Environmental Discourses and the Ivorian Savanna[1]

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The African continent is portrayed in development texts as experiencing environmental crises of staggering proportions. Despite a lack of reliable data, the World Bank considers environmental degradation to be so widespread that the "business" of environmental planning and regulation is now seen as a global affair. It currently requires low-income countries receiving its financial assistance to develop National Environmental Action Plans (NEAPs) which, in assembly-line fashion, are being produced according to a blueprint. Taking the West African case study of Côte d'Ivoire, this paper argues that the planning process, specifically the identification of environmental problems, is based on a poor understanding of the nature and direction of environmental change. We confront this data problem by contrasting the image of a deforested savanna landscape found in the Côte d'Ivoire NEAP with the more wooded landscape experienced by farmers and herders and confirmed by our analysis of aerial photographs. Our second objective is to address the policy implications of two geographical issues rising from this paper: the disjointed scale problem between local/regional environmental-change patterns and global environmental discourses, and the human-environmental consequences of ignoring actual versus imagined environmental problems. A third goal is to contribute to the growing convergence in cultural and political ecology around the use of multiple research methods to explain environmental-change dynamics. Our discussion of environmental change is informed by intensive data collection in two rural communities in the Korhogo region of northern Côte d'Ivoire. Research methods included focus-group discussions and household surveys to record local perceptions of environmental change. Aerial photo analysis, GIS mapping, and vegetation transects were used to interpret land-cover changes. Finally, interviews with individuals involved in the NEAP process in the Côte d'Ivoire government, World Bank, and NGOs illuminated the received ideas and institutional interests of various players in environmental planning. *Key Words: African savannas, cultural and political ecology, environmental discourses, national environmental action plans, World Bank.*

> As much as half of SSA's (Sub-Saharan Africa) farmland is affected by soil degradation and erosion, and up to 80% of its pasture and range areas show signs of degradation (Cleaver and Schreiber 1994: 3–4).
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> Although soil degradation, notably accelerated soil erosion, is unquestionably the result of expansion of farming into fragile areas [*zones sensibles*], little data exist to confirm this fact (World Bank 1994: 8).
>
> Humanity cannot stand by and let a whole continent disintegrate . . . The trees, earth, soil, water, wildlife, the urban environment—those are everyone's business (Falloux and Talbot 1993: xiii–xiv).

The image of an entire continent physically disintegrating due to the destructive land-use practices of its inhabitants conveys the magnitude of Africa's environmental problems—at least in the eyes of the World Bank. Yet there remains considerable uncertainty about the very processes generating this assumed degradation of the environment. As the Bank notes for Côte d'Ivoire in the second epigraph, "little data exist to confirm this fact." This is also the case for other parts of Africa (Watts 1987; Stocking 1987, 1996). Despite a lack of reliable evidence, the World Bank considers environmental degradation to be so widespread, that "the business" of environmental planning and regulation is now seen as a global

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affair, and one that falls within its own purview (Falloux and Talbot 1993: xiii–xiv). Indeed, since the late 1980s, the Bank has required low-income countries that receive International Development Association (IDA) funding to draw up national environmental-action plans (NEAPs).[1]

As demonstrated in World Bank policy papers and country reports, the link between environmental planning and development assistance is articulated within the discourse of sustainable development (Williams 1995). The fuzzy green notion of sustainable development is readily adopted by the Bank because of its compatibility with its basic "technocratic, managerial, capitalistic, and modernist ideology" (Adams 1995: 93). Under the banner of sustainable development, the Bank now promotes a "win-win" strategy of combining economic growth with environmental conservation (World Bank 1992: 2–3; Biot et al. 1995). Never considering that its past policies and interventions are in any way implicated in the so-called environmental crisis, the Bank presents itself as an impartial observer and promoter of good stewardship. It is currently assisting dozens of African governments to develop NEAPs which, in assembly-line fashion, are being produced according to a blueprint (Greve et al. 1995). NEAPS are heralded as modern vehicles that will lead its member countries down the road to rational and orderly sustainable development.

In this paper, we examine the contents of the NEAP for Côte d'Ivoire with special attention given to how environmental problems are constructed for the northern savanna region. Our objectives are threefold. The first is to highlight the problem of data gaps in the environmental-planning and sustainable-development discourses. Determining if an environmental problem exists would appear to be a critical first step in the planning process. Yet what is striking about the NEAP process is how quickly environmental problems are identified and prioritized on the basis of so little data. We confront this data problem by contrasting the image of a highly degraded savanna environment found in Côte d'Ivoire NEAP reports with the actual landscape as experienced by farmers and herders and confirmed by our analysis of aerial photographs and land-cover changes.

Our second objective is to address some of the policy implications related to the disjuncture between local and regional patterns of environmental change and national and global environmental discourses. One result of this disjointed scale problem is that the actual dynamics of environmental change are being overlooked. We consider, in turn, the ecological and human consequences of ignoring ongoing biophysical changes while planners are busy addressing imaginary environmental problems.

A third goal is to contribute to the growing convergence in cultural and political ecology on the need to consider multiple views and employ multiple research methods in assessing and explaining environmental change (Blaikie 1994, 1995; Batterbury et al. 1997). One of the challenges of doing cultural and political ecology is demonstrating the linkages between a variety of social and biophysical processes driving environmental change. As Blaikie has suggested, there is a "plurality of knowledges" on the environment and a host of epistemological and methodological issues that need to be addressed in combining natural and social scientific perspectives (Blaikie 1995: 204). Notwithstanding these formidable challenges, an ecologically invigorated political ecology is emerging that systematically integrates sociocultural and biophysical processes. Karl Zimmerer's study of the geography of cultivars in the Peruvian Andes and Matthew Turner's research on the species composition and grazing patterns of livestock in the West African Sahel successfully join social science and natural science perspectives to enhance our understanding of biodiversity and rangeland degradation, respectively (Zimmerer 1996; Turner 1993, 1999). The emphasis placed in cultural and political ecological research on local knowledge, environmental history, multiscale politics, and socially differentiated resource-management practices, requires intensive field study and multiple research methodologies. This paper presents a methodological route to scholars interested in traversing the social and biophysical realms of human geography.

Environmental Narratives and Regional Discursive Formations

The theoretical footing of this paper is set in a body of cultural and political ecological research that has coalesced around a set of ideas drawn from discourse theory, critical histories of science, and the sociology of development. Three recent volumes, all edited by geographers,

have contributed to the study of human-environment relations with their focus on environmental narratives, development discourses, and regional discursive formations (Crush 1995a; Leach and Mearns 1996; Peet and Watts 1996). Melissa Leach and Robin Mearns's interest in environmental policy draws them to consider how African environmental issues are framed and the practical implications of received ideas on policy. Their findings suggest that many environmental-crisis stories are either exaggerated or simply mistaken. The fundamental question they pose is why, in the face of contradictory evidence and new ecological theories, environmental orthodoxies such as desertification persist (Swift 1996; Warren 1996). Their examination of the structural, institutional, and scientific origins of various narratives (e.g., the tragedy of the commons) leads to the conclusion that such stories are ineluctably cultural constructs.[2] They argue that the persistence of received ideas on the African environment can in part be explained by their "practical effects" in serving the interests of individuals and institutions making up the development apparatus (Leach and Mearns 1996: 19). For example, the common idea that African land users are recklessly destroying the land, due to unregulated land access, has been used by a variety of actors in the past and present to intervene in rural land-rights systems (Bassett 1993a, 1995). The notion that land privatization will give land users the necessary security to invest in land improvements is commonly used by government agencies to extend their control over rural peoples and resources (Anderson and Grove 1987; Ferguson 1990; Roe 1991). We argue below that the dominant environmental narrative for the Côte d'Ivoire savanna is misconceived. In contrast to the view that wooded savannas are becoming desertified, characterized by a progressive loss of trees and an expansion of grasslands, we argue that the landscape is becoming more wooded. To explain the presence of the desertification narrative in the Côte d'Ivoire National Environmental Action Plan, we locate it within what Watts and Peet call a "regional discursive formation" in which the idea of desertification is integral to the discursive environmental history of the region (Peet and Watts 1996: 16).

Geographical images and environmental narratives are commonly used as framing devices by developers to set the scene for their subsequent interventions (Mitchell 1995). In this sense, they form part of the larger conceptual framework of development discourse. Jonathan Crush defines the focus of development discourse analysis as

> the ways that development is written, narrated and spoken, on the vocabularies deployed in development texts to construct the world as an unruly terrain requiring management and intervention; on their stylized and repetitive form and content, their spatial imagery and symbolism, their use (and abuse) of history, their modes of establishing expertise and authority and silencing alternative voices; on the forms of knowledge that development produces and assumes; and on the power relations it underwrites and reproduces (Crush 1995b: 3).

Images of chaos and environmental devastation run through the Côte d'Ivoire National Environmental Action Plan (NEAP-CI). Land-use practices are described as anarchic, as peasants and pastoralists are purportedly destroying savanna woodlands through agricultural land clearing, burning, and overgrazing. The plan proposes new laws and land-use regulations as a means of controlling what is uncritically described as a crisis situation. As a type of green conditionality that is imposed on poor Third World countries seeking assistance from the World Bank, NEAPs are inextricably linked to the development industry and networks of power (Escobar 1995; Rich 1994). The NEAP's focus on regulation, better planning, and rational land use are defining features of what Adams associates with mainstream sustainable development discourse (Adams 1995). It is at heart reformist and technocentrist: "there are no ideological conflicts with the dominant capitalist industrial development model . . . only debates about methods and priorities" (Adams 1995: 90).

The history of the idea of desertification in West Africa and its centrality to national and global environmentalist discourses is linked to what Peet and Watts theorize as a "regional discursive formation" (1996: 15–16). By this they refer to:

> certain modes of thought, logics, themes, styles of expression, and typical metaphors [which] run through the discursive history of a region, appearing in a variety of forms, disappearing occasionally, only to reappear with even greater intensity in new guises.

The image of desert-like conditions spreading into the savanna and tropical forest zones as a result of destructive land-use practices of Africans dates from the early twentieth century in West Africa (Mortimore 1989: 12–18). The French colonial forester Auguste Aubréville, who coined the term "desertification," described the process as taking place on two fronts. The first was occurring in the tropical forest area, which was undergoing a process of "savannization" as farmers cleared forests for farming, and purportedly uncontrolled burning prevented tree seedlings from reestablishing themselves. The second front, he argued, was advancing in the semiarid and humid savannas, where open deciduous forests [*forêt claire*] had become degraded wooded savannas [*savane boisée*] as a result of shifting cultivation and bush fires.

Leach and Fairhead argue that Aubréville's views formed part of a "pan-West African forest orthodoxy," in which British and French foresters shared a common set of ideas on African forest history and environmental change that linked deforestation with desiccation (Fairhead and Leach 1998). Elements of this orthodoxy included the notion that forests positively affected climate, especially rainfall levels (Aubréville 1938); that the "native customs" of "improvident" farmers who, with fire and axes, were, limb by limb, destroying the forest, needed to be regulated (Stamp 1940: 300; Stebbing 1935: 523); that it was the duty of colonial foresters and administrators to protect the remaining tracts and vestiges of forests by creating classified forests and better policing; and that more forestry personnel were needed to undertake these various tasks (Aubréville 1938: 175–89).

In an alternative reading of landscape history in West Africa, Fairhead and Leach (1995) argue that forest cover has increased in precisely those areas where devastation was considered to be greatest. Specifically, they show that forest islands in the forest-savanna transition zone of Guinea are not relicts of a formerly more extensive rain forest. To the contrary, they argue that these islands have expanded around human settlements over the past two centuries under changing political, economic, and social conditions. Their study is most compelling in its explanation of forest gain in and around settlement areas. It is less persuasive in its analysis of vegetation change in agricultural and pastoral zones. This is especially true in their discussion of the role of livestock raising on savanna vegetation, particularly pastoralists' use of fire as a land-management tool. Fires set by Fulbe pastoralists are generally described as oriented toward "pasture maintenance." That is, burning favors grasses while fire suppression encourages trees (Fairhead and Leach 1996: 230–33). Our case study shows that we need to go beyond these general categories of "burning" and "fire suppression" to examine the effects of different *fire regimes* on grass-tree dynamics. Fire does not have to be totally suppressed for trees and shrubs to invade savannas. For example, a change in the *timing* of fire can strongly influence the proportion of woody to herbaceous species. We show that Fulbe pastoralists in Côte d'Ivoire commonly set fire to the bush in the early dry season to encourage pasture regrowth. One of the outcomes of this practice is tree and bush encroachment.

In summary, this study complements Fairhead and Leach's analysis of vegetation change in the forest-savanna transition zone by extending it to the northern savanna area where we focus on the impact of agricultural expansion and livestock raising on savanna vegetation. More important, our analysis reveals that while the Ivorian savanna is not undergoing desertification, the vegetation cover does show signs of significant rangeland degradation. In the conclusion, we consider the implications of the Ivorian NEAP's failure to recognize this problem for the future of livestock development.

Research Area and Methods

This study is the product of a collaborative research project conducted by an interdisciplinary group of scholars at the University of Illinois, Urbana-Champaign and the Tropical Geography Institute (IGT) at the University of Cocody, Abidjan, Côte d'Ivoire. The research focused on the patterns and processes of environmental and social change in two highly contrasting rural communities in northern Côte d'Ivoire (Department of Korhogo). Katiali, a village of some 1900 inhabitants, is situated 60 km northwest of Korhogo in the subprefecture of Niofouin. Population densities in this area average 16 persons/km^2. Tagbanga, with a population of approximately 200 persons, is located 17 km south of Korhogo in the subprefecture of Tioroniaradougou. It is situated in the so-called "densely settled zone" of Korhogo where popula-

tion densities range between 80 to 120 persons/km^2 in the inner areas and between 40 to 80 in the outer areas. According to the most recent census (1988), the population density of the subprefect of Tioroniaradougou was 73 persons/km^2—more than four and a half times the level of Katiali.

Figure 1 situates the two study areas. The land area framed by the broken-lined boxes was subject to aerial-photo interpretation (see below). Regional rainfall averages between 1000 and 1200 mm, with most precipitation occurring during the rainy-season months of June through October. Soils and vegetation types vary with topography and land use (Figure 2).

We collected information on land-cover and land-use patterns using a variety of field research and analytical techniques. Survey-research methods were used to administer a questionnaire on environmental perceptions to a sample of 38 Senufo and Jula households in Katiali and to 42 Senufo households in the Tagbanga region. Group interviews were also held with Fulbe pastoralists in the Katiali area. To assess whether local perceptions of environmental change were congruent with scientific findings, we reviewed the specialist literature on human-induced modifications of savanna vegetation. We then examined aerial photographs located in Côte d'Ivoire and France for different time periods to compare land use/cover patterns for the two research sites. Geographic information systems (GIS) techniques were utilized to quantify land-cover trends. To gain a clearer understanding of vegetation change dynamics on the ground, we inventoried species along 50-m transects and in 10 × 10-meter plots following the contact-point method adapted from Daget and Poissonnet (1971) by César and Zoumana (1995).[3] Finally, we collected environmental policy and planning documents and interviewed individuals involved in the NEAP process in government ministries and at the World Bank's regional headquarters in Abidjan.

Farming and Herding in Katiali and Tagbanga

Rapid changes have occurred in the farming and livestock-raising systems of northern Côte d'Ivoire since the mid-1950s. The case of Katiali is indicative of general trends in the less densely settled areas of the Korhogo region. These include the expansion of cotton from 1 percent of the cultivated area in the early 1960s to 45 percent by the late 1980s. Over the same time period, there has been a near doubling in the average area cultivated by households. This transformation of agricultural production has been facilitated by the introduction of ox-plows into the area. The percentage of Katiali households possessing oxen rose from 37 percent in 1982 to 92 percent in 1992. This expansion of ox-plows has allowed households to increase the area under cultivation from an average of 4.75 ha to 8.20 ha. Despite the dominance of cotton in the farming system, peasant farmers continue to cultivate a wide range of food crops.

Farming systems of the Tagbanga region have not evolved as rapidly. Just 43 percent of the households owned oxen in 1995. Households using ox-plows cultivated an average area of 4.2 hectares. Households not owning ox plows cultivated less than 2 ha (1.9 ha). Farming was dominated by cotton, which covered more than half of the crop area.

Katiali's population grew at a low annual rate of 0.7 percent between 1955 and 1984. High infant mortality rates and the emigration of young men and women account for this low growth rate.[4] Low population densities permit farmers to practice a long-fallow agricultural system. Typically, fields are cultivated 5–6 years and then put into a 10–30 year fallow. The situation of land abundance and good pastures in the Katiali area has been a magnet to Fulbe pastoralists who have steadily immigrated into the region since the early 1970s (Bassett 1986). Population growth rates correspondingly increased at an annual rate of 2 percent between the 1975 and 1988 census.[5]

In the densely settled zone of Korhogo, short fallow periods and high rates of emigration are characteristic. A survey conducted in 1997 in two communities of the Tagbanga region revealed that between a quarter and a half of the population were absent.[6] More than half had migrated to urban areas while 46 percent emigrated to other rural areas in search of arable land.[7] Not surprisingly, high population densities and limited resources to improve soil fertility have resulted in shorter fallow periods in the Tagbanga area in comparison to Katiali. In Tagbanga, 87 percent of the land under cultivation in 1996 had been in fallow for just five years or less. Livestock play an important role in altering the vegetation cover in both regions.

Parallel to and in many ways associated with the transformation of farming systems, livestock

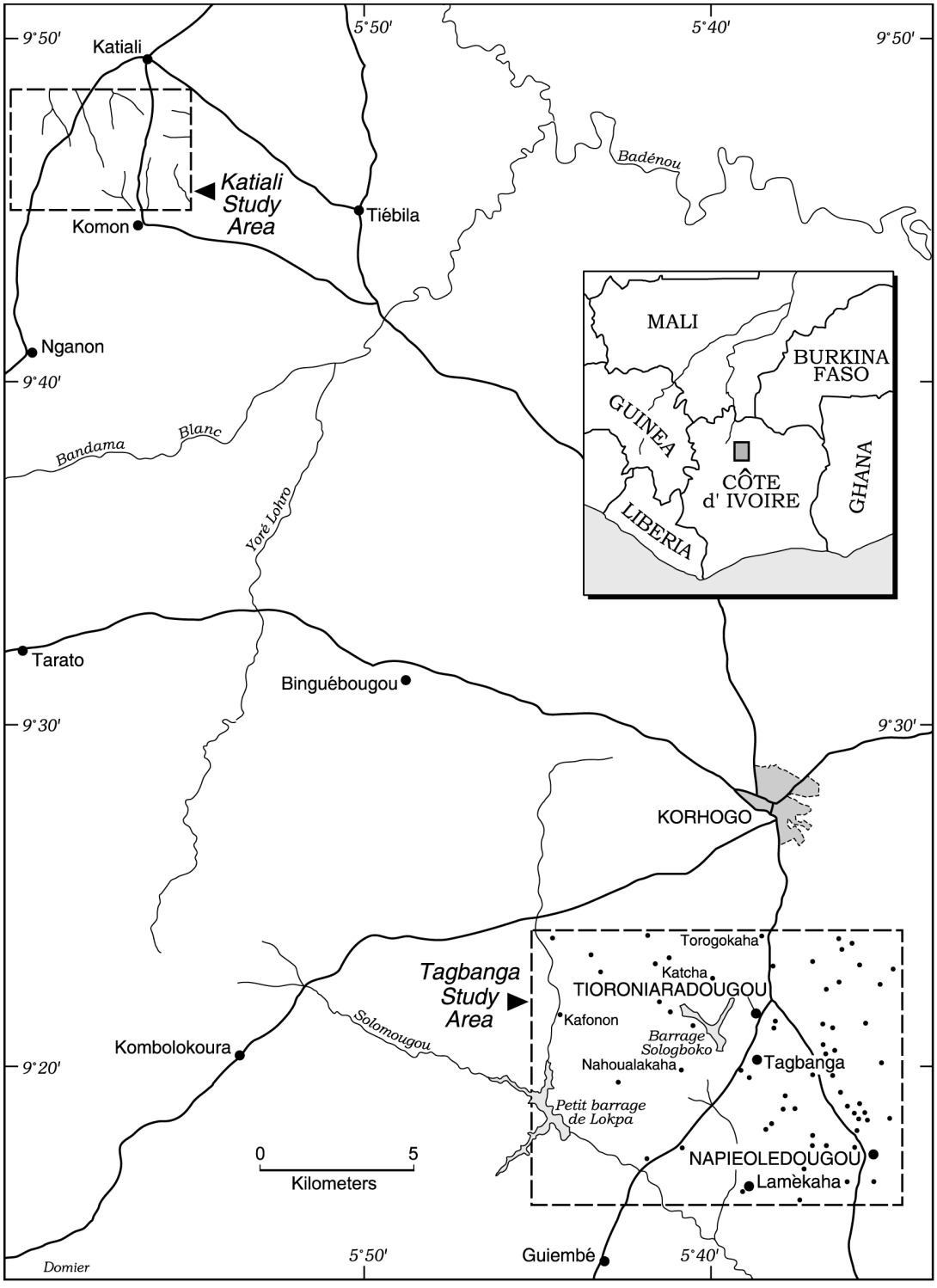

Figure 1. Location of case study areas: Katiali and Tagbanga, Côte d'Ivoire.

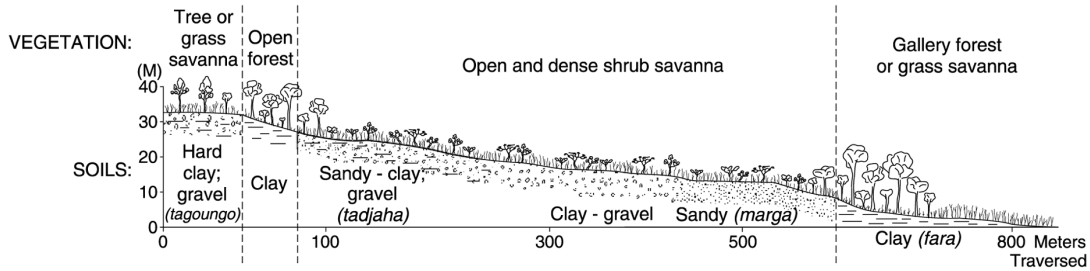

Figure 2. Vegetation cover in relationship to soil and slope characteristics in the Katiali region, Côte d'Ivoire.

raising has expanded considerably since the early 1960s. In 1962, there were an estimated 115,000 head of cattle owned by Senufo and Jula farmers in the Korhogo region (SEDES 1965: 200). Cattle owned by transhumant Fulbe pastoralists who had recently immigrated from the neighboring countries of Mali and Upper Volta (Burkina Faso) numbered no more than 8000 (Bassett 1986). Thirty years later, there were nearly a million head of cattle concentrated in the northern savanna region. Peasant-owned cattle increased four-fold over this period (1962–1991), while Fulbe cattle grew by a factor of 52 (Figure 3). The number of oxen in the north rose from 252 head in 1971 to 68,416 in 1991 (CIDT 1993: 46).[8] Albert Kientz estimated the annual growth rate of the combined sedentary and transhumant cattle population to be 6.51 percent between 1968 and 1989 (Kientz 1991: 23). Fulbe transhumant cattle grew at a faster rate (9.1 percent) than peasant-owned sedentary cattle (5.21 percent).

This expansion in livestock raising is truly remarkable because it is occurring well within an area where animal diseases have limited cattle keeping in the past to the relatively small but hardy *Bos taurus* breeds (N'dama, Baoulé). The most deadly disease by far is animal sleeping sickness or trypanosimiasis, transmitted by the tse-tse fly. Zebu cattle are particularly sensitive to this disease. How can we explain the massive movement of zebu cattle into this disease-infested area? During the 1970s and early 1980s, the most common techniques used to maintain animal health were herd mobility, the use of veterinary drugs, and the concentration of herds within farming areas where tse-tse fly habitats and hosts had been significantly reduced through land clearing and hunting (Bassett 1986). In addition to these measures, a tse-tse fly control program was launched with German technical assistance in the late 1970s, which has led to a dramatic reduction in flies, especially the riverine species *Glossina palpalpis gambiensis* and *G. tachinoides*. Both Senufo hunters and Fulbe pastoralists in the Katiali area remarked on the dramatic drop in tse-tse flies between the Badenou and Bandama Rivers where conical-shaped and insecticide-treated fly traps have been placed for more than a decade.[9]

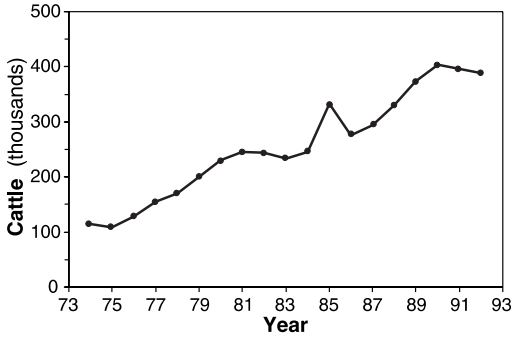

Figure 3. Fulbe cattle population growth, 1973–1993

The earliest livestock census data for Katiali dates from 1982, when there were 3310 Fulbe cattle in the area. By 1992, their numbers more than doubled (to 7033). Over the same period, peasant-owned cattle rose from 578 to 1,417 head. Oxen ownership also dramatically increased, rising from 4 to 381 between 1975 and 1992. In summary, by the early 1990s, there were close to 9,000 head of cattle grazing in the Katiali region. Eighty percent of the cattle were Fulbe-owned.

The data on cattle numbers in the Tagbanga area are not as detailed as those for Katiali. They are aggregated with livestock census data for the subprefecture of Tioroniaradougou and the southern Korhogo region, which together com-

Table 1. Cattle Populations and Densities for Korhogo II and Niofouin, 1985 and 1990

	Korhogo II		Niofouin	
Cattle/Zone	1985	1990	1985	1990
Sedentary	22,318	24,380	13,315	18,484
Transhumant	12,977	2,081	11,939	55,618
Total	35,295	26,461	25,254	74,102
Cattle density (km^2)	21	16	15	45

Source: Kientz 1991.

prise the "Korhogo II" pastoral zone.[10] When we compare these data with those for the Niofouin pastoral zone in which Katiali is located, a number of interesting points emerge (Table 1).[11] In the first half of the 1980s, cattle densities were higher in the more densely settled Korhogo II zone. By the end of the decade, however, cattle densities declined in the Korhogo II area and sharply increased in the Niofouin region. Shifts in the geographical distribution of transhumant cattle accounted for most of these changes. The departure of Fulbe herds from the Korhogo II area was linked to conflicts between Senufo farmers and Fulbe herders over the recurring problem of crop damage (Bassett 1988, 1994). A particularly violent conflict erupted in the dry season of 1986, which resulted in the sudden flight of tens of thousands of animals to the Côte d'Ivoire-Mali frontier.

In summary, the number of grazing animals increased dramatically in northern Côte d'Ivoire over the course of the 1970s and 1980s. Increases are evident in all three categories of livestock raising: transhumant, sedentary, and oxen. The most important contribution to livestock numbers is linked to the steady stream of Fulbe pastoralists from neighboring Mali and Burkina Faso. Peasant-herder conflicts over uncompensated crop damage resulted in periodic shifts in the distribution of Fulbe herds in the region. The important point for this paper is that grazing pressure has significantly increased in the region as a result of the expansion of cattle. Some of the consequences of this pressure on savanna vegetation are examined in the following sections. In the next section, we contrast the discourse on environmental change as articulated in the Côte d'Ivoire NEAP with the statements given by peasant farmers and herders in a survey focused on environmental perceptions.

Discourses on Environmental Change

Before examining the contents of the Ivorian NEAP, it is useful to provide some information on its origins.

The NEAP Process

According to the World Bank, the NEAP process involves four stages: the identification of environmental problems and their underlying causes; setting priorities; establishing goals and objectives; and proposing new policies, institutional and legal reforms, and priority actions. The Bank considers this process to be straightforward. "It is relatively easy to identify problems and formulate appropriate responses to them" (Greve et al. 1995: 8–16). The more difficult phase, it argues, centers around the implementation of reforms and other policy actions.

The elaboration of a National Environmental Action Plan for Côte d'Ivoire began on the eve of the U.N.-sponsored conference on the environment and development held in Rio de Janeiro, June 3–4, 1992. The Ministry of the Environment and Tourism organized a national conference (May 19–21, 1992) during which a rationale for a NEAP was presented. The World Bank worked closely with and helped to train the staff members who organized this meeting and who subsequently carried out the first "civilian phase" in the preparation of the NEAP (World Bank 1994: 4). This stage involved holding regional meetings at which local civic and political leaders, government officials, and selected farmers and herders were invited to present their views on regional environmental issues. This form of "participatory planning" did not involve consultations with ordinary men and women living in rural areas about what they considered to be the most important environmental issues. At the Korhogo regional meeting, a small number of peasants were invited to participate in a setting that was dominated by civil servants representing the agricultural services, planning, and rural development. If "participation" means "the ability of people to share, influence, or control design, decision-making, and authority in development projects and programs which affect their lives and resources" (Peters 1996: 22), then this so-called civilian phase of the Ivorian NEAP process involved very lim-

ited participation. As the Korhogo region NEAP report reveals (see below), the voices that were heard and the stories that were ultimately accepted suggests that "participatory" planning in the NEAP process is more rhetoric than reality.

A second national conference took place on November 28–30, 1994, where the NEAP coordinating committee presented its *White Paper on the Environment* that summarized the results of these regional meetings (RCI 1994a). This document became the basis of the Côte d'Ivoire National Environmental Action Plan whose appearance in June 1995 capped the second phase of the NEAP process. At the same meeting, the World Bank presented its own report on Ivorian environmental problems and policy recommendations, *Côte d'Ivoire: Towards Sustainable Development*, which it later revised and distributed in December 1994 (World Bank 1994). A comparison of the outlines and content of the two reports suggests that both the Bank and NEAP coordinating committee worked closely together. The Ivorian government approved the NEAP in 1996, thus bringing the formal planning phases to completion. The execution of the plan, however, quickly ran aground when the Ministry of Housing and the Environment established its own environmental agency to coordinate environmental projects estimated to cost $112 million. Aid donors, led by the World Bank, were critical of the structure of the agency, especially the lack of inter-Ministry coordination and the exclusion of NGOs from its operations. They also expressed serious concerns about the competence of the individuals appointed by the Minister to head the agency (World Bank 1998). The NEAP proposed the establishment of a National Environmental Agency that would be placed under the control of a Management Council, comprising twelve representatives from government and the private sector, including a representative of Ivorian NGOs. The NEAP process also envisioned the creation of regional commissions and departmental committees in which different social groups would participate in various environmental planning activities. In contrast to this partially decentralized planning apparatus, the Minister of the Environment "viewed environmental planning as a *business* and could only see millions of dollars falling from the sky," according to a well-placed member of the World Bank (World Bank 1998).

Discourse 1: The NEAP Report

What image of environmental change in the savanna emerged from this NEAP process? The most detailed picture is contained in the report summarizing the findings of the northern regional meeting held in Korhogo and published in March 1994. The Korhogo report presents a grim scene of environmental degradation in which peasants and pastoralists are blamed for the deforestation of wooded savannas. According to the report's authors, "vegetative cover is declining due to the practice of shifting cultivation, bush fires, and the anarchic exploitation of forests and overgrazing" (RCI 1994b: 14). This change in plant cover is specifically characterized by "a replacement of the tree savanna by the grass savanna." The report goes on to paint a portentous picture of this process:

> More generally, the progressive widening towards the south of (grassy) plant formations has climatic repercussions (temperature, rainfall . . .) which in turn affects vegetation cycles. To compensate for the corresponding lowering of productivity, the one recourse has been to use chemical fertilizers which engenders certain problems such as soil acidification, and the contamination of surface and subsurface waters (RCI 1994b: 14).

This image of a southerly advancing boundary of a vegetation type associated with more arid climates is similar to the "marching desert" view found in the desertification literature. That is, in the absence of field studies, it is assumed that the forms of environmental transformation purportedly taking place in the Sahel are also occurring in humid savannas. Bush fires and indigenous land-rights systems are signaled out as major forces in this assumed environmental devastation:

> We are increasingly witnessing a decline in vegetation cover, essentially due to bush fires used in an intensive and excessive manner leading to the disappearance of certain varieties . . . these assaults on the environment are essentially linked to the abuses of customary rights, the exaggerated interpretation of the declarations of [the former] President Félix Houphouet-Boigny such as: "*Land belongs to the person who improves it*" and "*that which has been planted by the hand of man must not be destroyed, no matter where*;" and especially the absence of a rural land code (RCI 1994b: 12).

According to this analysis, and that of the World Bank (Cleaver and Schreiber 1994: 8–

10), "traditional" land-rights systems are inadequate for the task of modern environmental planning. They may have worked in the past, but contemporary land conflicts and insecurity have prevented farmers from investing in land improvements that might increase agricultural output and conservation practices. The assumption is that only when customary rights give way to modern (i.e., freehold) tenure systems will the incentive to conserve natural resources exist. Indeed, the transformation of land-holding systems to freehold arrangements is considered in the Ivorian NEAP to be an important step towards addressing all sorts of environmental problems. Figure 4 illustrates this modernization model of tenure change, environmental conservation, and agricultural growth, which informs the Ivorian NEAP and which is at the heart of World Bank rural-development policies in Africa. The model points to the extent to which environmental crises are integral to neoliberal development discourses. These policies only have meaning with reference to agricultural stagnation and/or environmental decline. The desertification narrative serves such a need. This is not to suggest that environmental degradation is not occurring in sub-Saharan Africa. There is ample evidence of it (Batterbury and Bebbington 1998), whether it be soil erosion on the Borana plateau of southern Ethiopia (Coppock 1993), soil-fertility decline in southwestern Burkina Faso (Gray 1997), or rangeland degradation in southern Botswana (Abel and Blaikie 1989). Yet all of these examples are situated in local-level dynamics of resource access, control, and management. They emphasize, as do the case studies of environmental conservation in the Kano Close-Settled Zone of northern Nigeria (Mortimore 1998) and in Machakos District, Kenya (Tiffen et al. 1994), the importance of approaching natural resource management at multiple and nested scales (both biophysical and social). In the policy arena, these examples point to the need to provide "locationally and culturally appropriate technical and economic options" to different groups of land users and the necessity of moving away from "regulation and intrusive administration" (Mortimore 1998: 190–93). In contrast, blueprint development and cookie-cutter planning models like NEAP tend to be highly regulatory and intrusive. The case of Côte d'Ivoire's NEAP is indicative.

With reference to preserving the country's

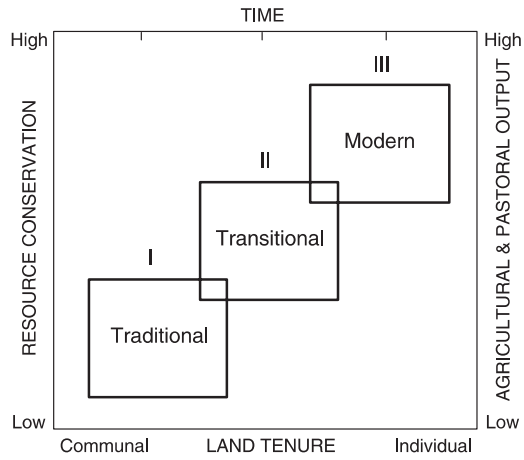

Figure 4. The modernization model of tenure change, environmental conservation, and agricultural growth.

biodiversity, the Ivorian NEAP makes a number of forestry policy recommendations. These include outlawing logging (*l'exploitation forestière*) above the eighth parallel, intensifying village tree planting, controlling bush fires, and creating a Forestry Police to enforce these new regulations (RCI 1996). The first recommendation is strikingly reminiscent of E. P. Stebbing's shelterbelt scheme, proposed more than sixty years ago (Stebbing 1935). The link between bush fires and desertification is commonly made in Côte d'Ivoire newspapers. An editorial in the ruling party's newspaper[12] warned that dry-season bush fires "each year contribute to the desert's advance in our country" (Gooré Bi 1999). A National Committee for Forest Protection and Bush Fire Control was organized in 1996 to raise public awareness about the assumed social and environmental costs of bush fires.[13] The committee organizes a national awareness day each year in which statements are made linking bush fires with desertification. A national arbor day is also held each year, during which public officials and billboards urge citizens to plant trees to stop the purportedly advancing desert (Figure 5).

The image of an increasingly degraded wooded savanna giving way to a grass savanna and, ultimately, desert-like conditions not only persists in the minds of environmental planners, journalists, and public officials but is also firmly implanted in the perception of Ivorian environmental nongovernmental organizations

Figure 5. "To each his own tree." Billboard promoting reforestation in the northern savanna region during "The Year of the Ivorian Forest," 1988, Korhogo, Côte d'Ivoire.

(ENGOs). For example, Côte d'Ivoire's leading ENGO, the Green Cross of Côte d'Ivoire, devoted a special issue of its monthly information magazine to bush fires and forests. In his editorial, Green Cross President Gomé Gnohité Hilaire emphasized the importance of educating the citizens of Côte d'Ivoire about the urgency of protecting the nation's remaining forests. He exclaimed that the paucity of funds going to environmental education was having disastrous consequences:

> We have forgotten that raising awareness, that environmental education, is a daily and unending task. We have continued more than ever to utilize the forest as the green gold of our development without concerning ourselves with the consequences. Our forest ecosystem has continued to degrade, forests are savannized. The savannas are desertified (Gomé Gnohité 1998: 4).

How accurate is this image of environmental change in the northern savanna of Côte d'Ivoire found in national environmental planning documents and in the pages of NGO publications? Has the expansion of livestock raising and the area under cultivation led to an increase in grass savannas and a decline in tree cover? Is fire the great destructive force that environmental planners and NGOs believe it to be?

Research undertaken in subhumid savannas of Cameroon (Boutrais 1995: 355–76) and Ethiopia (Coppock 1993) indicates that heavy grazing pressure and burning commonly result in savannas becoming more, not less, wooded. That is, in contrast to arid and semiarid areas where heavy grazing pressure leads to a greater exposure of soils to erosive forces, humid savannas show an inverse tendency towards greater vegetative cover. Woody encroachment has the beneficial effects of protecting soils from erosion and improving soil structure and fertility (Coppock 1993: 55). Do these distinctive attributes of humid savannas provide the basis of constructing an alternative environmental-change narrative? If so, what might its implications be for environmental policy? The examples of Katiali and Tagbanga will provide some answers to these questions.

Discourse 2: Land-User Voices

Local perceptions on environmental change were elicited from farmers and herders though a combination of focus-group discussions, structured and unstructured interviews, walks through the bush, and interviews with selected elders on the environmental history of the region. We first interviewed a sample of 38 peasant households with whom one of us (TJB) has worked for more than fifteen years. Five questions were systematically posed to this sample.

1. When you go out into the bush today, is it the same or different in comparison to when you were young?
2. If it is different, what is the difference and how do you explain this change?
3. There are more cattle in the bush today than there were twenty years ago. What has been the impact of these animals on the bush?
4. Are bush fires the same today as they were when you were younger, or are they different?
5. Is it more or less easy to find firewood today in contrast to when you were young, or has it remained the same?

We were surprised and intrigued by the responses given to the first question. A total of 68 percent of the respondents stated that the bush had become more wooded. Our informants repeatedly told us stories about how the landscape used to be more open in the past, that one could see for great distances, but how this was now impossible because there are so many trees. From our informants' descriptions of past landscapes, the savanna of the 1940s and 1950s was dominated by tree and open-shrub savannas characterized by tall grasses and scattered trees, a number of which were protected because of their economic value (e.g., *Parkia biglobosa*, *Vitellaria paradoxa*). One farmer's observations were representative: "Today there are trees everywhere. The road to M'bengué is closed in on both sides; before you could see far into the distance" (Silue 1995).

When asked to explain the origins of this more wooded landscape, more than two-thirds of the sample linked it to the arrival of Fulbe herds in the region. Respondents associated the increasing number of cattle to a decline in grass cover which has allowed trees to expand in numbers. The mechanisms most often alluded to explain the extension of trees were the dispersal of tree seeds in cattle manure and less intense bush fires. Apparent to some informants was cattle manure's role in favoring the growth of trees in the dense thickets growing up in former cattle corrals in the middle of the bush. Almost a quarter (21 percent) of the sample linked changes in the proportion of woody to herbaceous species to less aggressive bush fires.

Responses to the third question regarding the impact of cattle on the bush echoed those to the second. More than half (56 percent) of the respondents declared there are more trees because there are more cattle. Some (10 percent) associated Fulbe cattle with the appearance of new weeds in their fields like *Commelina benghalensis* and *Euphorbia heterophylla*. Another quarter noted that there is less grass with which to thatch houses due to grazing pressure and grass fires set by pastoralists. The principal grasses used for roof construction, *Andropogon gayanus*, *Andropogon schirensis*, and *Schizachyrium sanguineum*, are highly palatable to cattle (Hoffman 1985: 166). These tall, lignified grasses are burned during the early dry season when animal nutrition is at a stress point (Boudet 1991: 156–59). Farmers say that it takes considerably more time and effort to find sufficient thatch grass these days (Figure 6). Another sign of the shortage of grass is the higher price being paid for a bundle of thatch. In 1995, a large bundle cost 600 FCFA. In 1998, a much smaller bundle cost 750 FCFA.[14]

The largest consensus came in response to the question focused on the nature of bush fires. Ninety-two percent of households agreed that bush fires had changed, and most notably that they were occurring earlier in the dry season, were more frequent, and were less violent. Most respondents attributed the less aggressive fires to Fulbe cattle, saying that their animals "have eaten up all the grasses." Others noted that the presence of more trees and the expansion in cropping area further reduced the fuel that would normally produce extremely hot fires. In the past, fires were set later in the dry season (February-March) by hunters, to enhance their visibility while stalking game. Today, pastoralists set fires as early as October as a range-management tool, to obtain pasture regrowth.[15] Since grasses are not thoroughly desiccated at this time, they do not burn as hot as they would in the late dry season. The increase in area under cultivation has also resulted in larger fire

Figure 6. Dinaba Silue cutting and collecting grasses (*Andropogon spp.* and *Schizachyrium sanguineum*) to thatch the roof of his home, Katiali, 1998.

breaks. When a fire arrives at the border of a harvested field, it usually dies out.

In separate interviews, local hunters agreed that the decline in the proportion of grasses has adversely affected the habitat of a formerly abundant prey, the cane rat (*Thryonomys swinderianus*). Hunters indicated that cattle raising and bush burning had forced the cane rat "to leave the area." Hunting pressure must also be considered an important factor in the cane rat's disappearance.[16]

Responses to the fifth and final question on fuel-wood availability seemed to contradict the above views. Almost two-thirds of the sample of twenty-three women declared that it had become more difficult to find wood due to population growth, the expansion of area under cultivation, and the greater distance of fields from the village.[17] These responses suggest that wood is more difficult to procure as a result of increased demand and the burden of carrying it longer distances. They do not preclude the possibility that there are comparatively more trees in the landscape in comparison to twenty to thirty years ago. Indeed, a quarter of the women reported that it was easier for them to collect wood for three reasons: (1) there are more trees today in comparison to when they were younger (2) the lopping of tree branches by Fulbe herders to give browse to their cattle during the dry season,[18] and (3) because one is free to burn all types of wood today in comparison to the past, when smoky wood was not tolerated. Ten percent of the respondents did not see any changes in the general availability of fuel wood.

To summarize the results of the Katiali household survey, a clear majority of farmers believe that the most striking change in the savanna environment is that it has become more wooded over the past thirty years. They attribute this increase in trees and shrubs to the growing number of livestock, especially Fulbe cattle, and less aggressive bush fires. Grazing pressure and early dry-season fires combine to reduce the intensity of burns. The shift in the proportion of woody and herbaceous plants suggests a major change in savanna ecology due to a changing fire regime.

It is possible that farmers' emphasis on livestock and environmental changes was influenced by their strained relations with the Fulbe. A conflictual relationship exists between farmers and herders over the persistent problem of uncompensated crop damage caused by Fulbe cattle (Bassett 1988, 1994). Blaming the Fulbe for what might be perceived as negative environmental changes would not seem unusual under these circumstances. There are two factors, however, that weigh against a biased interpretation of environmental dynamics. First, farmers do not perceive the expansion of trees in negative terms. To the contrary, they view more trees in the landscape as a positive development because trees will enrich fallow soils while standing, as well as when cut and burned in newly opened fields. It remains to be seen if more trees and roots will hinder the cultivation of these fields by ox-drawn plows. Second, there was strong agreement among herders and farmers on the nature and dynamics of environmental change. The Fulbe also perceived the landscape as becoming more wooded; in explaining the dynamics of environmental change, however, they gave equal emphasis to the expansion of cropland and cattle numbers in the region.

In three separate group interviews, Fulbe herders commented on the expansion of both fields and trees in the landscape. Sita Sangare exclaimed that,

> Before, you could go all the way to Tiébila (15 km to the southeast of Katiali) without seeing a field. Now all that has changed. There are more fields and more cattle. . . . The cattle have eaten the grass which has allowed trees to grow" (Sangare 1995).

Informants declared that there are too many cattle in the region. A major factor behind the influx of cattle is the pastoral dam constructed in 1983 one km southwest of Katiali, which provides a year-round supply of good drinking water. Another factor is the decline in tse-tse flies in the region (Erdelen et al. 1994).

There was a consensus among Fulbe informants that grass cover has declined and trees have expanded as a result of higher grazing pressure, soil trampling, and declining rainfall. Grasses that are no longer common are *Andropogon gayanus*, *Rottobellia exalta*, and *Pennisetum pedicellatum*. These highly palatable species appear in fallow fields after two to three years of rest. Under heavy grazing pressure, however, they are replaced by less palatable annual grasses. The disappearance of *Andropogon* and other perennial grasses in the early years of long fallow cycles indicates that the soil is not reconstituting itself as it would in the absence of cattle (see below). Pastoralists attributed this vegetation change to the combination of grazing pressure and agricultural practices. One herder exclaimed:

> There are far too many cattle, and there is not enough rain. There used to be some rainfall during the dry season, which produced fresh grasses. Not any more. . . . There are too many animals and too many fields. It is more difficult to graze animals because you have to avoid crop damage (Sangare 1995).

One informant referred to the increased use of herbicides by peasant farmers as another reason for the decline in palatable species.

In summary, like farmers, herders believe that the savanna has become increasingly wooded in recent decades. They attribute the decline in good forage grasses primarily to heightened grazing pressure and reduced rainfall. Increased grazing pressure is thought to be the result of the combined expansion of cropland and cattle in the region. Herders clearly sensed a squeeze on range resources as relatively less land is now available for grazing. Despite these pressures, the Fulbe believe that rangelands are still in good condition and that their cattle find good pastures farther south during their seasonal 100–300-km trek.

The Tagbanga survey elicited remarkably similar perceptions of environmental change. Forty-two individuals residing in three communities (Tagbanga, Tiakaha, Nahoualakaha) were asked a series of questions pertaining to the evolution of the savanna, the frequency of fire, the availability of wood for construction and cooking, and access to arable land. In response to the question, if the savanna was more or less wooded since their childhood, more than half (57 percent) declared that it had become more wooded. Five percent of the respondents said that it had become less wooded. Fully 38 percent gave evasive responses. Concerning the frequency of bush fires, nearly three-quarters (74 percent) of the respondents stated that they were less frequent. Another 11 percent believed they were more frequent while 14 percent had no opinion.

A surprising finding was that all of the respondents stated that it was easier to find wood for construction and cooking today than in the

past. This is logical in light of the view that the landscape is more wooded, but surprising in light of the density of population. When asked if there was more or less land available for cultivation today versus the past, 48 percent declared that there was less land due to population increases, while 43 percent of the respondents stated that more land was available due to the breakup of collective fields, the individualization of holdings, and the emigration of young men.

In summary, the Tagbanga survey indicates that most people believe that the landscape has become more wooded, that wood is more readily available for construction and cooking purposes, and that bush fires are not as intense today as they were in the past. These observations are remarkably similar to those made by land users in the Katiali area. In the following section, we examine the literature on savanna ecology to determine if there is a scientific basis to these locally perceived landscape changes.

Fire, Cattle, and Savanna Ecology

Savannas are plant communities characterized by a continuous grass layer in which trees and bushes of varying height and density are found (Adams 1996; Menaut 1983). In natural savannas (i.e., regularly burned and lightly grazed lands), perennial grasses account for up to 95 percent of the grass cover. The extent of ligneous cover is the criteria most often used in the nomenclature to classify savanna-plant communities. According to Riou (1995: 45–46, 56–65, 96–100) an open forest [*forêt claire*] is made up of tall trees (8–20 m) which almost form a continuous upper story (60–80 percent) and a practically continuous herbaceous, primarily grass understory. The tree cover becomes more dense and irregular in the savanna woodland [*savane boisée*] where trees between 5 and 18 m cover 40–70 percent of the upper story. A tree savanna [*savane arboré*] is characterized by trees 8–15 m in height that enclose 20–50 percent of the upper story. A dense cover of grass encloses 90–95 percent of the lower story. Shrub savannas fall into two categories: open and dense. In an open shrub savanna [*savane arbustive claire*] with a rainfall regime similar to the Katiali region, low shrubs (2–8 m) dominate and enclose 15–20 percent of the upper story while grasses cover up to 90 percent of the understory. A dense shrub savanna [*savane arbustive dense*] is characterized by a greater diversity and density of shrubs (more than 20 percent of the upper story) in comparison to open shrub savannas (Mitja 1992: 64–72).

In northern Côte d'Ivoire, all of these types are present and usually distributed in mosaic form across the landscape. Figure 2 illustrates a typical soil catena of the Katiali region and its associated plant communities. This cross-section does not capture the common mosaic pattern of savanna vegetation. The distribution of plant communities is affected by a number of human and biophysical influences that include shifting cultivation, grazing, and fire, as well as topography, soils, and rainfall. Fire is considered to be so important in the maintenance of savannas that they have been called "pyro-climatic" formations. It is widely believed that in the absence of fire, savannas would become increasingly wooded. Controlled burning in experiment stations in Côte d'Ivoire and Nigeria shows that parcels protected from fire evolve toward forests, while those subjected to extremely hot, late-dry-season fires support very few trees. When fires are set during the early part of the dry season, fire-sensitive trees have a better chance of surviving a burn and tend to compete more aggressively with grasses (César 1994; Gillon 1983: 626–27) (Figure 7). During the early part of the dry season, grasses are not completely desiccated and will not burn as hot as they would if burned in the latter part of the dry period (Gillon 1983: 618–19).

In addition to the time of year in which burning takes place, fire frequency and grazing pressure will also influence fire intensity and rates of bush encroachment. Heavy grazing reduces the amount of combustible material that will burn. Shrubs compete more effectively with grasses for soil nutrients and water when grasses are weakened by repeated grazing (Gillon 1983: 636–37). Infrequent fires (e.g., once every three to five years) will produce higher fuel loads and more intense burns. More frequent (annual) burning will have the opposite effect. In summary, there is a consensus among savanna ecologists that frequent and early-dry-season fires, combined with heavy grazing, are conducive to tree and shrub encroachment.

These dynamics are particularly striking in fallow fields in the two study areas. Studies conducted by Mitja (1990), Bruzon (1990), and César and Coulibaly (1993) show that the reconstitution of soils and vegetation is severely

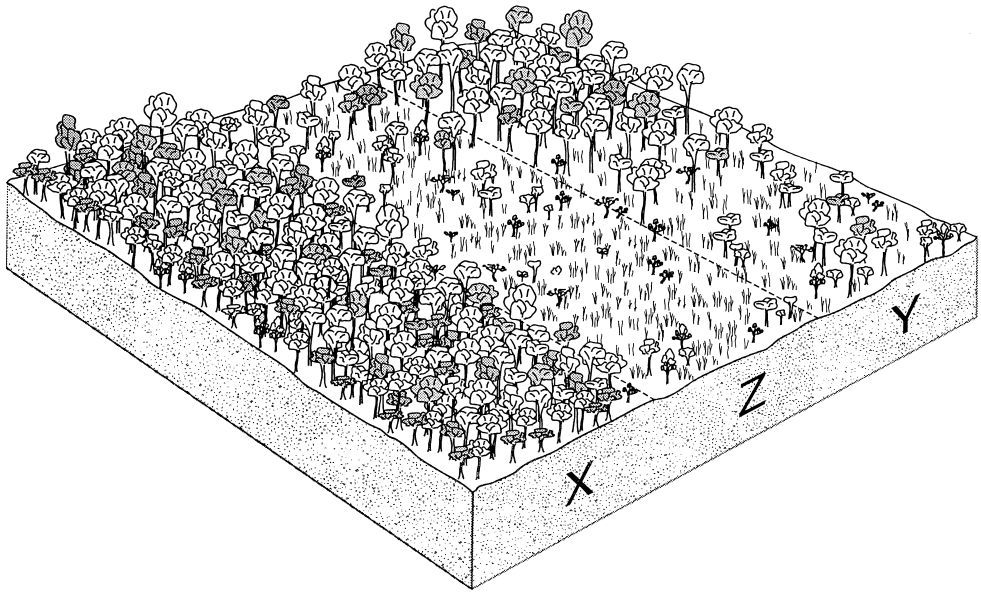

Figure 7. The impact on vegetation of fire control experiments at Konkondékro (Côte d'Ivoire). When fire is prohibited (parcel X), the savanna evolves towards a dense forest; intense late-dry-season fires in parcel Z result in either a grass or open shrub savanna; less violent early-dry-season fires lead to more wooded savannas in parcel Y. Source: Adjanohoun 1964: 131–32; Monnier 1974: 68–69.

disrupted by heavy grazing and weak fires. When grazing is light and fire is permitted to pass, a fallow field will evolve into a savanna woodland within 20–40 years time, depending on soil type and total rainfall.[19] César and Coulibaly (1993: 416–18) present a six-stage model of "natural fallow evolution" in a lightly grazed savanna on sandy-clay soils north of Korhogo.

1. Recent fallow (1–3 yrs): forbs and annual grasses dominate (*Euphorbia hirta*, *Borreia verticillata*, *Pennisetum spp*.
2. Young fallow (2–5 yrs): perennial grasses such as *Andropogon gayanus* and *Imperata cylindrica* begin to spread; young trees and shrubs begin to grow by suckers or crown sprouting.
3. *Andropogon gayanus* fallow (5–15 yrs): *Andropogon gayanus* becomes dominant and reaches its maximum extent; soil humus develops due to extensive above and underground biomass; trees attain a basal diameter of 5 to 10 cm.
4. Old fallow (15–25 yrs): *Andropogon gayanus* continues to dominate but savanna grasses like *Hyparrhenia subplumosa*, *Andropogon chiensis*, and *Schizachyrium sanguineum* begin to overtake it in later years.
5. Nearly reconstituted savanna (25–30 yrs): savanna grasses now dominate (95 percent) the herbaceous layer. *Andropogon gayanus* is eliminated. "The herbaceous strata has attained a state of equilibrium but the ligneous population is still young" (César and Coulibaly 1993: 417).
6. Reconstituted savanna (greater than 30 yrs): young tree savanna evolves into a wooded savanna or open deciduous forest. Fire passes regularly.

The replacement of *Andropogon gayanus* by savanna grasses in stage 4 is a sign to farmers that soil quality is sufficiently good to farm once again.

Heavy grazing and weak fires effectively block this evolutionary process. Xavier LeRoy's study of the evolution of fallow fields in Synofan, a community less than 100 km west of Katiali, showed that 15-year fallows had not yet evolved to the *Andropogon gayanus* stage (LeRoy 1993). They were instead dominated by annual leguminous plants (*Zornia glochidiata*, *Alysicarpus ovalifolius*, *Tephrosia spp*.) and characterized by "all the signs of pastoral degradation: bush invasion, the disappearance of perennial grasses, the multiplication of dicotyledons, and an over-

all decline in herbaceous ground cover" (LeRoy 1993: 167). Soil organic matter was not developing in these heavily grazed fallows, forcing Synofan farmers to search for much older fallows to cultivate. The case studies of Katiali and Tagbanga illustrate this dynamic operating in areas with contrasting population densities.

In summary, farmer and herder perceptions of environmental change are supported by extensive research on savanna ecology and range management in the tropics. Both the general literature and that focused on northern Côte d'Ivoire demonstrate clear links between increased grazing pressure and changing fire regimes on the competition between woody and herbaceous species. Local perceptions and the scientific literature agree that woody species become dominant in landscapes where heavy grazing and less intense fires have allowed tree and shrub seedlings to establish themselves. Controlled experiments show that areas protected from grazing, and in which late-dry-season fires are allowed to pass, evolve toward savannas in which perennial grasses dominate. Given the importance of fire in shaping the "natural" vegetation in this area, we can conclude that this is a nonequilibrium environment characterized by a variety of vegetation states and transitions depending on the timing and intensity of fire (Behnke and Scoones 1993; Sprugel 1991; Westoby et al. 1989). In areas where aggressive fires dominate, the landscape will evolve in the stage-like manner outlined by César and Zoumana. Where fires are less aggressive, due to changes in biomass or in their timing and frequency associated with livestock raising, different vegetation states will dominate. In short, the farmer-herder survey and specialist literature concur that the increasing dominance of woody growth in the Katiali and Tagbanga areas is linked to changing fire regimes and land use. In the following section, we present the results of aerial-photo interpretation to determine whether one can detect a shift in the proportion of woody versus grassy savanna types between the 1950s and 1990s.

Local Perceptions and Aerial-Photo Interpretation of Vegetation Change

Our analysis of aerial photographs was constrained by the dates, coverage, and scale of available photos. For Katiali, aerial photos were available for 1956 and 1989 at the scale of 1:50000, but the coverage of the two years is different. Only a 65 km^2 portion of the Katiali territory was included in the 1989 photographs. Despite the limited coverage, we believe that the land-cover changes discussed below are representative of the wider region. For Tagbanga, aerial photos are available for 1956 and 1993.[20] The territories of a number of neighboring villages are included in the Tagbanga analysis for two reasons. First, the relatively high density of villages makes for an imbricated land use pattern. Tagbanga farmers cultivate land controlled by lineages in neighboring villages. Second, the area covered in the aerial photos covers all of these villages (Figure 1).

The relatively small scale of these photos hinders interpretation in two significant ways. First, it is impossible to distinguish between savanna woodlands and open deciduous forests. Similarly, one cannot differentiate tree savannas from dense shrub savannas at a scale of 1:50000. As a result, we were forced to collapse these four savanna-plant formations into two categories, open forest-savanna woodland and dense savanna shrub, in preparing the land-cover maps for Katiali (Figure 8) and Tagbanga (Figure 9). Second, the extent of bush encroachment is not evident in these photos because of the difficulty in distinguishing the height of woody plants. Thus, what might appear on photos as woodlands may in fact be a tree savanna experiencing heavy shrub invasion. On the ground, there is a noticeable difference between a savanna woodland characterized by uniformly tall trees and a bush-encroached tree savanna marked by trees and shrubs of varying height but exhibiting a density comparable to a wooded savanna. These interpretive difficulties point to the limits of aerial-photo interpretation as a method of analysis. Yet when used in conjunction with the other methods employed in this study (household surveys, focus-group discussions, ground truthing, vegetation transects, or review of the savanna-ecology literature), aerial photos can be a useful interpretive tool.

Land Cover Changes in Katiali, 1956 and 1989

The most striking change in Katiali's land cover is the dramatic drop in open bush savanna

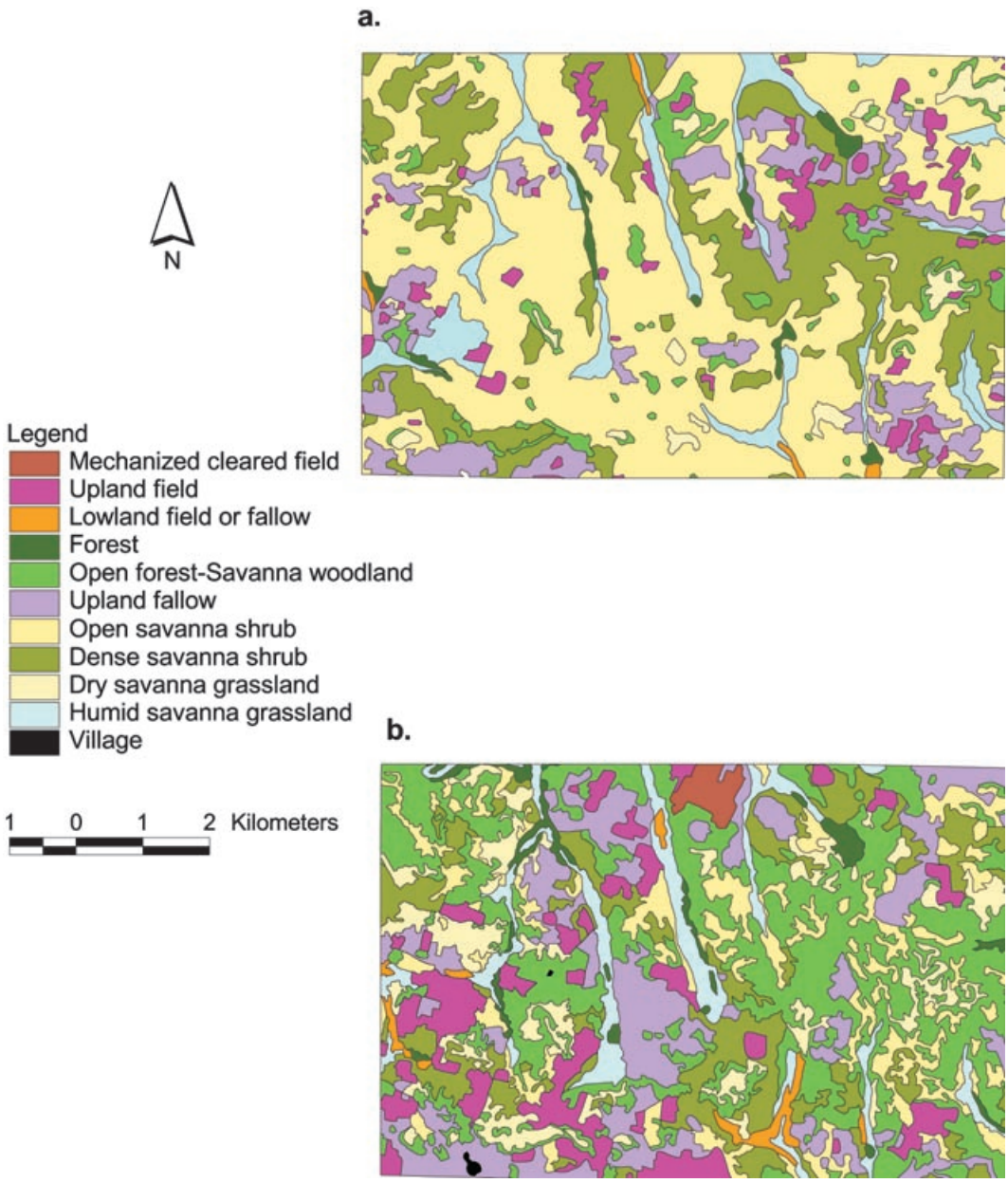

Figure 8. Land-cover changes between a. 1956 and b. 1989, Katiali (Côte d'Ivoire).

and the noticeable increase in area categorized as woodlands (savanna woodland and open deciduous forest) (Figures 8 and 10). Open bush declined from 46 percent to 12 percent between 1956 and 1989, while the area in woodlands increased from 4 percent to 31 percent of the area. These findings confirm the perceptions of local residents that the landscape has become more wooded. It has also become more cultivated as shown by the increase in area in cropland. This category includes both fallow lands for which the field limits were still visible in the photos and land under cultivation. The area in grasslands and gallery forests remained relatively stable while the area in dense bush declined by 6 percent.

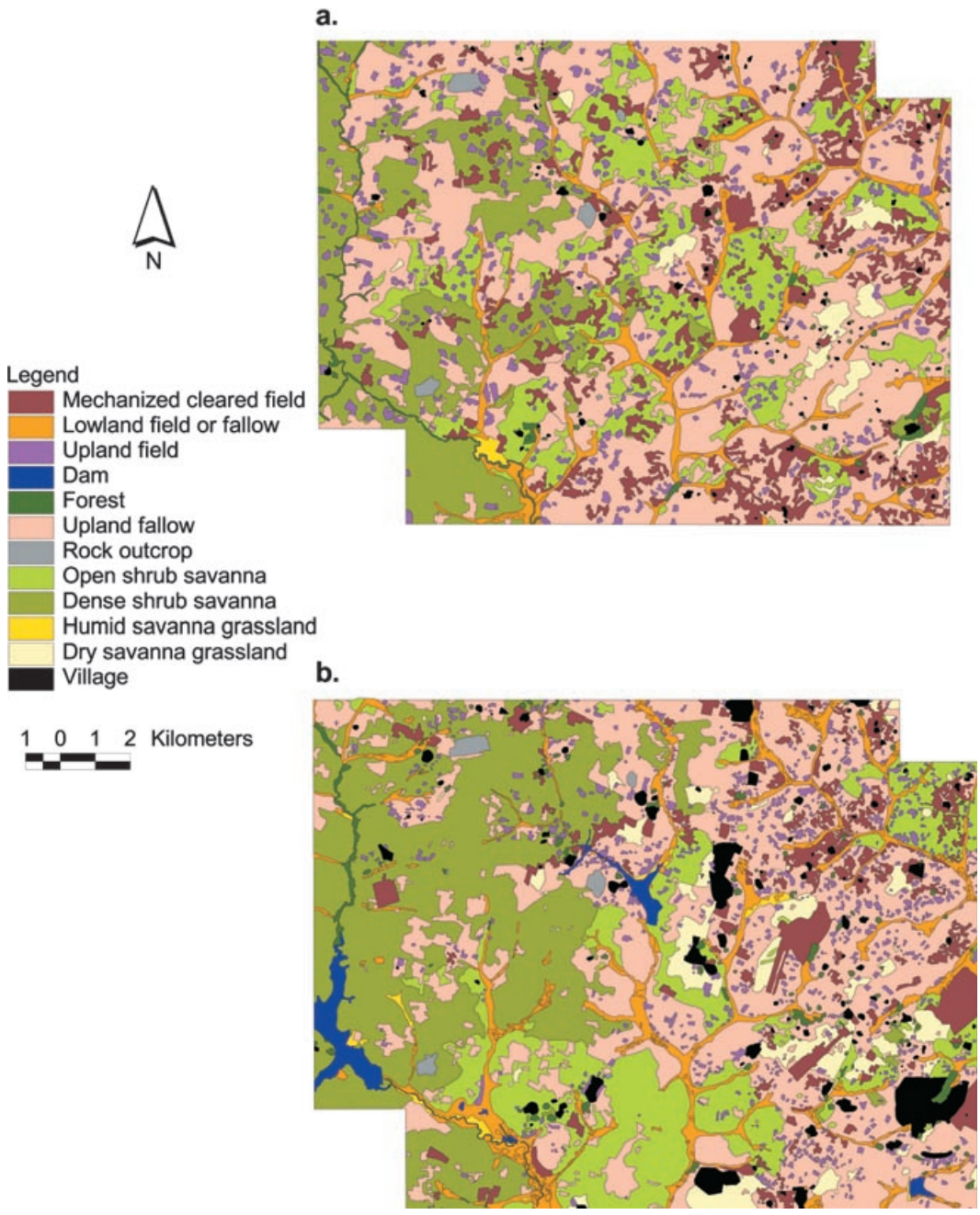

Figure 9. Land-cover changes between a. 1956 and b. 1993, Tagbanga (Côte d'Ivoire).

To examine more closely the dynamics of vegetation change, we visited a number of locations in the Katiali area where informants indicated the landscape had become more wooded.[21] We were shown two types of wooded places. The first was located within a 3-km radius of the village where both agricultural and grazing pressure is relatively high. Vegetation transects 50 m in length were run along different sections of the soil catena in the area locally known as "Kafongon." Figure 11 shows the results of one of these transects located 1 km from

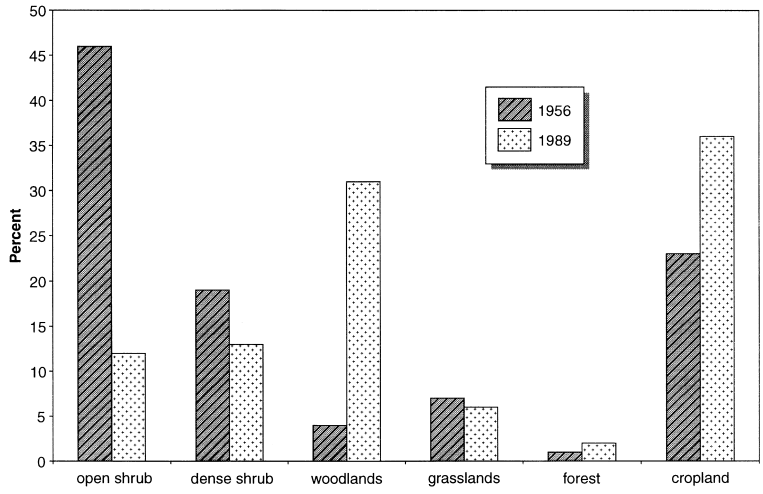

Figure 10. Land-cover changes, Katiali, 1956 and 1989.

the village in a 15-year-old fallow field situated at the upper slope on sandy-gravely soils. Before being cultivated in the late 1970s and early 1980s, it was an open tree savanna dominated by the economically useful and protected *Parkia biglobosa* and *Vitellaria paradoxa* and perennial savanna grasses such as *Schizachyrium sanguineum*. One informant said that when he was a child in the late 1950s and early 1960s, one could easily see into the distance because there were so few trees. He also mentioned that fires were so intense, they would light up the night sky (Kone 1998). In 1998, the site was obviously closed in on all sides and experiencing shrub invasion. It was described by Jean César, an authority on range management of tropical savannas who visited the Kafongon site with us, as a "bushed invaded savanna woodland that is becoming a dense open forest dominated by *Isoberlinia doka* but with an understory (i.e., grass layer) that does not correspond to its age" (César 1998). According to César and Coulibaly's model of fallow vegetation succession, the site should have been dominated by *Andropogon gayanus*, but there were only a few tufts of this perennial present. Instead, the site was dominated by the less palatable annuals *Tephrosia pedicellata*, *Hyptis suaveolensis*, and *Cassia mimo-*

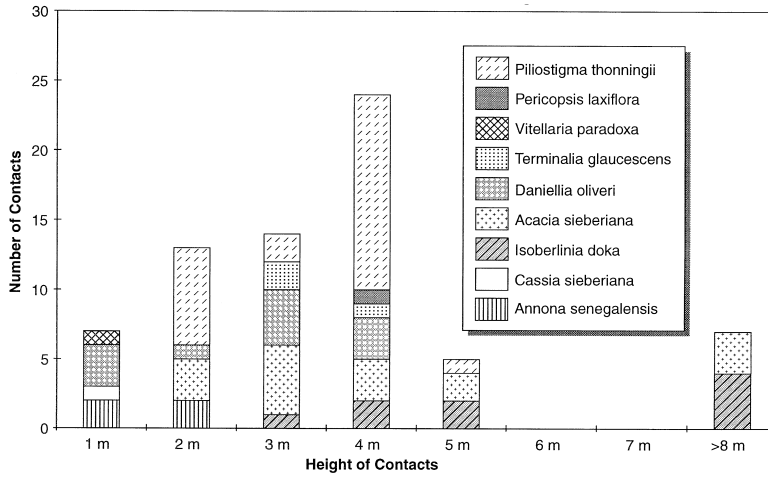

Figure 11. Structure of ligneous species in 1997, Kafongon transect, Katiali.

Figure 12. Coauthor Tom Bassett and plant specialist Amani N'guessan record ligneous species along a 50-m transect in the Kafongon area of Katiali, January, 1998.

sidies. From a range manager's perspective, the herbaceous layer was "extremely degraded" (César 1998).

Using the contact-point method adapted from Daget et Poissonet (1971) by César and Zoumana (1995), we found that 83 percent of the trees encountered along the Kafongon transect touched our pole at a height less than 4 m. This low height suggests a strong bush-encroachment dynamic (Figure 12). A mosaic pattern of burnt patches indicated low levels of flammable biomass and low-intensity bush fires (Figure 13). Three species of trees dominated the transect: *Piliostigma thonningii* (34 percent), *Acacia sieberiana* (23 percent), and *Daniellia oliveri* (16 percent).[22] César described the site as a "tree fallow" in which trees rather than perennial grasses are reconstituting soil-fertility levels.

The second type of "wooded place" we were shown was located in areas more distant (>3 km) from Katiali where village cattle do not graze but which are more frequented by Fulbe herds. In these locations (e.g., Loupka transect, Figure 14), trees and shrubs were seen expanding out from the edge of small clumps of trees to form larger agglomerations. Even in the absence of grazing pressure and changing fire regimes, trees expand in savannas in this manner (Skarpe 1991). Informants noted, however, that the agglomeration process had accelerated and that trees had succeeded in establishing themselves beyond the edge of these groves out into open areas. This became apparent to us when we examined the tree and grass species dominating the Loupka site—a 20-year fallow with sandy-clay soils that had been cultivated between 1973 and 1979. Following César and Coulibaly's scheme, the fallow should have been dominated by *Andropogon gayanus* and savanna perennials like *Hyparhennia dissoluta*. Although *Andropogon* and *Schizachyrium* were present, annual plants were everywhere, especially the unpalatable *Ctenium newtonii*, *Elionuros ciliaris*, and *Tephrosia pedicellata*. After 20 years, one would

Figure 13. Uneven burn pattern in heavily grazed 15-year-old fallow in Kafongon area of Katiali, January, 1998.

also expect to find trees like *Isoberlinia* 15–20 m in height. Instead, all of the trees we encountered along a 50-m-long transect were below 4 m. The three most common species were *Dicrostachys cinerea* (34 percent), *Piliostigma thonningii* (27 percent), and *Isoberlina doka* (20 percent).[23] Audru (1975: 31) identifies *Isoberlinia* and *Piliostigma* as aggressive invaders of disturbed savannas.

These invading woody species would normally have been checked by late-dry-season fires, but grazing pressure and changes in fire intensity have allowed these pioneering species to survive. Perennial grasses, with their dense root systems and tall height, compete vigorously with tree seedlings for water, soil nutrients, and sunlight. As grazing pressure increases, the root systems do not develop and grass height diminishes. Under these conditions, trees can compete more effectively and will spread, especially if bush fires are not too intense. We predict that the Loupka site will evolve into a more thickly wooded area in the next five years under existing conditions. The case of Tagbanga offers further proof that the desertification narrative is extremely problematic, even in the more densely settled areas around Korhogo.

Land Cover Changes in Tagbanga 1956 and 1993

Figures 9 and 15 illustrate the salient changes in the Tagbanga area. The most surprising trend is the overall decline in cropland and the increase in savanna vegetation. The cultivated area (including fallow) declined from 66 percent to 55 percent of the total area. This trend makes sense in light of the high rates of emigration and decline in population density in the subprefecture of Torioniaradougou between 1975 and 1988. Savanna vegetation cover increased from 34 percent of the area in 1956 to 44 percent in 1993. The category of savanna vegetation that showed the greatest increase is tree and dense shrub savannas. It increased from 16 percent of the area in 1956 to 25 percent in 1993 (Figure 15). This change is particularly apparent in the western portion of the land-use map shown in Figure 9. The amount of land in

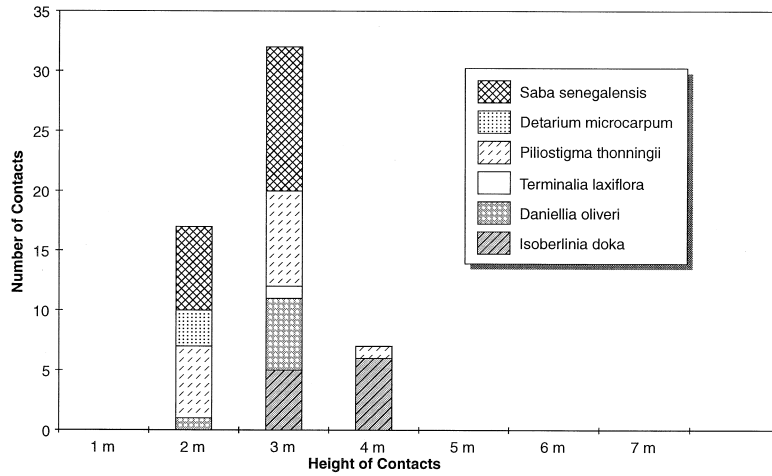

Figure 14. Structure of ligneous species in 1997, Loupka transect, Katiali.

forests and open bush savanna remained relatively stable while the area in grass savannas increased by 2 percent. A striking difference between the two research sites is the important presence of open forests and savanna woodlands ("woodlands") in Katiali and their absence in Tagbanga. Another contrast is the decline of tree and dense bush savannas in Katiali and their significant increase in Tagbanga. This diversity of savanna vegetation types points to one of the many lessons stemming from the two case studies.

The Lessons of the Katiali and Tagbanga Case Studies

A major finding of this comparative research on land-cover changes in the Katiali and Tagbanga areas is that, contrary to received wisdom, the savanna has become more wooded over the past thirty years. This finding runs counter to the dominant narrative, which assumes that the savanna has become less wooded and increasingly dominated by grass savannas. It also extends, both geographically and analytically, the

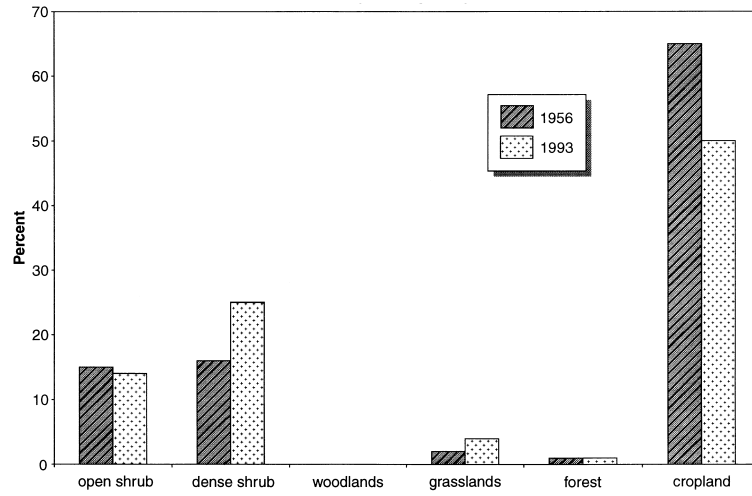

Figure 15. Land-cover changes, Tagbanga, 1956 and 1993.

findings of Fairhead and Leach on the expansion of wooded landscapes in the forest-savanna transition zone of Guinée (Fairhead and Leach 1996) to the sudanian savanna.

A second finding points to the diversity of savanna vegetation communities in the Korhogo region. The similarities and differences in the transformation of the Tagbanga and Katiali savanna areas underscore the importance of temporal and spatial variations in environmental change. This finding conforms to the scientific literature on savanna ecology that points to a wide range of plant communities, which are commonly distributed in mosaic form across the landscape. The most important factors influencing the nature and direction of vegetation change are farming systems, grazing pressure, population density, and changing fire regimes. These factors, which are themselves linked to changing political and economic processes extending beyond the region (e.g., cotton-development policies, immigration of Fulbe herders, or farmer-herder conflicts), interact with a host of biophysical factors such as soil type, slope, and rainfall to create temporally and locationally specific outcomes.

A third finding of this research is its relevance to environmental planning. Despite its problematic scientific status, the desertification narrative currently guides environmental policy. For example, NEAP-CI recommendations to combat the assumed reduction in tree cover include the regulation of bush fires through a range of increasingly coercive measures, restrictions on wood cutting, and the promotion of village-level tree planting (RCI 1994a). In light of the findings of this case study, such policy recommendations can be seen as misconceived and a waste of limited resources. The disjuncture between national and global environmental discourses and actual vegetation-change patterns is alarming. Our findings show that although desertification is not taking place, heavy grazing and early fires have significantly reduced the quality of the savanna for livestock raising. Tree and shrub invasion and a highly degraded herbaceous layer were evident in both the Katiali and Tagbanga study areas. Since livestock development is a priority of the Ministry of Agriculture, one would think that rangeland rehabilitation would be a centerpiece of the Côte d'Ivoire NEAP. Not surprisingly, it is nowhere to be found in NEAP documents which are more concerned with reforestation than range condition. While environmental analysts and planners are occupied with an imaginary environmental problem, tree and bush encroachment continues unabated. This disjointed scale problem also produces its contradictions. For example, the Ivorian NEAP's recommended regulation, permitting only *early*-dry-season fires, would result in further bush invasion. To improve range conditions, degraded areas will have to be protected from grazing for at least two or three years, and woody growth must be controlled by extremely hot (i.e., *late*) bush fires (César 1994).

Conclusion

Given the extraordinary amount of environmental planning currently underway in Africa and its far-reaching implications on land use, access and management, one obvious conclusion of this study is that further research on environmental-change dynamics is of utmost importance. Indeed, the World Bank places the identification of environmental problems and their underlying causes as the first step in the NEAP process. Yet, from all indications, the Bank does not consider this to be a particularly challenging phase. Despite the glaring gaps in our knowledge, the Bank believes that most environmental issues are easy to identify and can be classified along a simple color scheme.[24] A conclusion of this paper is that identifying environmental problems and their causes is one of the most difficult and time-consuming stages in environmental planning and policy making.

One of the challenges in confronting the environmental-data problem is that so little data exist with any meaningful time depth. Even where data like aerial photographs do exist, their relatively small scale rarely permits one to make little more than very general statements. This situation demands that multiple approaches be pursued to determine the spatial and temporal dynamics of environmental change that are not apparent in aerial photos. In this study, we have combined household-survey research focused on farming systems and environmental perceptions with aerial-photo interpretation and vegetation transects to identify the general trends in vegetation change. This multiscale, multimethod approach yielded different results from the so-called "participatory approach" followed in the NEAP process, in which the opinions of selected individuals from differ-

ent social strata were solicited in public meetings. Not surprisingly, peasants and herders were reticent in such fora.

A third point centers on competing discourses on environmental change. In contrasting the environmental narratives expressed in World Bank and NEAP documents with those of rural land users, it would be misleading to suggest that a homogeneous view prevails on either side. For example, peasant farmers downplayed their own role in transforming savanna vegetation through their agricultural activities by pointing their finger at Fulbe herders as the primary agents of environmental change. This tendency to "blame" the Fulbe must be contextualized in the often bitter conflicts that exist between farmers and herders in northern Côte d'Ivoire. Similarly, the tendency of the Fulbe to deny their use of fire as a range management tool and to "blame" farmers and hunters for bush fires must be seen in light of these land-use conflicts.

Fourth, it is also clear that the environmental-crisis lexicon is widespread. Despite the disparate goals of the World Bank, the Ministry of the Environment, and environmental nongovernmental organizations, they share an environmental-crisis imaginary that gives meaning and an immediacy to their missions. The visual imagery of an expanding desert is a powerful framing device that demands equally dramatic solutions, such as the establishment of green belts along the eighth parallel and imprisonment as punishment for lighting bush fires.

Finally, there are striking historical parallels between colonial-era writings on land degradation and control and contemporary environmental planning. Both blame farmers and herders for recklessly destroying the land and altering local climates, programmatic statements abound while good data are hard to come by, and proposed conservation measures invariably involve increased state intervention in the countryside with an emphasis on transforming land-rights systems, specifically the exclusion of local people from protected areas. These recurring themes, principal players, and silences regarding the goals and resource management strategies of farmers and herders suggest that we are operating within a regional discursive formation. What is different between the 1930s and the 1990s is the number of contestants involved in environmental management. In addition to the state, there are NGOs and development-aid organizations seeking to establish their authority and legitimacy as environmental advocates and stewards. The desertification narrative persists in part because it serves to mobilize support for these groups' varied agendas. This paper has privileged the voices and experiences of farmers and herders whose understanding of environmental change is more nuanced and sophisticated than the dominant narrative. From all indications, this local understanding of the nature and direction of environmental change is not reflected in the Côte d'Ivoire National Environmental Action Plan. As in the past and despite the rhetoric of decentralization and participatory planning (Little 1994; Ribot 1999; Schroeder 1999), this case study shows that the perceptions of ordinary men and women are marginalized in contemporary environmental planning in sub-Saharan Africa.

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Notes

1. The IDA is the "soft loan window" of the World Bank Group that offers loans to member countries with average annual per-capita incomes of $1,465 or less at concessionary rates.
2. On the social construction of nature in human-environmental research in geography, see Demeritt (1996).
3. Measurements were made every 50 cm along the 50-m transect. If a woody plant came into contact with the 8-m high pole at this interval, we noted the species of plant and the height at which it touched the pole. Figures 11 and 14 show the number of times a species touched the pole (y-axis) at a specific height (x-axis).
4. The relatively higher levels of male emigration from the subprefecture of Niofouin resulted in a population structure in which there were just 88 males for every 100 females (Kientz 1991: Annex 4, p. 2).
5. The 1975 census put Katiali's population at 1492

persons. By 1988, it had increased to 1870 (See Kientz 1991: Annex 5, p. 20).

6. The two surveyed villages were Takpalakaha (S-P Napié) and Sologo (S-P Tioroniaradougou).
7. The population structure of the subprefecture of Tioroniaradougou indicates that males dominate the migration stream. There were just 82 males for every 100 females in the subprefecture in 1988 (Kientz 1991: Annex 4, p. 2).
8. The oxen data are for the departments of Boundiali, Korhogo, and Ferké, which together accounted for 87 percent of the oxen in Côte d'Ivoire in 1991.
9. The success of this control program continues to rest on the placement of conical-shaped traps treated with Deltamethrine along the course of gallery forests. Sita Sangare also believed that tse-tse flies are killed by the insecticides (Biticol and Butox) owners spray on their animals.
10. The livestock census was conducted annually by village-based extension agents of the now-defunct national livestock-development agency (SODEPRA).
11. The land area of the Korhogo II and Niofouin pastoral zones amounted to 1680 km^2 and 1650 km^2 respectively.
12. *Fraternité Matin* is controlled by the Democratic Party of Côte d'Ivoire (PDCI).
13. Since 1986, committees were nominally organized at the prefecture and subprefecture levels to raise local awareness about the dangers of bush fires. The mission of the *Comité national de défense des forêts et de la lutte conre les feux de brousse* is "to study and propose to government the methods and means for fighting bush fires and for protecting the forest ("360 millions pour équiper le Comité de lutte" 1998: 13)." A miniscule budget ($5200 in 1998) severely limits this group's activities.
14. The exchange rate over this period was 500 FCFA to one U.S. dollar.
15. Fire is also used to control ticks and tse-tse flies (Gillon 1983: 630, 636).
16. Cane rats were the second most common animal sold in bushmeat markets in 1982. They accounted for 19 percent of all game sold to merchants visiting Katiali weekly over a twelve-month period. By 1997, cane rats accounted for just 3 percent of the animals sold to commerce. The green monkey (*Cercopithecus aethiops, var. sabaeus)* was the most abundant animal sold in 1982, accounting for 41 percent of all bushmeat sales. As they are commonly found in wooded areas, one would think that their numbers might increase with the expansion of tree cover in the region. Not so. The number of green monkeys marketed dropped to 7 percent of all animals sold in 1997. Hunters generally agreed that the green monkey's decline is due to hunting pressure.
17. Women typically collect wood in the vicinity of the household's fields.
18. The most commonly browsed tree species are: *Ficus gnatholcarpa, Pterocarpus erinaceus, Ficus capensis*, and the young leaves of *Pericopsis laxiflora* and *Isolberlinia doka*.
19. Fallows will evolve into wooded savannas in 20-years time in higher rainfall areas south of Korhogo on sandy-clay soils. This evolution will take up to 40 years in the northern savannas characterized by sandy-gravel leached soils and lower rainfall.
20. The 1993 aerial photos are at the scale of 1:20000.
21. Our Senufo and Jula informants distinguished between two general types of savanna landscapes: wooded and open. The Senufo say *tétungo* to indicate "a place where there are a lot of trees," in contrast to an "open place" or "*téfigue*." In Jula, the comparable terms are "*a yoro tura*" and "*a yoro kenegbe*."
22. In a nearby 10 × 10-m plot, trees were dominated by *Desmodium velutinum* (28 percent), *Piliostigma thonningii* (21 percent), and *Gardenia erubescens* (15 percent).
23. In an adjacent 10 × 10-m plot, the dominant species were: *Isoberlina doka* (52 percent), *Piliostigma thonningii* (15 percent), and *Dicrostachys cinerea* (11 percent).
24. Blue for water-related issues, green for land, brown for urban, and red for cultural-heritage issues (Greve et al. 1995: 8).

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