Shifting Cultivation and Deforestation:

questioning the dominant narrative in tropical Africa

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Introduction

When a narrative gets repeated often enough, it attains the status of 'truth' in peoples' minds. Most of the scientific community as well as policy experts, international research organizations and NGOs seem to accept a particular narrative about the relationship between shifting cultivation[1] and deforestation. It has been presented in so many papers and policy documents that its basic assumptions seem by now to be taken for granted. In this paper, I analyze the various themes within this narrative and evaluate the evidence behind each one.

The following quotations exemplify the commonly held view:

> The traditional system of shifting cultivation in the humid zone was successful as long as there was sufficient land for farmers to leave the soil to rest under naturally regenerating forest for periods in excess of a decade…. As demographic pressure has increased and more and more people have been forced to seek land in the forested areas, traditional systems have been replaced by crude slash-and-burn, in which the cultivation period is prolonged and the forest regeneration is endangered and is inadequate to maintain fertility. The net result is deforestation with its various undesirable consequences. (Sivakumar and Valentin, 1997, p. 912)

> The food crop production system (in West and Central Africa) is based on the practice of slash-and-burn farming, which, due to population pressure and reduced fallow cycle, is no longer sustainable. (Duguma, B. and J. Gockowski, and J. Bakala , 2001, p.177)

> Slash-and-burn agriculture as practiced by indigenous people in non-market settings does not result in large-scale environmental damage…But today slash-and-burn agriculture has lost its innocence. Population growth, transportation networks and market forces have intensified along contiguous margins…The 'ideal' slash-and-burn, where discrete patches

[1] [1] The terms shifting cultivation, slash and burn agriculture, and swidden agriculture are often used interchangeably in the literature. (Brady, 1996; Gilruth et al., 1995; O'Brien, 2002; Kleinman et al., 1995)

> of forest are incompletely cleared for short-term cultivation followed by succession to mature secondary forests is no longer operative. (Koto-Same, J., P. Woomer, M. Appolinaire, Z. Louis, 1997, p.246)

There is a striking similarity among these descriptions almost to the point of repetitiveness. They are presented here because they are representative of many papers written by natural scientists and policy 'experts' about shifting cultivation.[2]

There are several themes embodied in the quotations presented above which seem to have achieved the status of accepted wisdom. First, there appears to be one practice called 'shifting cultivation' with no differentiation. Second, although shifting cultivation sometime in its mythic past was sustainable, it is currently unsustainable. Third, the main indicator of this descent into 'unsustainability' is a decline in fallow lengths. And finally, the result of this 'breakdown' is deforestation. It is these themes and their general acceptance that I wish to analyze in this chapter. While most of the citations deal with shifting cultivation as practiced in tropical countries in general, I will focus my analysis on shifting cultivation in West and Central Africa.

I wish to make clear at the outset that while this paper is critical of the overall picture presented in many papers, it is not arguing that the actual scientific studies done are themselves flawed. Instead, I am evaluating the evidence linking those rigorous scientific studies with the larger narrative. The main thrust of my argument is that the results reported in many of these studies fail to provide convincing evidence of the strong statements that have been extrapolated from them and at times even provide evidence which contradict such statements.

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[2] Sivakumar is an agricultural meteorologist; Valentin is a soil scientist; Duguma is a biologist; Gockowski is an economist; Bakala is a botanist; Woomer is a soil biologist; and, Zapfack is a botanist.

Theme #1 – Shifting cultivation is 'the same'

A. Differences in practice

According to Brookfield and Padoch (1994), "(s)hifting cultivation is not one system but hundreds or thousands of systems."[3] (p. 7) Ruthenberg (1980) claims that "(t)he forms assumed by shifting cultivation are more varied than in practically any other land-use system." (p. 31) Shifting cultivation, according to Ruthenberg can be classified by how it fits into the following systems: vegetation, migration, rotation, clearance, cropping, and tool. (p.31-38) Thus, a particular practice will be distinguished by, for example, whether it is practiced in a forest or savanna; whether the cultivators are sedentary, recent migrants, or cyclical migrants; whether they clear the bush by fire, cutting, or ringing; the types of crops they plant; and, whether or not they hoe after the burn. Even within microclimatic regions where the same types of crops are planted with the same physical techniques, practices can differ by crop sequences, crop associations, crop rotation lengths, fallow management, burn intensity, burn timing, and the percentage and types of trees that are left standing**.**

More than three decades ago, in a study of agricultural practices in the Congo Basin, Miracle (1967) cautioned those who would refer to 'shifting cultivation' as a single process even within the region of the Congo Basin:

> ….the Congo Basin is a large and striking exception to such generalizations, with cultivation methods ranging from the simple slash, burn, plant technique to more intensive systems involving hoeing, and still more intensive ones characterized by use of specially produced ash fertilizers, composting, application of animal manures, irrigation, or

[3] Not everybody subscribes to the 'dominant narrative.' There have been voices questioning some of its assumptions over the last few decades from various disciplines. The point I am making is that these arguments and findings do not appear to have been incorporated into the conventional wisdom.

> terracing, some of which are very close to permanent field agriculture. *But even within the less intensive types of cultivation, in which there is no attempt to alter the decline of soil fertility through human effort – the classic long-fallow systems – cultivation methods vary greatly in intensity even within a single vegetation zone. Indeed, diversity appears to be the outstanding characteristic of shifting cultivation in the Congo Basin*. (emphasis added, p. 170)

And yet over and over again, as the citations at the beginning of this chapter illustrate, we see scientists and policy experts making generalizations about the practice of 'shifting cultivation' not only in specific regions such as the Congo Basin, but all over the world.

B. Differences in effect

Not only do practices differ, but the same practices will have different environmental impacts depending upon: soil type, clay content[4], soil quality, pH level, and land use history. According to Kleinman et al. (1995), "Inherent soil characteristics define the magnitude and quality of degradation that may occur as well as the potential productivity of low-input agroecosystems." (p. 243) They cite a claim by Andriesse (1980) "that the natural variability within one specific soil series may be greater than differences in nutrient level caused by the bush/fallow stage." (p. 243)

And according to Szott et al. (1999), "(w)ithin a climatic regime, fallow growth can vary greatly as a result of interactions among vegetation, soil, and management." (p. 165) A study by Mapa and Kumaragamage (1996) shows that different soil characteristics can vary widely even within the same immediate area: "(d)ifferences may be attributed to the previous management practice of shifting cultivation or due to natural variation in soil formation." (p. 194)

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[4] Palm et al. (1996), for example, claim that "clayier soils in general retain a higher percentage of organic inputs." (p.67)

This potential variability in ecological impacts should prevent researchers from extrapolating the results of particular case studies to make claims about the impacts of shifting cultivation in general. It should also alert us to be suspicious when researchers use a particular fallow length threshold as an indicator of sustainability for shifting cultivation practices in general.

Theme #2 – Mythic past

If one examines the historical record, it seems that a sense of imminent disaster has been pervading accounts of shifting cultivation in Africa for at least the last 80 years. Early accounts during the colonial era attributed the coming crisis to the ignorance and irrationality of the African farmer. Shantz and Marbut (1923): called the native farmer 'the greatest enemy of the forest," and believed that shifting cultivation was resulting in the loss of millions of hectares of forest.

Unwin (1920) recommended that shifting cultivators be excluded from forested areas:

> A child is not allowed to play with fire, although it may like to see the flames; in the same way…[the local administration]… cannot allow the inhabitants … to play fast and loose with their priceless treasures, the African forest, well knowing that the country will be permanently injured thereby." (cited in Williams, p. 402)

Jacks and Whyte (1939) lamented that

> …the African has no instinctive love for land as such, at all comparable to the European….until they develop a greater love of, and establish a 'symbiotic relationship' to the land they will not willingly hold or cultivate it in order to conserve it. It remains to be seen how far and how quickly the native can be educated to love the land and whether coercion, which in some degree is inevitable, will promote the education. (p. 257-8)

They argued that "…shifting cultivation, the sign of man's subordination to the vegetation, has become a principal cause of soil exhaustion and erosion in Africa…" (p. 249)

The following example from Sierra Leone shows the continuity of the narrative linking shifting cultivation and deforestation from colonial to modern times. In 1924, in a report to the British Empire Forestry Conference, on the status of Sierra Leone's forests, Thomas claimed that

> the 'primeval forest' is now almost disappearing. The native peoples have had a greater opportunity of multiplying and of devoting themselves to agriculture. Within a lifetime they have cleared up to about 90 percent of the virgin forests by their system of shifting cultivation…There are evidences that at no remote period the whole country was covered with dense high forest. (cited in Fairhead and Leach, 2000a, p. 73)

If that had been the case, then the forests would have had to coexist with shifting cultivators in that 'not remote period' since historians have shown that "Sierra Leone has been relatively populous, with shifting cultivators growing rice, fonio, and other crops on uplands, for many centuries." (Fairhead & Leach, 2000a, p.77)

In fact, however, a report written by a forester sent by the British government to assess Sierra Leone's forest resources in 1909 claimed that "**(p)robably in the earliest times** the whole territory was covered with some kind of aborescent growth, varying from open savannah and deciduous forest to close, impenetrable evergreen rain forest. Now scarcely 1 per cent of this forest remains…" (emphasis added, Unwin, 1920, p. 25) Thus the idea of how much forest actually once existed was completely conjectural with no basis in fact. Even these conjectural estimates, however, were far from claiming that at any point in the past 'the whole country was covered with dense high forest.'

Unwin (1920) estimated that the forested area of Sierra Leone in his day was about 48 square miles (12,432 ha). Despite this, as Fairhead and Leach (2000a) note, several researchers in modern times have suggested that Sierra Leone has lost huge tracts of forest since the second world war. They cite a claim by Myers (1980) that "… 'as much as 5,000,000 ha may still have featured little disturbed forest as recently as the end of World War II.'" (in Fairhead and Leach, 2000a, p. 74) The narrative of recent forest loss appears to have continued from the colonial period to modern times.

In more recent times, the looming environmental crisis that some foresee as a result of shifting cultivation is no longer thought to arise from ignorance (or at least not explicitly) but as a result of outside forces driving the shifting cultivator to desperate measures. The shifting cultivator is the classic 'victim' in this scenario:

> …the main causes of deforestation, viz. the commercial logger, the cattle rancher, and the smallscale farmer. The third appears to account for much more deforestation than the other two combined, while being far less 'blameworthy'. In his main manifestation of shifted (displaced) cultivator, the smallscale farmer is subject to a host of forces – population pressures, pervasive poverty, maldistribution of traditional farmlands, inequitable land tenure systems, inadequate attention to subsistence agriculture, adverse aid and trade patterns, and international debt – that he is little able to comprehend, let alone control…Without an integrated effort of sufficient scope, there is every prospect that we shall witness the demise of moist tropical forests within another few decades." (Myers, 1989, p. 4)

A common theme in most of the current literature on shifting cultivation is that the practice was 'once' sustainable. This sustainable practice is often described as 'traditional shifting cultivation' or as that practiced by 'indigenous populations' or when practiced at 'low population densities' or 'in non-market settings'. (Kotto Same et al., 1998; Szott et. al., 1999; Brady, 1996; Sivakumar and Valentin, 1997; Juo and Manu, 1996) In none of the articles cited above is there an actual date or period cited when the practice was sustainable. The issue is made even murkier since foresters and scientists in the early part of the century claimed that the practice was unsustainable in their day (see quotations above). Implicit in these unsubstantiated references to an earlier 'innocence', there lurks what Slater (1996) refers to as a 'quasi-Edenic' narrative. These stories "…highlight nostalgia for a perfect past or deep fears about continuing loss." (p. 116)

According to Williams,

> Nearly all the world's tropical forests were inhabited from earliest times. Not surprisingly, the descendants of the first dwellers wrought major changes in their surroundings, especially after the introduction of steel axes. And yet the idea has grown, especially in recent decades, that the tropical forests were barely touched in extent and composition before the coming of the Europeans because the native peoples were 'ecologically noble savages' who lived in perfect harmony and balance with their surroundings. (p. 336)

In fact, for many Westerners, the idea of African history usually begins with the arrival of the Europeans. (Isichei, 1997) In reality, the history of African ecological-human interactions is longer than anywhere else in the world[5] and the least understood because of archaeological difficulties[6] as well as the absence of a written tradition in most areas. Recent advances in archaeological palynology,[7] however, are turning up new evidence about this long interaction in West and Central Africa. White (2001) finds, for example, that the savannas in the Congo have been shown to have opened up from about 3000 B.P. "…suggesting that a combination of a dry Holocene climatic phase, poor soils, and human fires resulted in forest degradation and the opening of grasslands since maintained by fire."(p. 17) The forests of central Gabon " … seem to date to about 1,400 B.P., when

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[6] This is particularly the case for West and Central Africa because "high rainfall areas generally preserve little or no fossil material..." (Clark, 1988, p. 68)

[7] Palynology is the study of microscopic decay-resistant remnants of plants and animals.

human populations crashed and, in the absence of (anthropic) fire, forest colonized grasslands." White cites findings from researchers in other central African countries which confirms a widespread population crash leading to the creation of some of the areas that are thought of today as 'pristine' forest that represent the 'natural' vegetation:

> Given the tens of thousands of palm nuts and the extent of their distribution, Fay concludes that much of northern Congo, southeast Cameroon, and southwest Central African Republic was cultivated up to about 1,600 B.P. It seems that a population crash … resulted in widespread forest regeneration, although further archaeological exploration is needed to confirm this hypothesis. Similar results have been obtained in southwest Cameroon where *Elaeis guineensis* (believed to be restricted to human habitations) pollen in lake sediments rose from 2,730 B.P. to a peak around 1,600 B.P. and then declined… (White, 2001, p.18-19)

White's and others' research contradicts the long-held view that African forests have been in place for millennia and have only begun to be changed by humans in the last few centuries. His conclusion is that "… a picture of widespread and significant human impact on quaternary African forests is emerging wherever palynologists, ecologists, and archaeologists team up." (p. 19)

Theme #3 – Declines in fallow lengths

Regardless of past human influence on Africa's tropical forests, the important question of whether or not the practice is actually unsustainable today still remains. In order to distinguish between sustainable and unsustainable practices, many scientists have offered a benchmark fallow period as a threshold. Some of these are listed below in Table 1.

Table 1: Optimal fallow lengths for shifting cultivation as suggested by various writers

Source	**Region**	**'Ideal' or 'traditional' fallow length**
Nye & Greenland (1960)	humid tropics	10 years
Ruthenberg (1980)	volcanic soils of Zaire (Congo)	2-3 years
Kang et al. (1985)	tropics	6 years or more
Amanor (1994)	Krobo region of Ghana	3-6 years
Gilruth et al. (1995)	general	10 years
Szott et al. (1999)	humid tropics	3- 15 years
Tchoundjeu et al. (1999)	humid tropics	over 20 years

The wide range of these values (from 2 years to 20 years) is noteworthy. Since they are posited as 'ideals', we can wonder how their authors arrived at them.[8] The following table gives 'actual' average actual cropping cycle and fallow lengths reported by anthropologists and natural scientists for fields farmed in the forested regions of West and Central Africa in the years 1907 – 1956.

[8] Tchoundjeu et al., Kang et al., and Ruthenberg offer no justification for their choices of threshold. Szott et al. cite Nye and Greenland (1960) and Sanchez (1976). Gilruth et al. cite Wilkie and Finn (1988). Amanor bases his threshold on interviews with farmers. While Nye and Greenland do not offer a direct justification for their threshold, it seems to be a vague sense based on their experience and knowledge.

Table 2: Cropping and fallow periods for West and Central African forest areas

Place	Crops	Crop cycle in years	Fallow period in years	Original Source
1. Liberia	Rice, cassava	1-2	8-15	Reed (1951)
2. Sierra Leone	Rice, cassava	1& ½	8	Waldock et al. (1951)
3. Nigeria	Yams, maize, cassava	1 & ½	4-7	Vine (1954)
4. Central Congo	Rice, maize, cassava	2-3	10-15	Livens (1949)
5. West Africa	Maize, cassava	2-4	6-12	Irvine (1934)
6. Yombe, Democratic Republic of Congo (DRC)	Beans, cassava, plantains	5	6-7	C. Van Overbergh (1907)
7. Seke-Banza, (DRC)	Beans, maize	1	3	C. Van Overbergh (1907)
8. Lake Leopold II region, (DRC)	Cassava, bananas-plantain	2-3	6-7	J. Maes (1913-14)
9. Lake Bangweulu, Zambia & DRC	Cassava	1-2	2-3	C.G. Trapnell (1946)
10. Lukamba, Congo	Cassava, maize	"short"	5-9	V. Drachoussoff (1947)
11. Kuba, Central Africa	Maize, beans, cassava, peanuts	2 ½	7	Jan Vansina (1953&1956)

Note: 1-5 are reported in Nye and Greenland (1960); 6-11 are reported in Miracle (1967)

The wide range of cropping cycle to fallow ratios is striking. Also, the failure of all but one study (#4) to strictly meet the criterion of the 10-year fallow threshold suggested by Nye and Greenland[9] (1960) should be noted. None of them meets the criterion of over 20 years set by Tchoundjeu et al. (1999). Of course, arguments can be made that these actual practices did not meet the 'ideal' because by the first half of the 20th century, they were already unsustainable. This brings us back to Theme #2, the lack

[9] I single out their threshold because theirs is the most often cited since they are viewed as 'the authorities' on soil dynamics of shifting cultivation.

of precision as to when in the 'mythic past' do scientists believe that the practice was sustainable. Since this is rarely specified,[10] it is difficult to prove either way directly.

In light of the complexities highlighted above about the wide variation in both practices of shifting cultivation and their impacts, any definitive conclusion about changes in fallow lengths would require time series data for each micro-region. Without such data, it is not possible to say that fallow lengths have not declined over the last 50 years, but it is also not possible to say that they have.

Some of the areas covered in the table for which 'data' are reported are huge, making the figures highly suspect. For example, 'West Africa', an area including fifteen countries with a population of more than 200 million, has a range of 4-7 years of fallow. These figures are not presented here because I believe that they represent actual fallow lengths, but to give a sense of a baseline for the beginning and middle of the century when Europeans first began recording fallow lengths. The fact that they are reported in ranges (as opposed to weighted averages) makes it difficult to get a real sense of change. This is another problem for those arguing that fallow lengths have declined in tropical Africa (or as many claim 'in the tropics').

The classic text, "The Soil Under Shifting Cultivation," by soil scientists Nye and Greenland written in 1960,[11] is often cited as a reference for sustainable fallow length thresholds, but the text is actually quite vague about this threshold. This is further complicated by the fact that the language moves back and forth between description and

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[10] The only author that I have found who specifies a time period in which shifting cultivation was sustainable is Myers (1989) who claims: "Until roughly the mid-1960s the smallscale farmer was usually a shifting cultivator of traditional type…they made sustainable use of forest ecosystems." (p.7) If we use the 1960s as a benchmark, it does not appear from the data described above that there have been dramatic changes in fallow periods.

[11] This is the source of the first 5 entries in Table 1.

prescription so that a range of conclusions is possible. In one paragraph for example, they state that for tropical rainforests, "(r)ather longer periods of fallow are usually considered to be necessary … and it is thought that 1 and 1/2 to 2 years of cropping **should** be followed by about 10 years of fallow." (emphasis added, p. 3) Later on, they claim that "(i)n the superhumid forest regions of south-east Asia and Central Africa 1-2 years of cropping **are normally** followed by 10-20 years of fallow." (emphasis added, p. 127) In the text, they only have one example from Central Africa (#4 in Table 2) and it falls within their range. Other even earlier studies in Central Africa cited by Miracle (#6-#10 in Table 1), however, do not fall within Nye and Greenland's 10-20 year range.

The following is a quote from a 'typical' academic paper[12] written by soil scientists:

> In the humid tropics, the shifting cultivation cycle traditionally consisted of 3 to 15 years of growth of unmanaged secondary vegetation, which is cut and burned at the initiation of a one- to four-year-long cropping cycle…. (Nye and Greenland, 1960; Sanchez, 1976). However, fallow periods throughout the tropics have increasingly shortened as a result of land pressure arising from human population growth. (Szott, Palm, Buresh, 1999, p. 164)

While the large range in the traditional shifting cultivation fallow length (3-15 years) is probably accurate (because of differences in technique, soils, crops, and land history as described above), it makes it very difficult to use it as a baseline from which to deduce that fallow lengths have actually declined. Notice that while the authors claim that there has been a 'shortening of traditional fallows', no evidence is offered to back up this claim.

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[12] The fact that this presentation is 'typical' will be justified below.

The following table (Table 3) summarizes the information contained in twenty-five articles[13] related to shifting cultivation regarding declining fallow lengths either in general or in tropical Africa (it does not include articles specifically about Asia or Latin America). The table describes whether or not the article recites the narrative of declining fallow lengths, which region the claim is made for, the data used to back up the claim (if there is any), and the source of the data. Appendix I records the specific quotations from the texts in which the narrative is cited.

Table 3: Summary of fallow length information contained in recent articles on shifting cultivation

Source	Region referred to	Narrative (yes or no)	Current fallow length	Past fallow length	Source of data
1. Aweto & Iyanda (2003)	Ikoyi area, Ibadan area, Nigeria	yes	2-3	7-10	none
2. Voundi Nkana (2003)	Humid zone of Cameroon	no			
3. Hauser (2002)	southern Cameroon	yes	none	none	
4. Kanmegne & Degrande (2002)	Yaoundé region, Cameroon	yes	2-3	none	none
5. Akobundu & Ekeleme (2002)	Southeastern Nigeria	yes	less than 4	over 10	none
6. Aweto (2001)	Nigeria	yes	none	none	
7. Duguma et al. (2001)	West & Central Africa	yes	none	none	
8. Becker & Johnson (2001)	West Africa	yes	3-7 years	12-15 in early 1980s	DCTGx, 1989 & Becker & Assigbe, 1995
9. Giardina et al. (2000)	general	no			
10. Szott et al. (1999)	the tropics	yes	none	3-15 years	Nye&Greenland (1960);Sanchez (1976)
11. Brand & Pfund (1998)	Madagascar	no	5 years	none	
12. Duguma & Mollet(1998)	tropical Africa[a]	yes	1 year or less in highlands; less than 5 in lowland forest zones	> 10	Duguma et al. 1990; ICRAF 1988; Rocheleau et al. 1988; Balasubramaninan 1986; Kang et al. 1985

[13] The sample was selected in an unbiased manner since my initial intention for collecting the articles was to learn more about soil dynamics and biophysical relationships in shifting cultivation and not to write this paper.

13. Kotto-Same et al. (1997)	Cameroon	yes	none	none	
14. Sivakumar & Valentin (1997)	the humid zone	yes	none	none	
Source	**Region referred to**	**Narrative (yes or no)**	**Current fallow length**	**Past fallow length**	**Source of data**
15. Tinker et al. (1996)	general	yes	none	none	
16. Brady (1996)	general	yes	none	10-20	none
17. Juo & Manu (1996)	general	yes	none	none	
18. Palm et al. (1996)	general	no			
19. Slaats et al. (1996)	West Africa	yes	none	none	
20. Mapa & Kumaragamage (1996)	tropics	no			
21. Harwood (1996)	general	yes	none	none	
22. Juo et al. (1995)	Nigeria	no			
23. Gilruth et al. (1995)	West Africa	yes	none	none	
24.Kleinman et al. (1995)	general	no			
25. Amanor (1994)	Krobo, Ghana	no	mode=3; range 0-20	3-6	survey

[a] Although this article is about southern Cameroon, the quote is for 'densely populated areas of tropical Africa.'

Eighteen out of the twenty-five articles recount the conventional wisdom which this chapter is attempting to analyze. Of these eighteen, only four (Aweto & Iyanda, 2003; Akobundu & Ekeleme, 2002; Becker & Johnson, 2001; Duguma & Mollet, 1998) present any data trying to compare past fallow lengths to current fallow lengths to support the claim of declines. Aweto and Iyanda (2003) give no evidence to back up their claim about declining fallows. Although they give specific figures for fallows at present and in the past, they do not cite any surveys from which they arrived at these figures. The figures which they do cite pertain to a particular region in southwestern Nigeria, Ikoyi, which is located 20 km away from Ibadan, a large city. Their claim, however, in the first paragraph of the paper is about 'tropical Africa.'

> The application of inorganic fertilizers is very low in tropical Africa and most farmers depend on the use of natural bush regrowth vegetation, fallow, to restore soil fertility which declines during cropping. The system of shifting cultivation has become unsustainable **in most areas** as fallow periods are progressively shortened, consequent upon rapid increase of the population." (emphasis added, Aweto & Iyanda, 2003, p. 51)

This claim is even more surprising in light of an interesting study presented in an earlier paper by one of its coauthors – Aweto (2001). In this fascinating paper, Aweto compares tree density on farms on the outskirts of the city of Ibadan, Nigeria with those on farms in a rural district located 20 km north of the city. Aweto explains that many farmers around Ibadan practice continuous cultivation which " …is based on some form of traditional agroforestry in which the farmers allow field crops such as maize, cassava and yams to grow simultaneously with trees that help to reduce erosion and conserve soil organic matter and nutrients."(163-4) He chooses a sample of these continuously cultivated farms to compare with those in the rural area of Alagba where " (o)wing to nearness to Ibadan, the fallow period in Alagba area is considerably reduced[14]: 3-6 years of cropping being usually followed by about 4 years of fallowing or occasionally longer." (p. 164)

Aweto finds that "(c)ontrary to expectation, tree density was much higher in the continuous cultivation farms. The mean tree density in the continuously cultivated farms at the urban fringe was three and half times that of shifting cultivation farms in the countryside which are cultivated less frequently." (p.166-7) He concludes by stating that "The farmers at the outskirts of Ibadan, having eliminated the bush fallow, appear to appreciate the value of trees in conserving the soil and in regenerating soil fertility more

[14] Again, while the claim is that the fallow period is 'reduced', we are not offered any evidence of past fallow lengths nor are we presented with the way in which current fallow lengths were determined. In fact,

than shifting cultivators in the rural countryside who still practice fallowing." (p. 169) Thus Aweto's own research found that though indeed fallow periods were *shorter* (he does not show that they have *shortened*) around Ibadan compared with an area 20 km away, the system had **not become unsustainable**. Two years later, however, he is claiming that "(t)he system of shifting cultivation has become unsustainable **in most areas** as fallow periods are progressively shortened." Let us note further that Ibadan is a city of over 3 million people (World Gazeteer, 2003) which has been continuously occupied for almost two centuries. (Isichei, 1997) Thus even if fallow lengths are short there, it is strange to extrapolate from its situation to 'most areas.'

Akobundu & Ekeleme (2002) present no data to back up their claim. Becker and Johnson (2001) have two references which appear to have data on declining fallow lengths for rice production in West Africa.[15] Their claim that rice was produced in 'West Africa' with a range of fallow between 12-15 years in the 1980s, however, should be juxtaposed with the data in Table 2 from rice-producing farms in Liberia and Sierra Leone (both countries in West Africa) from 1951 which give average fallow lengths of 8-15 and 8 years respectively.

Duguma and Mollet (1998) offer specific fallow lengths and cite several studies to support their claim. One of their cited sources, Kang et al. (1985), however, presents no data on declining fallow lengths, but makes the familiar claim: "…in many tropical areas rapid population growth has resulted in shortening of the fallow periods so that more land stays in active crop production." (p. 267) Another of their sources, Balasuramanian and

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if we compare his '4 years of fallowing or occasionally longer' with the range reported by Vine in 1954 (see entry #3 in Table 2) for Nigeria of 4-7 years, fallows in Alagba do not seem to be 'reduced.'

[15] Unfortunately, both sources are French working papers that I have not been able to acquire.

Egli (1986) in a study on agroforestry in Rwanda reports the following: "Owing to the severe land shortage in the BGM (Bugesera-Gisaka-Migongo) region, duration of fallow has been reduced to one year or less." (p. 273) We are never informed what fallow rates were reduced from, so we cannot be sure that they have actually been reduced (they might have historically been low) nor do the authors cite a source or study for this information. More importantly, however, Rwanda is the most densely populated country in Africa. Population density in Rwanda is twelve times the average for sub-Saharan Africa (World Bank, 2003) making it a highly unusual case from which it seems incorrect to extrapolate. Finally, the data is for a savanna region which means that it has very limited applicability to 'tropical Africa' which is the region referred to by Duguma and Mollet.

Even if fallow lengths are declining, it is not immediately evident that this implies a 'breakdown' or a descent into 'unsustainability'. The question of why longer fallow lengths are desirable in itself is still contentious. There are two main reasons offered in the literature for why longer fallow lengths are preferable to short: 1) declines in fertility as fallow length decreases; and 2) increased weed pressure with shorter fallows (Nye & Greenland, 1960; Dvorak, 1992; Brady, 1996; Mertz, 2002). There is as yet no consensus as to which is the main cause of yield decline.[16] While the first possibility has implications for environmental sustainability as discussed above, the second does not. This does not mean that weed suppression is not an important goal for small farmers with implications for productivity, but this is an independent issue from that of deforestation. If, at the margin, farmers chose relatively longer fallow lengths in the past predominantly to minimize their labor input for weeding (and not to regenerate fertility), then a decline in fallow lengths in response to the increasing opportunity cost of the complementary input – land – could be optimal from an efficiency perspective without causing environmental problems.

Even when fallow lengths decline, it is important that we look at the whole picture to see if there are other changes taking place as well, before pronouncements of 'breakdown' are made. If farmers are shortening fallow periods, but finding other ways to increase soil fertility as the Aweto (2001) article discussed above suggests, then the practices appear to be sustainable. Indeed, this is what is normally considered 'development' in the mainstream literature – an intensification of production and preservation of the resource base through investment.

If fallow lengths are actually declining in certain areas (and again the evidence for this is scant), there might be a reason which again does not imply 'breakdown'. A majority of farmers surveyed in the East Province of Cameroon reported that the forest had expanded into the savanna over the last 20 years. (Ickowitz, 2004) The explanation most often offered to explain this phenomenon by local residents was the invasion of a non-native weed, locally known as 'bokassa' (its scientific name is *Chromolaena odorata*) began to colonize the savanna over the last few decades. It suppressed the native savanna weed species – *Imperata cylindrica*, which residents claim prevents the forest from growing. As the *Imperata cylindrica* diminished, the forest expanded into what was previously savanna. A study by Cameroonian and French scientists (Achoundong et al.) appears to corroborate local perceptions and concludes that "(i)n general, the weed tends to enhance the progression of forest into savanna." (p. 1)

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[16] Mertz (2002) even questions whether there is yield decline.

In a study of *chromolaena odorata* fallows in the humid area of South-West Côte d'Ivoire, Slaats et al. (1996) found that *C. odorata* rapidly established soil cover, is able to suppress herbaceous species, and accumulates significant amounts of nutrients and carbon during the initial fallow period. They conclude that

> …the *C. odorata* fallow system has a more intensive land use than the traditional forest fallow system, an adequate control of weeds, a satisfactory yield when cropping periods are short, and probably an efficient use of the nutrients present in the vegetation-soil system…Therefore, a fallow period of three years is considered optimal for both reducing the weed pressure and contributing to soil fertility maintenance in a semi-permanent crop production system. (p. 189)

Thus there is a possibility that in areas that have been invaded by *C. odorata*, farmers are leaving their land to lie fallow for shorter periods of time because that is all that is required for the soil to regain its fertility.

Theme #4– Deforestation

A major consequence of declining fallow lengths is said to be deforestation. The idea is that when the fallow length becomes too short, the soil can no longer regenerate adequate fertility to support forest vegetation. While few of the reviewed studies provide data to show that fallow lengths have in fact declined anywhere, none provides evidence to show an overall decline in fallow lengths in tropical Africa. As the issue of deforestation in all of tropical Africa is too large to cover in this paper, I will try to focus the discussion where possible on the situation of Cameroon.

According to Naugthon-Treves (2001), only 41.2 per cent of Cameroon's 'original forest' cover remains. In West and Central Africa in particular, however, baseline scenarios of 'original forest cover' or 'natural forest' are suspect because of changes in both climate and human populations that took place in several cycles over the last 15,000 years. Climate historians believe that what is today considered to be 'tropical Africa' underwent several cycles of desiccation and rehumidification. There was a period of protracted and deep aridity from 20,000 to 10,000 B.P., another shorter but intense dry period from 2800 to 2000 B.P., and a less dramatic, dry phase around 1300-1850. (Maley 2001, Fairhead and Leach 1998) "There has been a long history of climatic changes in central Africa resulting in periodic movements of forest-savanna boundaries." (White 2001, p. 179) Thus if forests have changed over the centuries due to climate and anthropic influences, how can scientists estimate 'original forest cover' as many statistics reporting on deforestation invariably do? There is no 'original' or 'natural' state!

Implicit in the idea of 'original' seems to lie a presumption of absence of human influence. This eliding of the history of Africa is unfortunately still quite commonplace. As explained above, many in the West seem to assume that African human-ecological interaction began with the arrival of the Europeans. What Europeans found in Africa in the 19^{th} and early 20^{th} centuries, however, might have been one of the peaks of African forest advance not only because of favorable climatic changes (recovery from the latest arid phase), but also the result of major depopulation.

Thomas (1997) estimates that between 1492 and 1870, about eleven million Africans were transported from Africa to the Americas. Countless others moved away from their traditional villages and often traveled further inland to escape slave raiders leaving behind their fields. In the 19^{th} century, according to Williams. "…if anything, there seems to be more evidence of forest advance than forest retreat because many areas of formerly thriving agriculture had been abandoned as a result of the depopulation following slave raids by rival tribes and Arab raiders." (p. 337)

An 1857 account by Henry Barth, a British traveler in northeast Nigeria gives a contemporary view of this phenomenon as he recounts his travels past a small town called Alamay:

> Here was exhibited the pleasant picture of a numerous herd of fine cattle lying tranquilly on the spacious area outside the wall…while a large extent of cultivated ground around the town gave ample proof of the industry of the people. But…when toward the end of the year 1854, I again traveled this same road, not a single cow was to be seen here, and the whole place looked mournful and deserted, tall reed-grass covering the fields which had been formerly cultivated. (in Bartlett, 1957, p.82-83)

He goes on to attribute the mass exodus to raids of a Fulbe slave-dealer. He continued to describe his visit past the town of Ghambaru, a town that had been destroyed in 1809 (it was unclear by whom and why). Although it lay in the midst of a region that had once been the site of 'hundreds of towns and villages' at the time of his visit (1851-1854), it was a region of "impenetrable jungle, the domain of the elephant and the lion…" (in Bartlett, 1957, p. 87)

And again as Barth leaves Nigeria on his way to French West Africa, he passes another town: "The little town of Yara had been devastated by raiders a week before, and all of its inhabitants, carried off into slavery, but the luxuriant rice crops remained, already three feet high…" (in Bartlett, p. 95)

The end of the Atlantic slave trade occurred about the same time that the colonialist period began in Africa. This too resulted in population decreases as many people died from diseases brought by the Europeans as well as by harsh treatment. Sauvage (1937) describes the situation in French Equatorial Africa, an area comprised of the Central African Republic, Gabon, Congo (Brazzaville), Chad, Central African Republic, and part of Cameroon: "French Equatorial Africa at the beginning of the century had about 20 million inhabitants, no more than 8 million in 1920-21; and today, following high mortality from colonial diseases brought by the extension of roads and the railroad, exploitation, famine, lack of care and emigration, French Equatorial Africa now only has about 3 million inhabitants." (translated, p. 20-21)

According to Reader (1998), "Outbreaks of cholera, typhus, and smallpox were frequent among malnourished communities in the 1890s…from the Great Lakes region, where it was reported that smallpox had already reduced communities to one-tenth of their former size, jigger infestations had left the survivors incapable of working in their fields…Rinderpest (cattle plague) killed between 90 and 95 per cent of all cattle in Africa between 1889 and the early 1900s." (p.588-89) This cattle disease brought by Italian forces to sub-Saharan Africa in 1889 had a devastating impact on the whole continent.

Thus, centuries of slavery and then the arrival of colonialism resulted in population declines and population shifts. The forest, in many cases, likely re-grew to take over abandoned fields and even in some cases entire villages that were decimated by slavery and disease. In their fieldwork conducted in the village of Boo, Guinea, villagers recounted just such a story to Fairhead and Leach (2000b).

> They point out groves of silk cotton and kola trees, and extra-dense vegetation within the reserve, overlying the sites of old villages and hamlets, such as the twenty-two small settlements once dependent upon Boo…Decades of protracted war between local polities and then with the French caused depopulation, allowing forest growth over the enriched, farmed soils in climatic conditions which appear to have been becoming more humid. (p. 41)

Savanna –forest transition dynamics

Since at least the 1920's, Western scientists have been concerned that shifting cultivation was turning forest into grasslands or savanna. (Shantz and Marbut, 1923) Throughout the 20th century, many have continued to decry this phenomenon (Jacks and Whyte, 1939; Aubréville, 1949; Nye and Greenland, 1960) and have argued that the situation is worsening due to population increases and new market pressures.

The population of former French Equatorial Africa has increased from an estimated 8 million in 1920-21 (Sauvage, 1937) to about 30 million today[17] (World Bank, 2002). Farmers have continued to practice shifting cultivation and according to many, the practice has become more destructive (through the declining fallow lengths) so it would seem logical that there would be a steady, if not dramatic, change of forest into savanna. A comparison of vegetation maps of Cameroon from 1910, 1965, and 1995 reproduced in Appendix II, seems to show, however, little more than marginal changes, at least to the untrained eye. Although a careful professional analysis of these maps would clearly be desirable, it seems clear that they do not substantiate claims of 'massive deforestation.'

Fairhead and Leach (1998) have argued that the extent of deforestation in West Africa has been greatly exaggerated. They use historical data, accounts from current inhabitants, aerial photographs, and satellite images to show that deforestation in West Africa is only about a third of what has been estimated and cited by most agencies. Kull (2000) makes similar estimations for Madagascar and finds that while the accepted view was that 'original' forest once covered 90 percent of the island, the more likely figure is about 30 percent.

[17] Although this is slightly inflated since it includes the population of what was once British Cameroon as well.

From the early part of the 20th century, ecologists believed that every bio-climatic region could be characterized by an equilibrium of a specific 'climax vegetation' defined as " …the vegetation that a given climatic zone would support in the absence of disturbance." (Leach and Mearns, 1996, p. 10). If the designated 'climax vegetation' was absent from its associated bioclimatic region, it was concluded that the area was 'degraded.' These ideas were "…premised on a conviction that nature is a stable, holistic, homeostatic community capable of preserving its natural balance more or less indefinitely if only humans can avoid 'disturbing' it." (Cronon 1996, p. 24) Although ecologists began to abandon this view as early as the 1960s, this view remains imprinted on the popular imagination and even on statistics (as will be explained below). The current view among ecologists is that "…the natural world is far more dynamic, far more changeable, and far more entangled with human history." (Cronon, p. 24) Natural disturbances and anthropogenic behaviors interact in complex, highly nonlinear, and non-monotonic ways which likely preclude the attainment of a stable equilibrium. According to Williams (2003),

> …no one is sure if natural vegetation acts as it is thought to theoretically, by achieving, eventually, a climax state. Some vegetation is disturbance dependent and thrives on frequent perturbations like cutting and fire…Additionally, natural occurrences like lightning fire, wind throw, disease, and frost, which are so important in forest dynamics, find little place in the traditional models of succession and climax, which make these models very incomplete. (p. 15)

For the first half of the 20th century, however, it was common for botanists and foresters to deduce the 'potential vegetation' of a particular area by the prevailing climatic conditions. Fairhead and Leach (2000a) claim that "…such speculative vegetation history was most strongly elaborated for the savanna areas on the northern margins of the forest zone. Having concluded that these savannas were bio-climatically capable of supporting forest, early foresters and botanists assumed that forest had once existed in these areas but had since been savannised by the farming and fire-setting practices of local inhabitants." (p. 66)

When individual trees or patches of forests were found around villages in savanna areas, it was assumed that these were remnants of a forest. Fairhead and Leach (1996) have argued that certain areas in Guinea that were long interpreted as receding forests becoming 'savannized' are actually 'forest islands' created by farmers within savannas. Thus their work has shown "…that in the forest-savanna mosaic, far from the forest 'islands' being relics of a once greater forest that disappeared under human pressure, are the effects of intensive cultivation, settlement, and fertilization, so that fallow areas became progressively more woody. Population growth has implied more forest, not less…" (Williams, 2003, p. 404) In the Kissidougou area of Guinea, for example, which lies in the savanna-forest ecotone, Fairhead and Leach (2000b) did something 'revolutionary' and actually listened to the local communities. The region has been interpreted by scientists from colonial times until the present as one where there are a few surviving forest relics as a result of ongoing deforestation and savannization. They found a very different interpretation of the landscape by listening to villagers.

> Villagers describe how forest patches, far from being relics of destruction, have been created by themselves or their ancestors in savannas, whether the emphasis is on tree planting, settlement foundation and forests as early fortresses (as elderly men frequently suggest) or on the gradual vegetation-enhancing effects of gardening, household waste, and the grazing of domestic animals (as others, including many women, imply)…Villagers consider forest islands as intrinsically linked with settlement and sociality. They consider many local farming and fire-setting practices such as early-burning to have enhanced the progressive expansion of forest into savanna over the last century. (p. 43)

The most significant and ‘revolutionary’ part of their research is that they began by listening to the people that lived in the communities in the forest-savanna transition zones and took that as a starting point for their research. The Ziama forest in Guinea, for example, is considered to be a relic of the country’s declining forest by conservation organizations. French botanists declared the region to be one whose climax vegetation was dense, humid forests that had been ‘degraded’ into savanna by the 1930s and Ziama was turned into a forest reserve in 1932. The dominant narrative was of a dense forest with Toma-speaking ‘forest people’ living in harmony with the forest by hunting and gathering in small numbers until the twentieth century arrival of Manding farmers and traders and other pressures changed their way of life toward shifting cultivation and cash crop production.

> Yet villagers (on the reserve-edge)…talk of their past in very different terms…They point out the tall cotton trees in villages which their ancestors planted as look-out posts to see allied settlements across the open savannas – expanses now covered with high forest. Elders recount the handed-down descriptions of the mid-nineteenth century economy: of intensive, short-fallow rice, fonio and cotton farming in savannas and bush fallow and of vibrant markets where they interacted with the Manding traders long part of the region. (Fairhead and Leach, 2000b, p. 41)

Fairhead and Leach (2000b) recount how when the Ivorian historian, Ekanza (1981), recorded the oral histories of the Agni people in the Moronou region of Central Côte d’Ivoire, “he was astonished to hear elders recounting how, at the time of their occupation of the territory (which Ekanza had dated to the eighteenth century), the area had been ‘open savanna.’” (p. 39) Since the area was well within what ecologists described as the ‘forest zone’, however, he dismissed their claims.

While Fairhead and Leach analyze how farmers have historically replaced savanna with trees and even forests in some areas of West Africa intentionally, Bassett and Boutrais (2000) find evidence of a gain of forest at the expense of savanna in an 'unintentional' process in the Adamaoua region of Cameroon over the last few decades. Through interviews with herders and a careful look at the historical record, they conclude that cattle overgrazing on the Adamaoua pasture has resulted in the "widespread invasion of trees." (p. 248) The herders whom they interviewed view this process as a negative one since it makes feeding their cattle more difficult. As one herder explained, "Tree invasion blocks the landscape's horizon. Trees have become so dense that they prevent grasses from growing and lead to an impoverishment of pastures." (p.249) The authors did a second study in Katiali, a savanna region in northern Cote d'Ivoire where Fulbe pastoralists had migrated in the 1970s and found that in that region as well, more than two-thirds of those interviewed claimed that 'the savanna had become more wooded.' In an ironic twist, most of those surveyed believe that the changes are being brought about by the herders themselves. Pastoralists tend to set fires early in the dry season to encourage pasture re-growth. Farmers, on the other hand, tend to burn late in the dry season to clear new land. This difference in fire timing may be crucial. Early dry season fires combined with grazing pressure have been shown to suppress grasses and allow fire tolerant trees to survive.

Such research based on ethnographic data, historical accounts, and old aerial photographs is being validated by findings of palynologists. Maley (2001) reports that

> Wherever accurate observations have been made at the periphery of the African forest, recolonization of savannas has been shown to be under way particularly since the beginning of the twentieth century. This phenomenon has surprised observers in that it takes place despite the annual propagation of fires started by humans, and, even more astonishing, traditional agricultural practices and

> livestock passages further this phenomenon by removing vegetation cover and hence limiting the propagation and the intensity of fires…In Cameroon south of the Adamaoua, the process was described in detail by the highly experienced botanist Letouzey (1968, 1985). The phenomenon of forest colonization, which he observed over more than forty years, occurs mainly in fallow areas after abandonment of the fields by the farmers, without an intermediary stage of savanna vegetation, as has often been suggested. In effect, temporary agricultural occupation promotes forest development in certain regions. This phenomenon of afforestation of savannas can be seen clearly by comparing several sets of aerial photographs and satellite images and occurs over a large area of up to one million hectares south of the Adamaoua, in the basins of the Kadei, Lom-Pangar-Djerem, and Ndjim-Mabam-Noun-Kim…Thus it is reasonable to suggest that the extensive peripheral band of semi-deciduous forest in southern Cameroon has developed over the past two millennia as a result of establishment and development of pioneer forest formations. (p. 78)

In a study done by Obale-Ebanga et al. (2003) on the Diamare plain of Cameroon which contains the largest area of physically degraded soils (Brabant & Gavaud, 1985 cited in Obale-Ebanga et al., 2003), the researchers found organic carbon and nitrogen were significantly higher ($P < .001$) on slash-and-burn plots compared with ploughed soils. "Eight decades of continuous annual slash and burn agriculture on zero-tilled Vertisols eliminated the natural savannah plant species that cannot survive annual burning. They were replaced by *Setaria pumila* grass species with dense shallow roots, whose seeds survive burning. Soil cover of about 90% by *Setaria pumila* grass, increases organic carbon contents (Obale-Ebanga, 2001) in that system." (p. 85) They conclude that "Impacts of eight decades of slash and burn on the chemical and physical properties of the Vertisols for crop production appears to have been positive…(and)… have led to a new equilibrium in plant succession, dominated by *Setaria pumila* grass." (p. 86) And, as explained above, in some areas of the forest-transition zones in the East province of Cameroon, farmers are noticing an increase in the forest at the expense of savanna which they attribute to the invasion of *chromolaena odorata.*

While it is difficult to say how widespread these phenomena of forest advance and savanna retreat are in West and Central Africa as a whole, they clearly demonstrate a complex and non-monotonic human-environmental interaction which should make us look carefully at simplistic narratives of forest dynamics.

The final part of this section uses Cameroon as an example to examine the evidence behind the final theme of the dominant narrative. According to Sunderlin et al. (2000), "(t)he rate of forest cover loss in the humid tropics of Cameroon is one of the highest in Central Africa." (p. 284) And Thiele and Wiebelt (1994) estimate that at current rates of deforestation, Cameroon's forests would be 'depleted' in about 130 years. Table 4 lists commonly cited figures for forest cover in Cameroon and their sources beginning with 'original forest cover' and ending with the latest figures from FAO's 2000 Global Forest Resources Assessment.

Table 4: Forest cover statistics for Cameroon

'Original Forest Cover'	**'Current Forest Cover'**	**Source**	**Original source**
220,000 km^2		Myers (1994)	
376,900 km^2		Naugthon-Treves & Weber (2001)	White (1983)
	179,200 km^2 (1980)	Wilkie & Laporte (2001)	Lanly (1981)
	215,690 km^2 (1980)	Wilkie & Laporte (2001)	FAO (1996)
	155,330 km^2 (1985)	Naughton-Treves & Weber (2001)	Sayer et al. (1992) who cite Letouzey(1985)
	249,800 km^2 (1985-87)	World Resources Institute (1991)	
	256,200 km^2 (1980s)	World Bank (1989)	
	175,200 km^2 (1990)	Wilkie and Laporte (2001)	FAO (1990)
	203,500 km^2 (1990)	Wilkie and Laporte (2001)	FAO (1996)
	240,800 km^2 (1990)	FAO (2001)	
	202, 440 km^2 (1990)	WRI (2001)	
	242,958 km^2 (1998)	Laporte et al. (1998)	
	195,980 km^2 (1995)	WRI (2001)	
	238,580 km^2 (2000)	FAO (2001)	

According to Myers (1994), of Cameroon's approximately 475,000 km^2 of territory, 220,000 km^2 was 'originally' covered in forest. Naughton-Treves and Weber (2001), however, report that 376,900 km^2 of Cameroon's territory was 'originally' covered in forest. This would mean that about 80% of Cameroon was 'originally' forest. A quick glance at the vegetation map in Figure 2a from 1910, shows that this would have had to be centuries before 1900.

From the discussion presented above, it should be clear that any estimation of 'original forest cover' is inherently problematic. Not only must it rely on some fictitious 'original state', but it carries with it an assumption of a stable climax equilibrium. The following chart (Figure 1) taken from Maley (2001) dramatizes the question of what to use as a baseline for calculating Cameroon's 'original forest cover'. It shows the relationship between forest and savanna based on pollen analysis over the last 28,000 years.

Figure 1: Chart from Maley (2001) depicting changes in forest relative to savanna in Western Cameroon over the last 28,000 years.

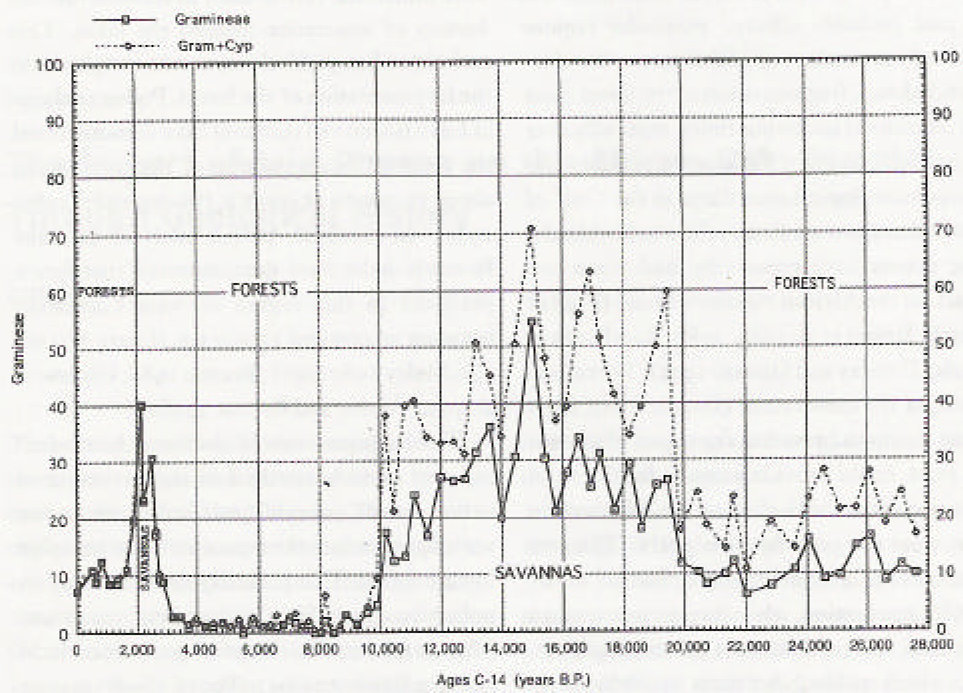

Figure 5.1. Variation in savannas and forests in western Cameroon during the recent Quaternary reconstituted from analysis of pollen in sediments of Lake Barombi Mbo, near Kumba (Maley and Brenac 1998a). A core about 23 m long was taken from this crater lake, located at about 300 m altitude in lowland rain forest about 40 km northeast of Mount Cameroon and 60 km from the sea. Pollen analyses were undertaken on 82 samples, 12 of which were radiocarbon dated to establish the chronology of the core (Maley and Brenac 1998a). The figure shows relative changes in tree pollen compared to pollen from grasses (unbroken line). The dotted line represents the percentage of Cyperaceae pollen added to that for Gramineae. The Gramineae pollen are almost exclusively from herbaceous plants found on well-drained soils, characteristic of open savanna vegetation. The Cyperaceae are mostly aquatic. This figure allows us to depict the different phases of forest and savanna expansion over the past 28,000 years. We can see that from 28,000 to c. 20,000 B.P. forest cover was similar to that seen today (the percentages are similar). From 20,000 to 10,000 B.P., during the last major global and regional cold period, the climate was much drier, resulting in replacement of forest by savanna vegetation. However, in the Barombi Mbo region grass pollen remained at about 30–40% and never dominated tree pollen. This suggests that the landscape at the time was a forest-savanna mosaic in which forests were more widespread. This has been confirmed by an analysis of carbon isotopes (Giresse et al. 1994). This landscape probably corresponds to the forest refuges thought to have occurred in equatorial Africa during this period (Maley 1996a; Sosef 1994). From c. 9,500 to 2,800 B.P. forest was at its most dominant; between 2,800 and 2,000 B.P. there was a brief and intense period of forest retreat and savanna expansion. This climatic pejoration was probably due to increased seasonality associated with a shorter rainy season (see text). Finally, forests have expanded from about 2,000 B.P. up to the present.

This highlights the question of what baseline was used to arrive at the figures for ‘original forest cover’ presented above. Unfortunately, I have not been able to determine how Myers arrived at his figure. He lists his figure for Cameroon’s original forest cover in a table entitled: “Tropical Moist Forests: Present Status in Select Countries.” At the bottom of the table for sources he writes, “References listed, and the author’s travel and fieldwork throughout the biome during the past two decades.” Presumably the references are those in the back of the paper which include over 400 entries. There is no discussion in the text about the issue of ‘original forest cover.’ It is simply taken for granted that this is an uncontested figure. Naughton-Treves and Weber (2001) cite White (1983) who bases his conclusions on the by now highly questionable idea of ‘climax vegetation potential.’

Depending on how we read these figures, we can create several different narratives. One iconoclastic story beginning with Myers’ figure on ‘original forest cover’ and ending with Laporte et al.’s figure for 1998, could be that the forest cover of Cameroon has grown over the past few centuries due to a period of rehumidification or human transformation of savannas to forests or a combination of both. Another way to use the statistics is to begin with White’s figure for ‘original forest cover’ and end with the World Resource Institute’s figure for 1995; this story is one in which Cameroon’s forest cover has been reduced by about half since such and such time (since we do not have a date for original) most likely due to human transformations. If we begin with Letouzey’s 1985 figure and then use only the FAO’s 2001 figures for 1990 and 2000, we could argue that although the extent of Cameroon’s forests has overall increased over the last decade and a half, it has declined slightly over the 1990s.

These figures are not presented here to make an argument for a 'grand narrative' of forest expansion, but rather to show the extent of the disagreement and inconsistencies regarding even the most basic questions: How big is the forest and how has it changed in recent years? The answer is that we are still not sure. Shockingly, the forest cover data for Cameroon are judged to be the best of the six other central African countries. (Wilkie and Laporte, 2001) Thus the contradictory data on forest cover is certainly not limited to Cameroon: A recent article in *Science* by Achard et al. (2001) claims that "…our knowledge concerning their (humid tropical forests) distribution and rates of change remains surprisingly limited." (p. 999) The Intergovernmental Panel on Climate Change has pointed out that "for tropical countries, deforestation estimates are very uncertain and could be in error by as much as $\pm$ 50%." (in Achard et al., 2002, p. 999)

Until the 1970s, and in some areas until the 1980s, forest cover estimates were made using aerial photography with ground observation. According to Smouts (2003), the margin of error using this method is considerable. The older FAO estimates (prior to 1996) also relied "on secondary information, expert opinions, and outdated country data." (Achard et al, 2002, p. 1000)

After 1972, various satellite images were used to deduce forest cover change in some places, but where primary data are not available, the FAO still relies on secondary sources and expert estimates. A recent study, known as TREES, (Tropical Ecosystems Environment Observation Satellite) which is jointly directed by the European Union and the European Space Agency, has been assessing humid tropical forests since 1990 using comprehensive satellite data and selective sampling of deforestation 'hotspots'. The study found that deforestation estimates were 23% lower between 1990 and 1997 than those reported by the FAO. (Achard et al., 2002)

Another study headed by De-Fries and Skole based on low-resolution images using a different algorithm and different sample, "…also finds that the FAO forest cover loss estimates are too high for the 1990s, but it gets different results for each continent than TREES did. 'The regional differences indicate that we don't have a definitive answer,' says another co-author, ecologist Chris Field…" (Kaiser, 2002, p.919) The World Resource Institute and the World Wildlife Fund, on the other hand, believe that the FAO's estimates of deforestation are too low. (Smouts, 2003)

Conclusion

This paper should not be read as a denial that deforestation has occurred or is occurring in tropical Africa. Nor is it claimed that shifting cultivation is always sustainable or that there are no places where fallow lengths have declined. Its purpose is to take a critical look at the evidence that researchers and policy experts have presented over the last half-century to support their conclusions. I am advocating a more careful and nuanced reading of the diverse tropical African landscapes with a consideration of history (including both oral accounts of residents and written accounts of travelers) and biophysical complexities. The point is not to argue that shifting cultivation is always and everywhere sustainable or that savannas never advance and forests never retreat. There is, however, little evidence to show a widespread 'crisis' or 'breakdown' in shifting cultivation as the conventional wisdom seems to imply. Nor is there clear evidence to show a dramatic and unilinear process of shrinking forests and expanding savannas in tropical Africa.

I wish to end the paper the way I began, with a quotation about shifting cultivation which illustrates the dominant narrative:

> Under humid tropical conditions, where natural regeneration is rapid, the practice of shifting cultivation may be permitted, provided that the period under forest in the bush-fallow field-crop rotation is not reduced below the minimum which permits the increase in fertility in the fallow years to a level suitable for crop production…this native custom was not dangerous, but with increasing settlement, and more frequent return to the same plot, the soil is not being given time to become revegetated and thus to regain its fertility. As a result the vegetation deteriorates from its natural climax forest type to a degenerate forest or a savanna containing remnants of the original tree flora. (Jacks & Whyte, 1939, p. 62 &161)

Note the date and how little the story has changed!

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Appendix I
Citations for Table 3
(numbers refer to sources listed in Table 3)

1. **Aweto and Iyanda (2003):** While the article deals with a specific region of Ikoyi near Ibadan the following is stated in regard to 'tropical Africa': "The system of shifting cultivation has become unsustainable in most areas as fallow periods are progressively shortened, consequent upon rapid increase of the population." (p. 51)

3. **Hauser (2002):** The article is about southern Cameroon, but quote is about West and Central Africa: "With increasing population densities, the land-use frequency increases and fallow phases are being shortened. A succession to fallow into secondary forest is, in most areas, no longer possible." (p. 139)

4. **Kanmegne & Degrande (2002**): This article is about two villages in the Yaoundé neighborhoods of southern Cameroon: "In recent years, population densities have increased causing reduction in fallow period length to two or three years." (p. 116)

5. **Akobundu & Ekeleme (2002):** "In the humid zone of southeastern Nigeria, shifting cultivation is widely practiced by smallholder farmers…Increasing human population pressure on land has contributed to a reduction in the duration of the bush fallow period from over ten years to less than four years." (p.162)

6. **Aweto (2001):** While the article is specifically about the Ibadan area of Nigeria, the following quote is about Nigeria in general: "the traditional extensive system of shifting cultivation is gradually breaking down and is being replaced by continuous farming." (p. 163)

7. **Duguma et al. (2001):** This quote is about West and Central Africa: "The food crop productions system is based on the practice of slash and burn farming, which, due to population pressure and reduced fallow cycle is no longer sustainable." (p. 177)

8. **Becker and Johnson (2001):** "The majority of food crops, including upland rice, are produced in extensive production systems where farmers traditionally rely on extended periods of fallow to restore soil fertility and control insect pests and weeds (Nye and Greenland 1960; Johnson and Adesina 1993). However, current demographic pressure forces farmers to intensify their land use in an unprecedented way (Becker and Assigbe 1995). Surveys of rice based systems in West Africa indicate a reduction from about 12-15 years of secondary forest fallow in the early 1980's to at present 3 to 7 years (DCGTx 1989; Becker and Assigbe 1995)." (p. 107)

10. **Szott et al. (1999):** " In the humid tropics, the shifting cultivation cycle traditionally consisted of three to 15 years of growth of unmanaged secondary vegetation, which is cut and burned at the initiation of a one- to four-year-long cropping cycle…. (Nye and Greenland, 1960; Sanchez, 1976). However, fallow

periods throughout the tropics have increasingly shortened as a result of land pressure arising from human population growth.” (p. 164)

12. **Duguma and Mollet (1998):** “In traditional farming system of the tropics (*sic*), soil fertility and crop production were sustained through adequate fallow period (> 10 years). In densely populated areas of tropical Africa, such fallow periods have been reduced sharply: to one year or less in highlands and less than five years in lowland forest zones (Duguma et al., 1990; ICRAF, 1988; Rocheleau et al., 1988; Balasubramanian and Egli, 1986; Kang et al., 1985).” (p. 283)

13. **Kotto-Same et al. (1997):** "Slash-and-burn agriculture as practiced by indigenous people in non-market setting does not result in large-scale environmental damage...But today slash-and-burn agriculture has lost its innocence. Population growth, transportation networks and market forces have intensified along contiguous margins…crops are cultivated for one season or two seasons before weed encroachment and nutrient depletion lead to land abandonment. As a result, the original forest steadily retreats at a pace greater than secondary succession…” (p. 246)

14. **Sivakumar & Valentin (1997):** “The traditional system of shifting cultivation in the humid zone was successful as long as there was sufficient land for farmers to leave the soil to rest under naturally regenerating forest for periods in excess of a decade (Robinson & McKean 1992). As demographic pressure has increased and more and more people have been forced to seek land in the forested areas, traditional systems have been replaced by crude slash-and-burn, in which the cultivation period is prolonged and the forest regeneration is endangered and is inadequate to maintain fertility. The net result is deforestation with its various undesirable consequences.” (p. 912)

15. **Tinker et al. (1996):** "Slash-and-burn agriculture was traditionally practiced on a small or local scale by many farming societies, with long fallow periods, and hence a large relative area of undisturbed forest. It was then a fully sustainable system…The dramatic change in recent decades has been the intensity and extent to which slash-and-burn of forest is practiced worldwide. Increasing pressure on the land gradually reduces the fallow period until only scrub woodland regenerates, yields are reduced, and the average biomass on the land is greatly reduced." (p. 14)

16. **Brady (1996):** “The traditional shifting cultivation systems practiced by indigenous forest dwellers are generally sustainable…In areas where more land is not available, the period of fallow during which the soil nutrients can be replenished has been shortened." (p. 4)

17. **Juo and Manu (1996):** "In a greater part of the humid and subhumid tropics, the fallow period has been reduced and the areas cleared for cultivation have become larger. These modifications have led to an eventual breakdown of the slash and burn system in the long run because loss of mineral nutrients during the cultivation phase can no longer be restored by short periods of bush fallow." (p. 49-50)

19. **Slaats et al. (1996):** “In humid West Africa traditional shifting cultivation can no longer provide enough food for the increasing population. Moreover, further extension threatens the remaining tropical forests. Farmers extend cropping periods and shorten fallow periods but they keep relying on the natural fallow to maintain the chemical and physical soil properties…The trend to shorten fallow periods is clearly demonstrated in some parts of Africa and Asia.” (p. 179-180)

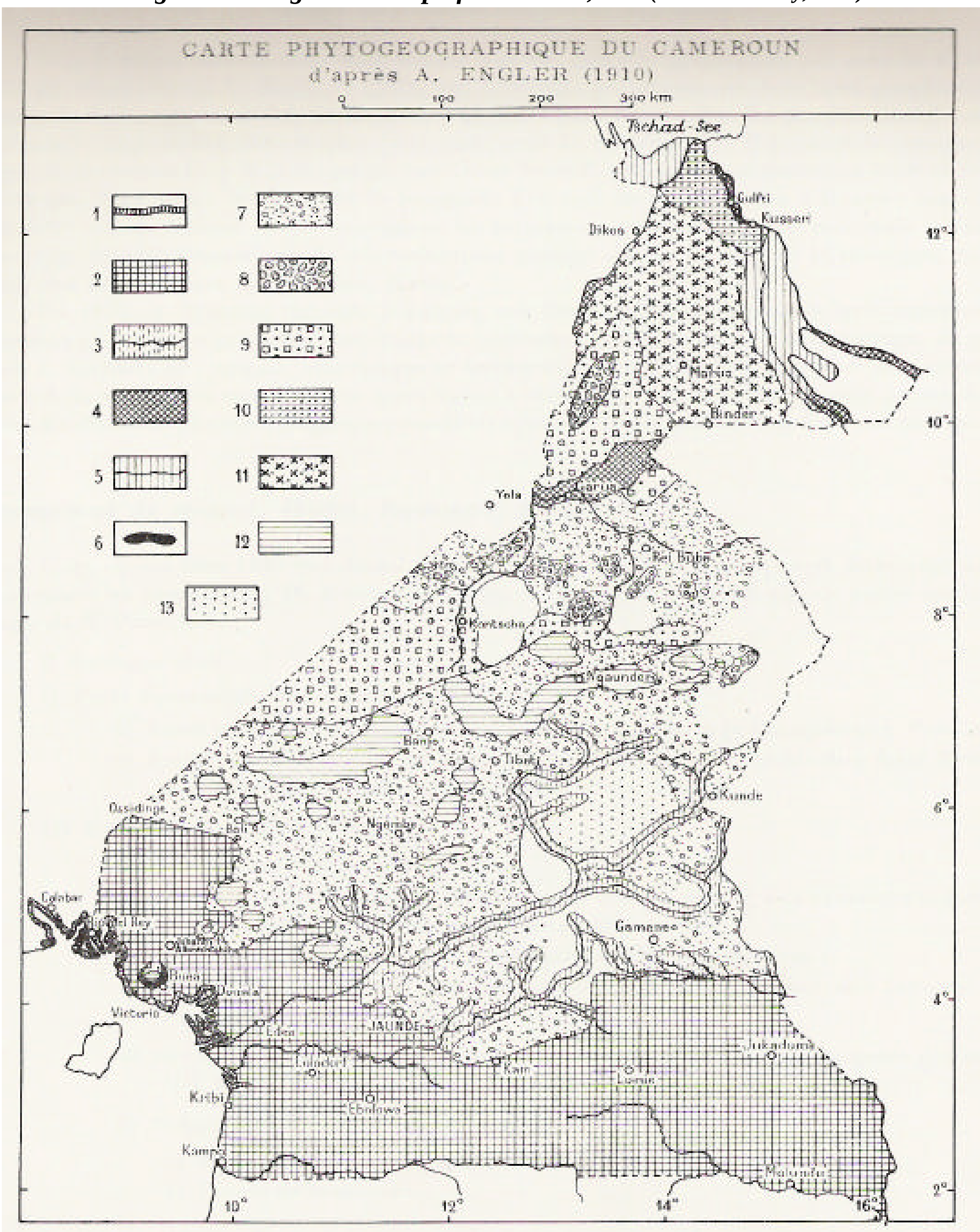
21. **Harwood, R. (1996):** “It is fully recognized that shifting cultivation, if properly practiced, can be sustainable. It must be accepted, however, that evolving demographics and changing political, and social environments make the traditional, formerly stable system less and less productive.” (p. 75-76)

23. **Gilruth et al. (1995):** "Increased demand for land has resulted in a shortened fallow period, and more land under cultivation during each cycle of vegetation clearing and planting. Without a change in management strategy, a downward spiral is inevitable." (p. 180)

Appendix II

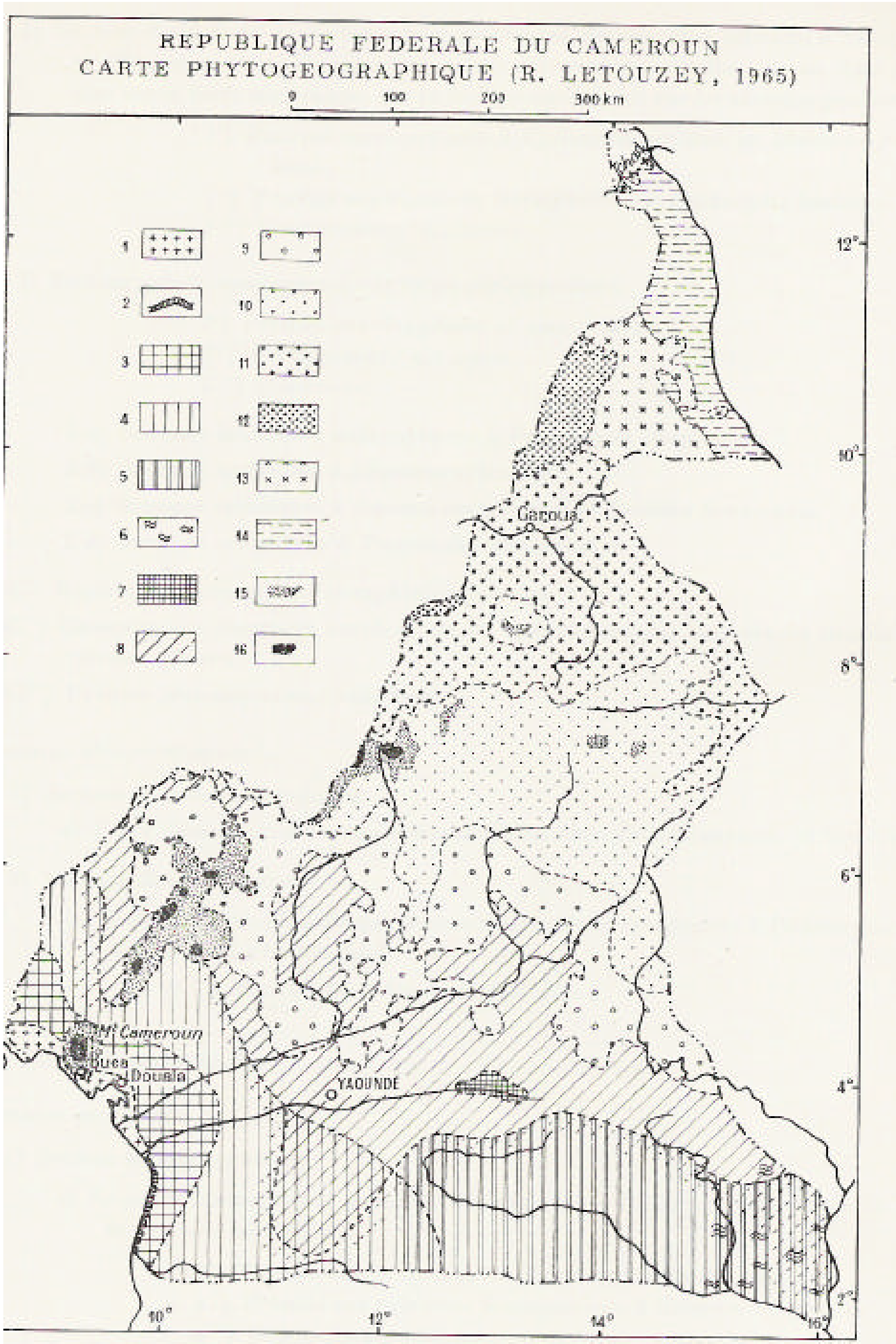
Vegetation Maps of Cameroon

Figure 2a – Vegetation Map of Cameroon, ***1910 (source:Letouzey, 1968)***



1. Mangrove 2.Humid dense forest of medium altitude 3.Gallery forest (similar to those of West Africa) 4. Gallery forest (similar to Central Africa with palm trees) 5. Swamp 6. Cloud and mountain forest 7. Dry thicket and mountain thickets (corresponds to Letouzey's forest-savanna mosaic and Sudo-Guinean savanna) 8. Thicket 'islands' 9. Wooded savannas 10. Dense piney forest (mostly Acacias) 11. Grassy steppes 12. Pasture & mountain prairies 13. Grassy savanna

Figure 2b – Vegetation Map of Cameroon, 1965 *(source: Letouzey, 1968)*



1. Mangrove 2. Shrubs and thickets 3. Coastal Forest 4. Biafran Forest
5. Congolese Forest 6.Forest inundated by the Sangha River 7. Swampy Forest of the Haut Nyon
8. Semi-deciduous Forest 9. Savanna-forest mosaic 10. Savannas of Adamaoua
11. Wooded Savannas 12. Sudanese vegetation 13. Sahelian Steppes
14. Prairies of North Cameroon 15. Submountainous and mountainous 16. Afro-subalpine

Figure 2c- Cameroon vegetation map derived from AVHRR imagery 1990's by Laporte *(*source: Laporte, 2004*)*