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## Natural forest management in semi-arid Africa: status and research needs

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*This article reviews a number of the major issues related to natural forest management in arid and semiarid Africa. It is based on the authors' experiences and the results of the FAO Workshop on Participatory Management of Natural Forests in the Sahelian Zone, held in Ouagadougou, Burkina Faso in May 1990.*

One of the primary causes of environmental degradation and loss of natural forest cover in Africa is the lack of forest management plans and the means to implement such plans. This is largely a result of the fact that past efforts have focused on plantation forestry to introduce fast-growing exotic species rather than managing existing forests. Official (i.e. government) forest management in the past has often involved uprooting existing "useless brush" to make space for industrial plantations or village woodlots. Many of these efforts have failed for a variety of reasons: plantation costs were underestimated; production was overestimated; and perhaps most importantly, the projects did not involve local people (or even local technicians) in the design phase. The end result of this approach has been a wealth of research and information regarding the growth and silvicultural practices related to exotic species, and relatively little experience with the management of natural forests. Moreover, traditional management systems have been discouraged by governments who continue to maintain authority over vast forest areas, which are grazed and cut haphazardly with little control by forest agents (who attempt to apply laws in the absence of a forest management plan). Land-use planning and natural forest management must be made an immediate priority if the remaining forest resources of arid and semiarid Africa are not to be further diminished or even entirely lost.

### Location and composition of semiarid forests in Africa

#### West Africa

The semi-arid areas of West Africa can be divided into two belts with respect to rainfall: the Sahara-Sahel belt, with an annual rainfall of between 150 and 600 mm, and the Sudano-Sahel belt, with an annual rainfall of between 600 and 1000 mm. The isohyet for 600 mm cuts through the northern parts of Senegal, Burkina Faso and Nigeria, while Mauritania, Mali, the Niger and Chad have most of their territories north of this line. Most of the region's natural forests are found south of this line, except for riverine forests of mainly *Acacia nilotica* and open gum forests (*Acacia senegal*). This article concentrates

on the Sudano-Sahel, between the isohyets 600 and 1000 mm and the countries Burkina Faso, Mali, the Niger, Senegal and Chad. Nigeria is omitted as we have no information dealing specifically with the Sahelian forests in the northern part of the country.

Jackson *et al.* (1983) describe the composition of Africa's semi-arid forests as follows:

"In the driest areas, *Acacia tortilis* ssp. *raddiana* dominates. As the rainfall increases, it is succeeded by other acacias, notably *A. senegal* and *A. laeta*, with *A. seyal* on the heavier soils; and areas of *Commiphora africana* and *Ziziphus mauritiana*. Under still higher rainfall the Combretaceae begin to dominate, with *Anogeissus leiocarpa*, *Combretum glutinosum*, *C. micranthum* and *Guiera senegalensis*. This zone is succeeded by forest that includes *Isoberlinia doka* *Pterocarpus erinaceus*, *Daniellia oliveri* and *Khaya senegalensis*. In the wetter parts, closed stands may form. Finally, in Casamance in Senegal, species more characteristic of the tropical rain forest, such as *Daniellia ogea* and *Erythrophleum ivorence*, begin to appear.

A characteristic of many areas is a forest that is strongly influenced by man's activities and in which certain species that are chiefly valued for their fruits are left after the remaining forest has been cleared for cultivation, thus leaving an open parkland. In drier areas, the main species of this 'anthropogenic' forest are *Adansonia digitata* (baobab) and *Acacia albida*. In the wetter parts of the zone, *Vitellaria paradoxa* (karite), *Butyrospermum paradoxum*, *Parkia biglobosa* (néré) and *Tamarindus indica* occur over large areas.

Some formations are restricted to particular conditions, such as *Acacia nilotica* spp. *nilotica* and *tormentosa* in seasonally flooded areas; and mangroves (*Rhizophora*, *Avicennia*) in areas periodically inundated by salt-water or brackish water.

Mention should also be made of forests of doum palm (*Hyphaene thebaica*) and ronier (*Borassus aethiopium*). The former is characteristic of temporary watercourses and river banks in very arid areas, while the latter is more generally distributed in moister areas."

TABLE 1. Area of natural woody vegetation estimated at the end of 1980

Countries	Tree formations <sup>1</sup>	Woody formations and fallows <sup>1</sup>	Annual clearing <sup>1</sup>	Dry woodland <sup>2</sup>
('000 ha)				
Burkina Faso	7200	14700	60	
Mali	8800	17300	40	
Niger	2900	11900	60	
Senegal	11045	14160	49	
Chad	13500	24050	80	
<b>West Africa</b>	<b>43445</b>	<b>82110</b>	<b>289</b>	
Botswana	32560	52560	30	51900
Ethiopia	27150	62450	10	70500
Kenya	2360	40465	20	46300
Malawi	4271	4651	150	1000
Somalia	9050	62100	10	60900
Sudan	47650	146250	500	127000
United Rep. of Tanzania	42040	59950	120	54100
Zambia	29510	40310	30	23200

Zimbabwe	19900	20800	70	38000
<b>Eastern and southern Africa</b>	<b>241581</b>	<b>489526</b>	<b>940</b>	<b>472900</b>

<sup>1</sup>Source: FAO, 1981.

<sup>2</sup>Source: Wormald. 1984.

The total area of natural woody vegetation in the five countries mentioned above is shown in Table 1. It should be noted that some parts of these areas are to be found south of the 1000 mm isohyet and therefore do not strictly belong to the semiarid region. The Table also provides estimates of the annual clearing of the tree formations as estimated by FAO (1981). The total for the five countries is 0.67 percent, which seems to be a low figure.

Certainly, the annual reduction of the forest area is much higher in densely populated areas. For example, in Burkina Faso, Ouadba (1983) studied the development of forest cover and land use in an area situated 50 km from Ouagadougou. Using a test area of 8000 ha, Ouadba compared aerial photos from 1958 and 1979 (see Table 2). The results showed that natural forest vegetation almost completely disappeared over the 21 years, to be replaced by cultivated areas and young fallows.

**TABLE 2. Vegetation cover and land use as a percentage of a total test area in Burkina Faso**

Land type	1958	1979
	(Percentage)	
Cultivated land and young fallows	0.2	72.3
Old fallows	15.6	22.4
Natural (forest) vegetation	73.9	1.4
Other types	4.3	3.9
<b>Total</b>	<b>100.0</b>	<b>100.0</b>

Source: Ouadba, 1983.

**TABLE 3. Forest reserved for government use in five West African countries (1980)**

Country	Area (km <sup>2</sup> )
Burkina Faso	7270
Chad	4500
Mali	11307
Niger	2118
Senegal	13550
<b>Total</b>	<b>38745</b>

Source: Jackson *et al.*, 1983.

**TABLE 4. Whole sale price breakdown for stacked fuelwood**

Item	Cost per stere <sup>1</sup>
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	(CFAF)
Woodcutter's direct salary	610
Revolving account of the cooperative	200
Forest tax	300
Forest management fund	500
<b>Total</b>	<b>1610</b>

<sup>1</sup>stere = 1 m<sup>3</sup>.

## Eastern and southern Africa

In his report, *The management of the natural forests in the arid and semi-arid zones of East and southern Africa*, Wormald (1984) examines the following countries: Botswana, Ethiopia, Kenya, Malawi, Somalia, the Sudan, the United Republic of Tanzania, Zambia and Zimbabwe. Excluding the wettest miombo forests, Wormald divides the remaining area into two main vegetation types:

"In the north - Ethiopia, Somalia, Kenya, the United Republic of Tanzania and the Somalia-Masai - Acacia and Commiphora deciduous bushland and thickets [dominate]. They include *Acacia tortilis*; *A. seyal*; *A. nilotica*; *A. senegal*; *A. albida*; *A. xanthophloea*; *A. mellifera*; *A. drepanolobium*; *A. etbaica*; *A. reficiens*; *Commiphora* spp., including *C. molmol* which is tapped for myrrh in Somalia; various *Combretum* spp., *Adansonia digitata*; *Terminalia brownii*; and *T. prunoides*.

In the south, the miombo vegetation [dominates], with *Brachystegia spiciformis*, *B. longifolia*, *B. boehmii*, *B. microphylla*, *Pterocarpus angolensis*, *Julbernardia peniculata*, *J. globiflora*, *Azelia cuanzensis*, *Burkea africana*, *Commiphora* spp., *Combretum* spp., *Pericopsis angolensis* and *Dalbergia melanocylon*."

The total area covered by tree formations in the nine countries studied by Wormald was 215 million ha in 1981 (FAO, 1981). Some of the area concerned is certainly too wet to be called arid or semi-arid. However, comparing the FAO figures for woody formations with those for dry woodlands in the nine countries studied by Wormald, we find that the total figure for woody formations is close to the total figure given by Wormald for dry woodlands, although there are some differences for individual countries.

According to FAO (1981), nearly 1 million ha or 0.44 percent of these tree formations are cleared each year. As in West Africa, it may be surmised that clearing is unevenly distributed and is concentrated in densely populated areas and areas close to urban centres. One example to be mentioned is from the lowland areas south of Addis Abeba where, in the last 20 years, large areas of the Acacia savannah forests have been transformed into open woodlands with scattered trees. The reason for the clearing in this case is the combination of fuelwood-cutting and intensive grazing (Peterson Ole, oral communication).

## Natural forest management

Interest in conserving and managing the natural forests of West Africa dates back to colonial times when forest area was "reserved" for government use. According to Jackson *et al.* (1983), around 1980 the area of these *forêts classées* in five in West African countries was equal to 9 percent of the total area of tree formations (see Table 3). To this area should be added much bigger areas set aside as national parks or game reserves.

The intention was that the reserved forests be conserved, managed and utilized by the respective governments. However, notwithstanding the theoretical interest in natural forest management, it usually remained little more than a concept. Some of the main obstacles to the development of natural forest management in Africa have also been inherited from the former colonial governments, i.e. outdated practices and approaches. Foresters continue to be involved mainly in raising seedlings in nurseries for the numerous afforestation and plantation programmes. Natural forests, on the other hand, have been subjected to a protectionist mentality. The cutting of live trees for commercial purposes is still against the law in most countries, with the result that many of the national forests and woodlands are dominated by overmature stands. At the same time, new growth in these forests is being impeded by uncontrolled grazing.

When conservation efforts have been initiated, they have often been focused on severely degraded national forests, while neglecting areas that are in relatively good condition. Many of the degraded forests and woodlands of Africa are "stable" in their degraded state; the high investment required for afforestation often might be better spent in managing woodlands and forests that are more or less intact and which could be sustainably managed for wood, animal and other forest products.

In his review of nine countries in eastern and southern Africa, Wormald (1984) concluded that: "Management of the public and communal woodland is negligible. Even in the forest reserves management is not intensive and does not involve much more than early burning in the miombo and teak forests, and patrolling to control grazing and agricultural encroachment." The only example of more intensive forest management of natural forests identified by Wormald was the production of gum arable, mainly from *Acacia senegal* in the Sudan. Recently, a number of efforts have been initiated, including several concentrating on wildlife management; overall, however, natural forest management in the subregion is still minimal.

In contrast with the overall negative pattern, a few major breakthroughs in improved natural resource management indicate that there are great possibilities for sustainable and profitable management of natural forests in semi-arid West Africa provided that the work is planned and performed in close cooperation with the local population. Following is a brief description of three of these "success stories".

#### [Inspecting half-moon ditches with young seedlings in a barren area of the Guesselbodi forest](#)

#### [A camel-mounted guard in the Guesselbodi forest](#)

#### [Small branches are spread on the soil and decomposed by termites](#)

#### [Control of fire is one of the major challenges to the Nazinon forest management project](#)

#### [Regrowth of \*Combretum nigricans\* after coppice cut](#)

### **Guesselbodi forest, the Niger**

The Guesselbodi forest is situated about 25 km to the east of Niamey in the Niger, where the annual rainfall is about 700 mm. In 1981 an effort was begun to manage 5000 ha of bushland which, in the previous years, had been very degraded as a consequence of excessive wood cutting, overgrazing, fires and subsequent erosion. Aerial photos documented that 40 to 60 percent of the vegetative cover had disappeared between 1950 and 1979.

The strategy for management was built on the concept of popular participation whereby

the villagers would use the forest to generate the income required to assure continuity of the operation. According to the management plan, applied from 1983, the forest was divided into ten parcels of approximately 500 ha each. One of these parcels is harvested and treated each year, giving a rotation of ten years which corresponds to the time needed for the dominant species (mainly *Combretum* genus) to again reach an exploitable size after a coppice cut.

All trees down to a given minimum diameter (3 cm for *Guiera senegalensis* and 4 cm for all other *Combretum* species) are felled and the commercial fuelwood is stacked at the roadside for sale. The smaller branches are spread out on barren areas where they are decomposed and mixed into the earth by termites, thereby improving soil conditions and the content of organic matter as well as increasing water infiltration. The debris also acts as a trap for leaves and other organic matter carried by the wind. These measures are combined with others such as stone or earth mounds or trees and grass planted in half-moon ditches. The result is a microenvironment supportive to growth.

The cleared areas are protected from grazing for the first three years but may then be used for controlled grazing. The harvesting of grass for fodder is also permitted at certain times of the year.

This management system is designed to lead to sustained and even increased production, being economically feasible for the surrounding population and possible for them to carry on in their own interest. Thus, the incomes from the sale of firewood and grazing rights, as well as other benefits such as the harvesting of fodder for stall feeding, cultivation and hunting, can cover most of the costs involved, i.e. harvesting, anti-erosive measures, protection, etc. At the time of writing, the Guesselbodi forest effort is close to achieving sustainability, and ongoing monitoring is being carried out to further improve management methods and profitability.

### **Nazinon forest, Burkina Faso**

The project for this area was initiated in 1986. The Nazinon forest is situated 90 to 120 km south of Ouagadougou in Burkina Faso, an area with an annual rainfall of 800 to 900 mm. The Nazinon forest comprises 25000 ha which are divided into management units of 2000 to 4000 ha. Each of these units is then divided into 20 parcels of which one is cut each year, giving a rotation of 20 years.

According to the established preliminary rules, 50 percent of the harvestable volume is cut, deliberately leaving vigorous and well-formed trees of certain species that might give a more valuable yield in the future.

The wood is sold to private buyers who transport it to Ouagadougou for sale. They pay CFAF 1610 per stere (1 m<sup>3</sup>) of stacked fuelwood (see Table 4 for a price breakdown).

The total sum received covers all costs involved, including the management of the forest. The forest management fund is used to cover the cost for training of the villagers/forest workers and some silvicultural costs such as direct seeding of areas degraded through previous clearing for crop cultivation. It should be mentioned that direct seeding of indigenous species has been done with great success on more than 2000 ha, even in heavy grass vegetation.

Research is under way to study the effects of the current cutting systems and silvicultural operations. The most serious technical problem to date is forest fire. Early controlled burning is a possible solution, but more research is needed in this area.

### **Nazinga Game Ranch, Burkina Faso**

The Nazinga Game Ranch is situated within the big complex of natural forests in southern Burkina Faso where the mean annual rainfall is about 900 mm. The centre of the 940 km<sup>2</sup> ranch is situated 200 km south of Ouagadougou.

In 1979, after several years of planning, the project was initiated with the aim of improving the ecological situation for wildlife in the area by arranging for a permanent water supply through small dams and for the control of forest fires and illegal hunting. All the work was to be done by the local population which would eventually share in the profits of the controlled hunting (ranching).

The positive results were soon apparent. The wildlife population nearly doubled between 1983 and 1989, when there were close to 500 elephants, 300 buffaloes, 5000 wart-hogs and 7000 antelopes. Parallel to the increase in wildlife was an increase in tourism; in the 1988/89 season there were 2500 visitors to the area.

In 1988 the project started controlled hunting activities, which included culling and subsequent sale of meat by the project personnel and safari hunting (sport and trophy hunting). The first hunting season (December 1988 to June 1989) gave a gross income of US\$ 135000, of which 45 percent came from the sale of nearly 20 tonnes of meat, while 37 percent came from sport and trophy hunting and 18 percent from viewing tourism. After deduction of running expenses there was a net gain of \$37000.

During the same period, more than 80 biologists conducted studies at the ranch, producing more than 150 reports on soils, vegetation consumption and production and on ungulate diets, habitat preferences, carcass composition, reproduction, etc.

The Nazinga Game Ranch is expected to continue to yield profits for the surrounding population as well as being a valuable experience and producing research results that will serve in the development of similar efforts in West Africa and in other parts of the world [*Ed. note: see the article, Wildlife management in Zimbabwe: the CAMPFIRE programme, p. 20 of this issue*].

From what has been said above, it is clear that there are many prerequisites to be fulfilled if the natural forests of semiarid Africa are to be protected and managed for sustained use. A first step toward appropriate land-use planning will be the redefinition of forest boundaries; in many instances the original boundaries of national forests are meaningless because large areas of the forests have been completely converted to other land uses. As part of this first step, the areas with the highest potential for sustainable management must be identified and prioritized. Aside from macro-level land-use planning, there is also a need to develop local or "micro" plans, defining village territories and demarcating zones for agriculture, forestry, pasture, etc. An intrinsic part of these plans would be the definition of land-tenure and user rights. For example, the decision of the Government of the Niger in May 1990 to give village communities usufruct and management rights over local forests as long as management plans were drawn up and agreed upon (ARD, 1991) is certainly a step in the right direction.

Management plans must create a situation in which it is in the interest of local people to manage and use the forest on a sustainable basis. This means involving local people in the conceptualization as well as the implementation of these plans.

Finally, to reduce the pressure put on forest resources by expanding agricultural frontiers, farmers must be helped to improve their agricultural methods in order to allow for a sustainable and improved yield from their agricultural land.

It is obvious that there is a great need for knowledge if all these prerequisites are to be fulfilled and the natural forests subsequently protected and managed for sustainable use.

## Research needs

Throughout arid and semi-arid Africa, silvicultural research has a long history. The main efforts, however, have been on establishment trials with various species rather than on studies of natural forests. Forest managers and trainers involved in natural forest management are obliged to make do with scanty information, or to make risky extrapolations from European or American silvicultural texts that may have limited application in the African context.

Some of the areas in which there is urgent need for research include: the value to the population of the products from the natural forests such as wood for fuel, construction and other purposes, food, fodder, fibres and pharmaceuticals; management methods and the possibilities of influencing the production of these various products; factors influencing coppicing and coppice production; factors influencing seed production, regeneration and the possibilities of improving forest cover and composition by means of direct seeding and planting; the importance of forest fires and the possibilities of controlling and managing them; logging and hauling methods appropriate to arid zones; wildlife management; inventory methods for identifying and evaluating natural forests and for management planning.

### Co-author John Heermans with stacked fuelwood from the Guesseboldi forest

#### **IDEA forestry award**

For his work on the Guesseboldi forest project in the Niger, the co-author of this article, John Heermans, received the 1990 Innovation for Development Association (IDEA) award, along with his counterpart from the Niger, Sani Siddi. IDEA supports valuable innovations in the developing world that support technological and economic development while taking social and ecological conditions into consideration. Financial support for IDEA comes from the Sven and Dagmar Sahlén Foundation and the Swedish International Development Agency (SIDA).

This list is nowhere near exhaustive but is certainly sufficient to illustrate the great variety of challenges connected to the management of natural forests. It should be added that the lack of available hard data should not be used as an excuse to delay management efforts. Rather, activities should be started, using existing knowledge, and further "action" research built into the practical work.

A strategy for parallel efforts on implementation and research might be structured as follows:

- Identify existing natural forests by means of satellite images and aerial photos, when available.
- Select a forest area or areas that are of obvious value to local residents and study their actual value to the population.
- In collaboration with the local population, make a tentative management plan for the selected forests.
- Train and organize villagers and start implementation and parallel monitoring.
- At the same time start research trials, using alternative socio-economic, biological and technical methods. The choice of research areas will then depend on the problems encountered during the implementation of the management activities.



In the event that management activities are already under way, monitoring and research activities should be incorporated to facilitate the identification of successful methods and areas for improvement.

Research connected to the management of natural forests can be undertaken on at least three different levels. The first level is directly through development projects dealing with natural forest management. The second level would be where areas for research are identified by a project but dealt with by an independent organization; for example, a research institution or university inside or outside the country. The third level would be work initiated by a research institution independently of a single project. In the first case, funding would come directly through the project budget. In the latter two cases, provision would need to be made for adequate funding both from internal and external sources.

## Conclusion

The natural forests in semi -arid Africa are disappearing at a rapid rate but, except for a few success stories in West Africa, very little has been done with respect to management of these forests for a sustained and improved yield. Yet the results from these pilot efforts, based largely on the involvement of local people, clearly demonstrate that the potential for sustainable yields and maximum benefits to local populations exists.

The severe lack of data on the arid and semi-arid forests of Africa with respect to composition, wood resources, biology, techniques for improvement, etc., should not hold up the immediate implementation of management efforts. Rather, research should be combined with practical management efforts in order to avoid the risk of the forests disappearing before any useful research results are at hand.

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