	353	274	448	−22.4	63.5
33.	Yem-Essakoé	(1967) 125	58	98	148	69.0	51.0
34.	Nsimi	(1962) 419	413	473	623	14.5	31.7
35.	Biyi	(1967) 298	324	351	448	8.3	27.6
36.	Azem	(1962) 397	435	400	418	−8.0	4.5
37.	Akié	(1967) 503	462	388	357	−16.0	−8.0
38.	Kouambo	(1966) 344	298	241	292	−19.1	21.2
Total			15,616	16,910	24,610	8.3	45.5

NOTE.—ORSTOM = Office de la Recherche Scientifique et Technique d'Outre Mer; RGPH = Recensement Général de la Population et de L'Habitat; CIFOR = Center for International Forestry Research.

* For 1976, the populations of Nkolekono and Ndokoa are estimated.

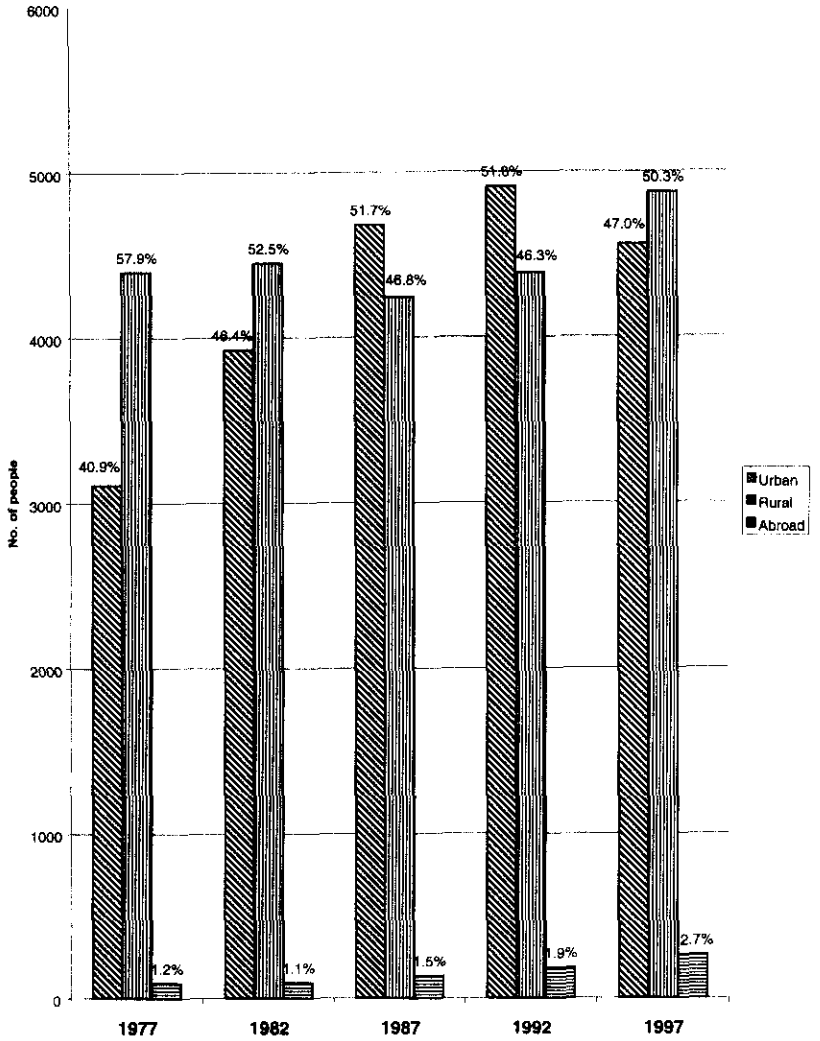


FIG. 2.—Places of residence in 1977, 1982, 1987, and 1997 of long-term migrants born in the 38 study villages.

migrating were relatively steady in all periods (between 1,157 and 1,338) but that return migration quadrupled from 353 in the 1978–82 period to 1,439 in the 1993–97 period. The number of "net in-migration" villages in the sequence of periods shows the abruptness of the change: none in 1978–82, one in 1983–87, five in 1988–92, and 25 in 1993–97.

Analysis was done to compare the livelihoods of adult villagers (ages 18 years and older) who had never migrated longer than 6 consecutive months (i.e., migrated "long-term") with villagers who had left the village and then

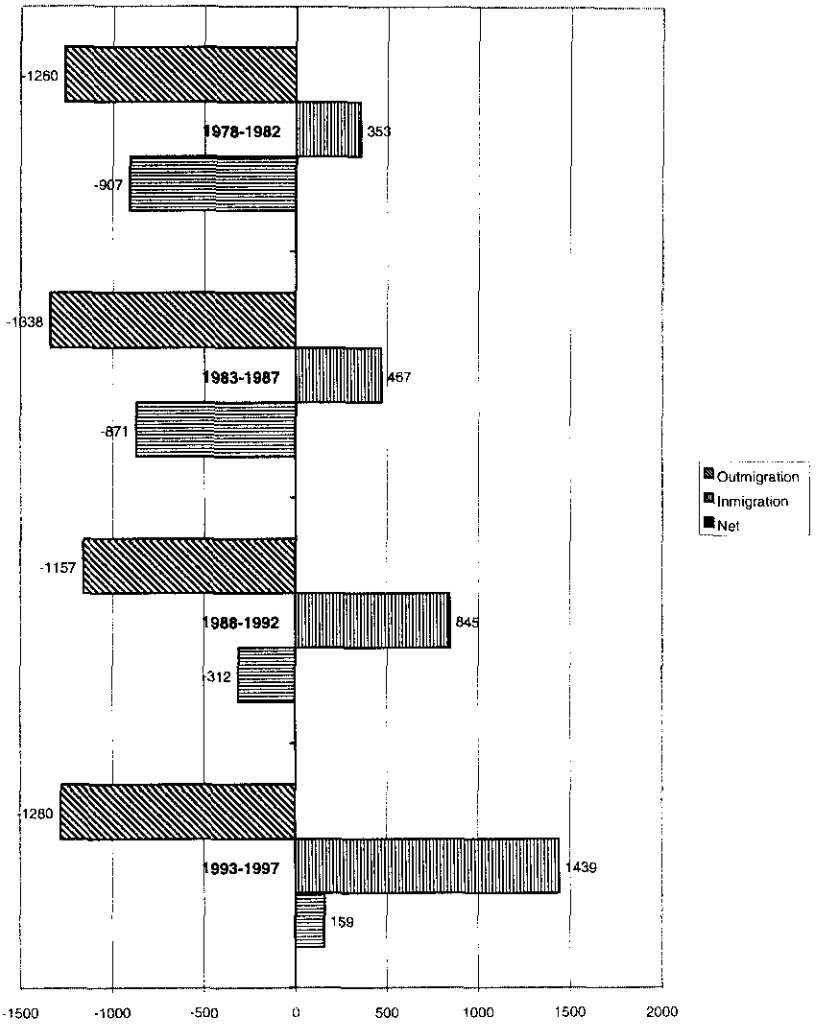


FIG. 3.—Number of out-migrations, in-migrations, and the net migration flow among long-term migrants born in the 38 study villages, 1978–97.

returned in the 1993–97 period. Among men, 51.6% of those who had never migrated long-term and 57.5% of recent return migrants were involved in agriculture. Among women, 60.5% of those who had never migrated long-term and 64.3% of recent return migrants were involved in agriculture.

It is important to note that the return migration observed in this study is not mainly a peri-urban phenomenon (where forest cover implications might be minimal). The proportion of return migrant households in the 1992–97 period (as a percentage of long-term migrant households) averaged 14.9% for

the 19 villages nearest Yaoundé and 14.3% for the 19 villages farthest from Yaoundé. Moreover, the forest cover consequences of return migration are important even for peri-urban villages near Yaoundé (with the exception of Ngoulemakong) because these villages are dominantly forested and rural. The proportion of crop-producing households in Ngoulemakong was 14% of the total, whereas the average for the other 18 villages near Yaoundé was 81%. The proportion of households clearing forest in Ngoulemakong in 1996 was 3%, whereas the average for the other 18 villages near Yaoundé was 28%.

In summary, on average, total population grew rapidly in the study villages in the last decade. There is reason to believe this has put additional pressure on forests because livelihoods are still overwhelmingly agricultural—especially in villages far from Yaoundé where forest cover is densest. The sources of population increase were in-migration rather than local growth. Sources of rural population growth were slowed urbanization, increased migration to rural destinations, and net "return" migration in recent years. Return migrants add pressure on forests not only through their numbers but also because they are somewhat more likely than nonmigrants to be involved in agriculture and because all villages except one are agricultural and forested.

Test of Hypothesis 2

The second hypothesis states: Between the years prior to the crisis and the present, the production of cocoa and coffee has stagnated, especially in terms of area increases. Farmers have compensated by increasing the production of food crops, especially by growing plantain, which is usually produced in primary forests.

This study result demonstrates that there has been a dramatic turn away from the production of plantation crops (cocoa and coffee) and toward food crops. In 1974–75, 83.7% of all heads of household were "planters" (producers of cocoa or coffee), 6.5% were "cultivators" (producers of food crops), 6.6% had other activities, and 3.2% were inactive (see table 2). In 1997, 27.1% of all heads of household were planters, 32.8% were cultivators, 34.2% had other activities, and 6.0% were inactive. If we remove Ngoulemakong (which accounts for much of the nonagricultural employment) from the 1997 calculation, 35.3% of all heads of household were planters, 40.5% were cultivators, 17.1% had other occupations, and 7.1% were inactive. Note that in 1974–75, the vast majority of planters had no other economic activity, whereas in 1997 most of those who remained as planters had additional sources of livelihood (table 2).

Analysis of the change of land area allocated to different crops over time tells much the same story but with certain important differences. Figure 4 shows that, on average, the area of cocoa has grown little since 1985. The area of coffee, however, has grown considerably, especially in the period from 1993 to 1997. But the growth of coffee lands is on a small base (approximately one-tenth of all households), so the impact on forest cover may not be that large.

TABLE 2

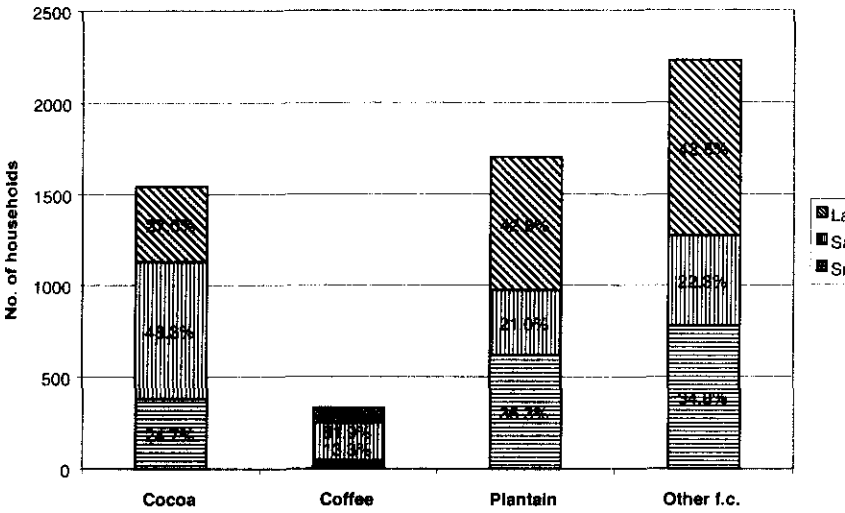
COMPARISON OF THE ACTIVITIES OF THE HEADS OF HOUSEHOLD IN THE 38 STUDY VILLAGES, 1974–75 AND 1997

	1974–75						1997					
	Without Other Activity		With Other Activity		Total		Without Other Activity		With Other Activity		Total	
PRINCIPAL ACTIVITY	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Planter	1,863	93.4	211	52.0	2,074	83.7	162	7.9	942	53.0	1,104	27.1
Cultivator	131	6.6	31	7.6	162	6.5	985	47.8	351	19.8	1,336	32.8
Other	...	...	164	40.4	164	6.6	912	44.3	483	27.2	1,395	34.2
Total economically active	1,994	100.0	406	100.0	2,400	96.8	2,059	100.0	1,776	100.0	3,835	94.0
Inactive	...	...	...	...	79	3.2	...	...	...	...	243	6.0
Total heads of household					2,479	100.0					4,078	100.0

SOURCES.—André Franqueville, *Une Afrique entre le village et la ville: Les migrations dans le sud du Cameroun* (Paris: Éditions de l'ORSTOM, 1987), p. 138; and Center for International Forestry Research (CIFOR) 1997 field research.

NOTE.—*N* = number.

A. "Was the area in 1993 of your cocoa / coffee / plantain / other food crop land larger / the same / or smaller than the area in 1985?"



B. Is the present area of your cocoa / coffee / plantain / other food crop land larger / the same / or smaller than the area in 1993?

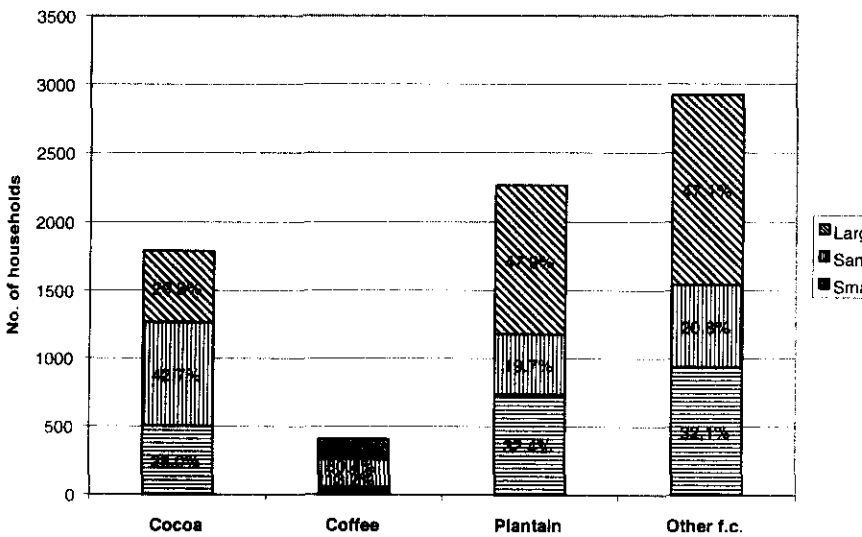


FIG. 4.—Change of land area dedicated to various crops: 1985 compared with 1993, and 1993 compared with 1997.

Why is it that the number of heads of household stating they are planters can drop so precipitously (table 2), yet we do not see a corresponding sharp decline of lands allocated to cocoa and coffee (fig. 4)? The answer is that large numbers of planters either stopped or limited their cocoa and coffee harvests, yet maintained their cocoa and coffee stands in the hope that, at some point in the future, the price would rise again and they could revive their former source of livelihood. This is the reason the area of cocoa and coffee lands remained the same for approximately half of all study households in 1985–93 and 1993–97 (fig. 4). This has strong implications for forest cover because, perforce, many farmers clearing land for production of food crops for the market would do so by clearing forest rather than by clearing their cocoa and coffee plots.

In contrast to the relative stability of cocoa and coffee areas, the areas of plantain and other foods crops are volatile. Notice that although the areas of plantain and other food crops increased in more than 40% of the households growing these crops since 1985, the areas of these crops also declined in more than 30% of the households (fig. 4). To understand the reasons for this volatility, we returned to all 38 villages and conducted a follow-up survey. In the villages close to Yaoundé, the main reason for the decline of plantain is the growing infertility of soils and lack of forests in which to establish plantain. (Plantain is often planted on freshly cleared forest land.) With the decline in soil fertility, farmers tend to turn to nonplantain food crops. In the villages far from Yaoundé, the principal reason given for the decline of plantain is the "aging" of the household and lack of household labor resulting from outmigration. This was also the main reason given for the decline of nonplantain food crops both near to, and far from, Yaoundé. Other reasons included lack of land for some households, soil infertility, inadequate means of transport and roads, weakness of demand and absence of markets, and destruction of crops by animals.

In the follow-up survey, we asked the respondents to name the crop in each village that contributed most to household income in the calendar year 1997. In 20 of the 38 villages, cocoa was the principal income earner, indicating that it enjoyed a modest revival through the effects of the 1994 currency devaluation. This revival is not necessarily indicated in crop area change (fig. 4) because much of increased production can come from formerly underutilized or idle cocoa plots. The second most important income-producing crop was cassava (principal crop in nine of the 38 villages). It is interesting to note that seven of these nine villages are close to Yaoundé, where soil fertility is on the decline. (Cassava is noted for its adaptability to low-fertility soils.) The respondents were asked to name the food crop that grew most rapidly in terms of area since 1993. The two principal crops were cassava (13 villages, or 34.2% of all villages) and cocoyam (seven villages, or 18.4% of all villages). Here again, it is noteworthy that nine of the 13 villages where cassava area was increasing rapidly are close to Yaoundé.

Table 3 (based on the initial household survey data) summarizes some of

TABLE 3

INCREASE OR DECREASE IN THE AREA OF LAND DEDICATED TO PLANTAIN OR OTHER FOOD CROPS IN THE 38 STUDY VILLAGES IN THE 1993–97 PERIOD, AS A FUNCTION OF DISTANCE FROM YAOUNDÉ (Near or Far)

VILLAGE	PLANTAIN		OTHER FOOD CROPS	
	Increase	Decrease	Increase	Decrease
Near to Yaoundé:				
1. Ngoulemakong	...	X	...	X
2. Messamendongo	...	X	X	...
3. Vian et Lobe	X	...	X	...
4. Meyo	X	...	...	X
5. Ekiembie I	...	X	X	...
6. Kala	...	X	X	...
7. Mekoumbou I	...	X	...	X
8. Ezezang Mendoum	...	X	...	XX
9. Ekoumdouma	...	X	...	X
10. Nkolyem	...	X	X	...
11. Nkolekono	X	...	X	...
12. Adjap	Same	Same	...	X
13. Nkoelon	X	...	X	...
14. Zamakoe	X	...	X	...
15. Benebalot	XX	...	X	...
16. Olamndoe	X	...	X	...
17. Ndokoa	Same	Same	Same	Same
20. Ekok	XX	...	XX	...
28. Mom I	XX	...	X	...
Far from Yaoundé:				
18. Simbane	X	...	X	...
19. Zengoaga	X	...	X	...
21. Salla	XX	...	X	...
22. Akok-Maka	XX	...	XX	...
23. Kella	XX	...	XX	...
24. Assala II	XX	...	XX	...
25. Poneck	XX	...	XX	...
26. Issandja	...	X	...	X
27. Ndikitiek	XX	...	XX	...
29. Dingombi	X	...	X	...
30. Logbabem	X	...	XX	...
31. Nyouya	...	X	X	...
32. Ekouk	XX	...	XX	...
33. Yem-Essakoe	XX	...	XX	...
34. Nsimi	X	...	X	...
35. Biyi et Mbe-eto	XX	...	XX	...
36. Azem	Same	Same	...	X
37. Akie	XX	...	XX	...
38. Kouambo	XX	...	...	XX

NOTE.—X = The difference between area increase and area decrease is less than a factor of two. XX = The difference between area increase and area decrease is more than a factor of two.

the overall tendencies of changes in food crop area with respect to distance from Yaoundé. Note that, broadly speaking, the volatility of food crop area occurs mainly in villages near to Yaoundé, whereas there is a tendency toward more rapid growth of food crop area in the villages far from Yaoundé (table 3).

Our hypothesis was generally confirmed, but we did not anticipate the tendency toward growth of coffee area. There is one other departure from our hypothesis. It is true that plantain is generally established in forests but not necessarily in primary forests. Our results show that in 1996, among households that produced only plantain and other food crops, 58% cleared primary forests.[38] Among those households that produced only cocoa and nonplantain food crops, 62% cleared primary forests, and among those that produced only nonplantain food crops, 51% cleared primary forests. Although more research must be done to make this finding conclusive, it appears that plantain does not necessarily stand out among crops leading to the conversion of primary forests.

Test of Hypothesis 3

The third hypothesis states: "The collapse of plantation crop prices has led to growing participation by men in the production of food crops. Although the gender division of labor has been strong (i.e., in the past, men produced almost exclusively cocoa and coffee, and women, food crops), it has weakened as a consequence of the urgent need to increase household income."

A strong gender division of labor has given way to a flexible division in the face of economic necessity. We have seen in table 2 that heads of household living in the study villages (78.9% of whom are men) greatly increased their involvement in the production of food crops since 1974–75. However, men's increased involvement in the production of food crops has not altered women's dominance in this area of production. A comparison of the principal activities of adult men and adult women (aged 18 years and older) shows that 64.5% of women and 23.3% of men are involved in food crop production. In absolute numbers, women outnumber men more than three to one in food crop production.

Regression Analysis of Factors Influencing Forest Cover Change

Linear multiple regression was used to understand factors influencing forest clearing at the village level. Three dependent variable measures were applied: (1) the percentage of all village households clearing forest land in 1996 (labeled FCR1), (2) the average area of forest land cleared in 1996 in each village (FCR2), and (3) a "forest clearance index" (FCRIN1) that is the product of the first and second measures (table 4).

The village is used as the unit of analysis in order to understand a wide variation in village-level scores observed in the course of preliminary analysis. The proportion of village households clearing forest land in 1996 ranges from a low of 2.2% (Mekoumbou I) to a high of 70.1% (Biyi et Mbe-Eto). The proportion of households clearing forest land in 1996 was far lower in the

19 villages closest to Yaoundé (18.6%) than it was in the 19 villages farthest from Yaoundé (38.9%). The average area of forest land cleared per household varies from a low of 0.67 hectares (Messamendongo) to a high of 2.58 hectares (Vian et Lobe). Interestingly, the average area of forest land cleared in 1996 was higher in the 19 villages closest to Yaoundé (1.55 hectares) and lower in the 19 villages farthest from Yaoundé (1.31 hectares).

The independent variables were (1) the percent change of total village population between 1987 and 1997, (2) the average household size, (3) the village population density, (4) the ratio of 1993–97 return migrants to all long-term migrants born in village, (5) the percentage of village cocoa growers expanding cocoa land in 1993–97, (6) the percentage of village coffee growers expanding coffee land in 1993–97, (7) the percentage of village plantain growers expanding plantain land in 1993–97, (8) the percentage of village "other" food crop growers expanding "other" food crop land in 1993–97, (9) the percentage of all village households clearing fields with a chainsaw in 1996, (10) the estimated distance in kilometers to travel from the village to Yaoundé, (11) the proportion of village timber concession area exploited since 1993, (12) the distance from the village to the closest paved road, and (13) the percentage of all households who had bought or used fertilizers since 1993.

All three calculations (FCR1, FCR2, and FCRIN1) used backward regression, and the regression models selected for display were those that maximized the value for adjusted R^2. Scores discussed here are those with a t value that exceeds two and that are significant at the .05 level. Variables for which no values are shown are those that were removed in the course of the backward regression analysis.

The results show that there is a strong and positive association between the variable "percentage of nonplantain food crop growers expanding nonplantain food crop land in 1993–97," on the one hand, and the percentage of households clearing forest land in 1996 (FCR1) and the index of forest cover change in 1996 (FCRIN1), on the other hand. Note, however, that there is a negative association between this variable and the average area of forest cleared in 1996 (FCR2).[19] The variable "percentage of plantain growers expanding plantain land, 1993–97" shows a strong and positive association with the average area cleared per household in 1996 (FCR2).

The variable "average household size" shows a negative and significant correlation with FCR2. It is possible that this reflects the fact that the heads of household in households new to farming in the study villages since 1993 are significantly younger than those who have been farming in the villages since 1993 or before. These new entrants cleared more land (1.65 hectares) than established farmers (1.37 hectares) in 1996, though the difference is not statistically significant. But this assumption is inconclusive because analysis on the basis of household data shows a positive association between size of household and area of forest cleared, and there is no significant correlation between household size and the age of the head of household.

TABLE 4

REGRESSION ANALYSIS OF FOREST CLEARING IN 1996 WITH VILLAGE AS UNIT OF ANALYSIS

VARIABLE	FCR1 % OF HOUSEHOLDS CLEARING FOREST LAND IN 1996		FCR2 AVERAGE AREA (in ha) CLEARED PER HOUSEHOLD IN 1996		FCRIN1 (FCR1 × FCR2)	
	B Coef.	*t*-Statistic	B Coef.	*t*-Statistic	B Coef.	*t*-Statistic
(Constant)	4.080	.274	2.720	5.224	58.347	2.072
Village total population change, 1987–97	...	...	−.002	−1.595	−.064	−1.060
Average household size	−2.916	−1.411	−.189**	−2.412**	−6.971	−1.650
Population density	...	...	.001	1.043	...	...
Ratio of 1993–97 return of migrants to all long-term migrants born in village	.667	1.242	...	...	1.250	1.267
% cocoa growers expanding cocoa land, 1993–97	...	...	...	...	−.442	−1.483
% coffee growers expanding coffee land, 1993–97	...	...	−.010	−1.098	−.728	−1.523
% plantain growers expanding plantain land, 1993–97	...	...	.019**	2.327**	...	...

% nonplantain food crop growers expanding nonplantain food crop land, 1993–97	.669**	4.405**	−.010	−1.368	−1.351**	3.981**
% of all households clearing fields with a chainsaw in 1996	...	...	...	...	−.155	−1.009
Distance of village to Yaoundé	.101**	2.982**	−.003**	−2.174**	...	...
Proportion of village timber concessions exploited since 1993	...	...	...	...	...	...
Distance from village to closest paved road	...	...	...	...	...	...
% of all households having bought or used fertilizers since 1993	...	...	...	...	−12.321*	−1.814*

	Model Summary				ANOVA	
	R	R^2	Adjusted R^2	Standard Error of Estimate	F	Significance
Dependent variable:						
FCR1	.741	.549	.492	12.958	9.721	.000
FCR2	.581	.338	.173	.434	2.043	.085
FCRIN1	.722	.521	.379	22.314	3.670	.005

* = Significant at the .10 level.
** = Significant at the .05 level.

Finally, the variable "distance of the village to Yaoundé" is positively and significantly associated with the percentage of households clearing land in 1996 (FCR1) and negatively and significantly associated with the average area of forest land cleared per household in 1996 (FCR2). These results are expected, given the relatively high percentage of households clearing land far from Yaoundé and the relatively high average area of land cleared per household near to Yaoundé, as explained earlier.

IV. Discussion

The discussion of the three hypotheses above does not encompass all relevant aspects of the explanation of increased net deforestation. The following aims to round out our understanding of the circumstances contributing to increased forest cover loss. There are seven facts, some of which emerge from the 38-village study and others from the literature, that jointly explain the higher rate of deforestation in the crisis period. (1) The population of the villages in these provinces is now, on average, substantially larger than it was in the prior period. (2) There are now more heads of household involved in agriculture than in 1974–75 despite the fact that agricultural occupations have declined as a proportion of the total (see table 4). (3) The demand for national food crop production has been boosted by a decline of food imports in the period of the crisis.[40] (4) With declining prices for tree crops and increased demand for food crops, small farmers reduced their cocoa and coffee harvests and increased production of food crops for the market. (5) Food crops imply increased forest cover loss not only because they generally require more sunlight compared with tree crops but also because they require fallow land, whereas tree crops do not.[41] (6) The degree of intensification of plantation agriculture has declined because of the elimination of generous government input subsidies for fertilizers and pesticides since the oil boom period.[42] (7) Logging was accelerated after the currency devaluation, and particularly in the East province—a process that has tended to facilitate migration, colonization, and clearing of agricultural lands.[43]

As noted earlier, the rate of net deforestation increased significantly in the 10 years after the onset of the economic crisis as compared with that of the 10-year period prior to the crisis. We conclude that this increased net deforestation is largely attributable to the crisis-induced changes shown above, that is, increased rural population, the change from tree to food crops, and changes in the gender division of labor at the household level. How is it possible to conclude confidently that increased forest cover loss results mainly from crisis-induced factors rather than from factors that either predate the crisis or are otherwise unrelated to the crisis? It is impossible to distinguish crisis and noncrisis factors through empirical analysis. Our conclusion is based on the following three linked insights. First, small farmers are clearly the most important agents of forest cover change in the villages studied.[44] Second, there is no competing lead explanation for increased forest cover loss during the crisis other than the combined effect of more small farmers and increased

average clearing at the household level resulting from the turn to food crops. Third, there is no plausible rival explanation for the observed population increase and the turn to food crops at the village level other than the crisis and policies in response to the crisis.

But is it not possible that overall national population growth—a trend that predates the crisis—contributed to increased net deforestation? Certainly this is possible. However, our research shows that it is important to view population as an intermediate variable, strongly influenced by macroeconomic events, rather than purely as an independent variable operating through a logic of its own. Recall that rural population growth was low during the oil boom, prior to the economic crisis, when urban employment possibilities were good and when rural-urban migration rates where high. With the onset of the crisis, urban employment possibilities deteriorated, rural-urban migration slowed, and migration to the villages increased. Likewise, it is evident that crop selection and labor allocation at the household level are appropriately viewed in this study as intermediate variables.

We are not saying that economic crisis necessarily leads to increased tropical deforestation. High rates of deforestation are also evident in countries experiencing strong economic growth, for example, in Indonesia from the mid-1970s through the mid-1990s, when average annual GDP growth exceeded 6%. The Cameroon case study shows that, under particular circumstances, economic crisis and follow-up adjustment policies can significantly accelerate the process of deforestation.

We elaborate on our finding of higher overall rates of forest clearing in the 1986–97 period by interpreting them within the context of survey, case study, and modeling research done in southern Cameroon in the 1986–97 period. Drawing on this literature, we are also able to reach a more nuanced understanding of some of the phenomena observed.

A substantial "jump" in forest clearing probably occurred in 1991–93, that is, after the 1990 slashing of plantation crop producer prices and input subsidies and before the 1994 devaluation began to make plantation crop prices attractive again. One of the reasons for this probable jump in forest clearing is that much of the expansion of food crop production took place in freshly cleared forest lands rather than on lands formerly used for cocoa and coffee production. As pointed out by Courade, some commentators reached the hasty and false conclusion that cocoa, coffee, and cotton would disappear and would be replaced by food crops.[45] There were ample reasons for assuming that cocoa production was moribund, among them, the fact that yields had been exceptionally low in the Center and South provinces and the fact that the average age of cocoa stands in these provinces is high.[46] However, even in the depths of the crisis, cocoa farmers viewed regeneration and replanting of their stands as essential.[47] Other reasons for the tenacity of old cocoa stands are that local customs dictated that inherited orchards should not be cut down, whatever their age, and that maintenance of the stands did not require significant investment.[48] Moreover, surveys showed that most farmers were will-

ing to increase their area of cocoa production, even with the sharp decline of producer prices, in order to compensate for the lost value of cocoa.[49] Bruno Losch says that efficient and dynamic production of plantation crops in Cameroon has been impeded historically by various factors, among them the oil boom and subsequent rural-to-urban migration and labor shortages.[50] With the disappearance of these factors, there is reason to believe the cocoa and coffee production will increase if prices remain stable.

Another reason for a probable burst of forest clearing activity in the 1991–93 period was that, with the collapse of cocoa and coffee prices, plantain suddenly became important for household income. As mentioned earlier, plantain tends to be established in freshly cleared forest lands, whether primary or secondary. Ludovic Temple, J. Chataigner, and F. Kamajou found that a gradual decline in consumption of plantain at the national level is explained by the inability to create systems of peri-urban plantain production.[51] Precisely because of the difficulties in maintaining peri-urban plantain production (see table 3), plantain production will take place farther and farther from urban areas where there are more forests to clear and more fertile soils.

It is tempting to suppose that with the revival of cocoa and coffee production since 1994, dependence on food crop production will decline and there will be a corresponding decline in forest-clearing activities. Several facts should caution us against assuming that such a trend would be evident soon. First and foremost, Cameroon plantation crop farmers have shown themselves to be risk averse by maintaining their stands when plantation crop prices plummeted, and there is every reason to believe they will maintain a diversity of income sources as a hedge against unstable international commodity prices. Second, an ample labor supply (facilitated by local population growth, in-migration, and return migration) and a more flexible gender division of labor make crop diversification more possible. Third, field research has shown that whereas cocoa and food crop production compete with one another near cities, they tend to be complementary at the forest margin; moreover, in the Center province, unlike in the Southwest province, a higher cocoa price and intensification do not take women away from food crop production.[52]

V. Conclusion

Field research done by the Center for International Forestry Research (CIFOR) in 1997–98 provides the first regionally representative assessment of population and migration patterns, changes in cropping decisions, and household farm labor allocation in more than a decade in Cameroon's Center and South provinces. On the basis of these data, we conclude that in the period from 1986 to 1997 there was, overall, a substantial increase in the rate of forest clearing.

We agree with the conventional wisdom that population and smallholder agriculture are important in any explanation of forest cover change in Cameroon and Central Africa. However, we part company with most observers in pointing out that, in certain circumstances, changes in population and smallholder agriculture, and the gender division of labor as well, are best viewed

as intermediate variables and not as fundamental causes. Our research demonstrates that macroeconomic conditions can have an important role in determining the way that population, agriculture, and labor roles affect forest-clearing activities. In the precrisis era, macroeconomic conditions affected these variables in such a way as to alleviate pressure on forests; after the onset of the crisis, macroeconomic conditions affected these variables in such a way as to increase pressure on forests. The main implication of our finding is that any policy change that aims to address seriously the problem of inappropriate and excessive deforestation must look not only at the range of factors that are known to influence forest cover loss (growth of smallholder and plantation agriculture, commercial logging, construction of roads, etc.) but also at macroeconomic events and policies that can have an important influence on how these factors exert their effects on tropical forest cover.

Notes

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27. Gubry and Lamlenn.

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29. Heidhues et al. (n. 19 above); and James Gockowski, Blaise Nkamleu, and John Wendt, "Implications of Resource Use Intensification for the Environment and Sustainable Technology Systems in the Central African Rainforest" (unpublished manuscript, International Institute for Tropical Agriculture, Humid Forest Station, Yaoundé, Cameroon, 1998).

30. Heidhues et al.

31. André Franqueville, *Une Afrique entre le village et la ville: Les migrations dans le sud du Cameroun* (Africa between village and city: Migration in southern Cameroon) (Paris: Éditions de l'ORSTOM, 1987).

32. MINEF/PNUD/Banque Mondiale, *Plan national de gestion de l'environnement au Cameroun* (National environmental management plan for Cameroon), vol. 1 (Yaoundé: Ministère de l'Environnment et des Forêts, 1996); Jacques W. K. Pokam, "Les migrations dans la zone forêt humide du Cameroun" (Migration in the humid forest zone of Cameroon) (unpublished manuscript, Center for International Forestry Research, Yaoundé, Cameroon, 1996).

33. The survey did not enumerate half brothers or sisters—that is to say, those who were not offspring of the same set of parents as the head of household.

34. The study defined a "forest field" (*champ de forêt*) as one that could be created or enlarged in either a primary or secondary regrowth forest but not in a plantation crop orchard or in a *chromolaena* fallow field.

35. This rate of growth is less than the 2.9% average annual population growth rate observed at the national level in the 1976 and 1987 censuses.

36. Franqueville recalls that approximately 10% of male inhabitants and a somewhat larger proportion of female inhabitants in the 38 study villages were born outside the study villages. Personal communication with André Franqueville, July 22, 1998.

37. Franqueville.

38. For purposes of making the best possible comparison, it was not possible to isolate those that produce "only plantain," "only coffee," or "only cocoa" because almost all households grow nonplantain food crops.

39. This is principally because those 91 farmers not growing nonplantain food crops since 1993 have an unusually high (1.7 hectares) average rate of land clearing in 1996.

40. Ndoye and Kaimowitz (see n. 25 above).

41. Ibid.

42. The results of a 54-village farming systems survey by CIFOR show the following changes in the proportions of all households using the following agricultural inputs: insecticides declined from 42% to 20%, fungicides declined from 82% to 72%, chemical fertilizers declined from 8% to 5%, and herbicides declined from 5% to 3%.

43. Richard Eba'a-Atyi, "Cameroon's Logging Industry: Structure, Economic Importance, and Effects of Devaluation," Occasional Paper no. 14 (Center for International Forestry Research, Bogor, Indonesia, 1998).

44. Logging is selective in Cameroon and results most often in degradation rather than wholesale forest cover removal. Historically it has been an important indirect cause of deforestation, mainly through facilitating colonization of forested areas. The pace of logging has declined in the Center and South provinces and has increased in the more densely forested East province. Only eight of the 38 study villages had active logging concessions. Establishment of agricultural plantations accounts for a relatively small portion of forest cover removal in the Center and South provinces.

45. Courade (see n. 16 above).

46. Bruno Losch, "Cacaos Africains: Comment la Côte d'Ivoire a devancé le Cameroun" (African Cacao: How the Ivory Coast was able to get ahead of Cameroon) *Plantations, recherche, développement* 1, no. 2 (1994): 15–22; Ludovic Temple and Andréa Fadani, "Cultures d'exportation et cultures vivrières au Cameroun" (Export crops and food crops in Cameroon), *Économie rurale* 239 (1997): 40–48.

47. Alary, Courade, and Janin (see n. 13 above).

48. Ibid.

49. Ibid.

50. Losch.

51. L. Temple, J. Chataigner, and F. Kamajou, "Le marché du plantain au Cameroun, des dynamiques de l'offre au fonctionnement du système de commercialisation" (The market for plantain in Cameroon and the dynamics of supply in the marketing system), *Fruits* 51 (1996): 83–98.

52. Temple and Fadani.