

West African agroforestry parklands: keys to conservation and sustainable management

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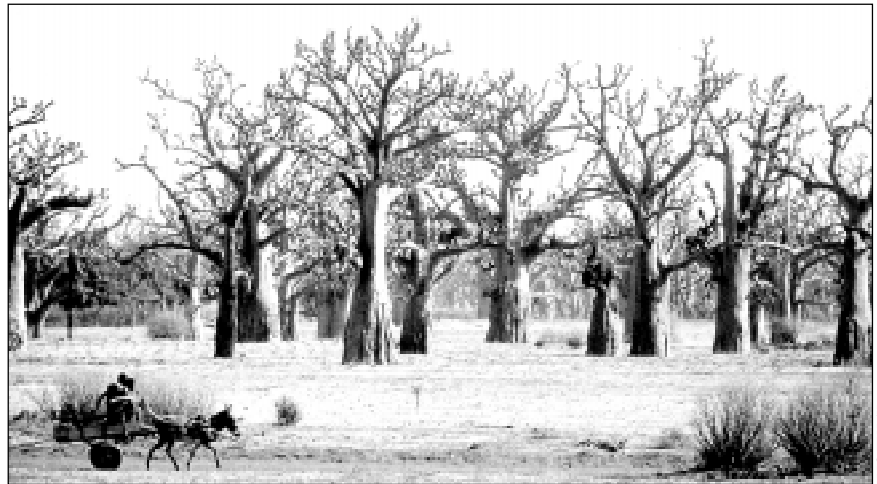
Developing the economic potential of tree products and modifying prohibitive policies can help maintain a traditional land use system combining trees and agriculture.

*Aerial view of a
Faidherbia albida
parkland around the
village of Dolekaha,
Côte d'Ivoire*



D. LOUPPE

*Adansonia digitata
parkland in Senegal*



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Most subsistence farmers in semi-arid West Africa consider trees as an integral part of agriculture. For centuries, they have maintained a traditional land use system known as the “agroforestry parkland” system, in which trees occur scattered in cultivated or recently fallowed fields.

Through careful tree selection, farmers have deliberately shaped tree production on their farmland to fulfil their specific needs. Parkland trees provide

traditional medicines as well as basic food commodities, including a variety of gums, oils, proteins, fruits and drinks, which are of nutritional importance for a large number of people, especially in rural areas. Agroforestry parklands are also a major source of wood and non-wood products, which provide significant household income and appear to be important for local economies. Some of these products – gum arabic (*Acacia senegal*) and shea nuts (*Vitellaria paradoxa*) – provide primary export

earnings for several nations in the Sahel. In some places in West Africa agroforestry parklands account for up to 75 percent of total harvests of wood and non-wood products.

Parkland resources are of considerable social and cultural significance. Specific social groups including women, the poor, immigrants and young adults tend to be particularly involved in the gathering and sometimes the processing of parkland products, because these activities require no cash investment. The marketing of these products is also predominantly a women's activity. It tends to generate a higher proportion of income for women than for men, which may have a positive impact on the nutritional status of children.

Although frequently dominated by just one or a few species, parklands have contributed to the maintenance of numerous species, often 40 to 50 in the cultivation cycle alone. Scattered trees fulfil fundamental ecological functions in soil and water conservation and environmental protection. Most of the agricultural production in areas of the Sahel where there are settled populations occurs under the discontinuous cover of parkland trees. Therefore the improved management of agroforestry systems has potential impact for the whole Sahelian region.

This article gives an overview of the primary parameters underpinning the management of agroforestry parklands and outlines research and development strategies for their conservation and improved management (see Boffa, 1999 for a more comprehensive analysis).

TRENDS OF TREE DENSITY CHANGES OVER TIME

Despite the importance of agroforestry parklands, few quantitative data are available to assess trends in the condition of these systems in terms of

density, age composition and spatial extent. In general, tree densities in rural landscapes and sometimes in parklands have significantly declined in past decades, especially since the droughts of the 1970s, and they are characterized by a predominance of old trees and a sometimes alarming lack of regeneration.

For instance, in the village of Petit Samba, Burkina Faso, the density of large trees declined at an annual rate of 0.15 trees per hectare from 1957 to 1984, but almost four times faster – at a rate of 0.57 trees per hectare per year – between 1984 and 1988 (Gijsbers, Kessler and Knevel, 1994). This markedly accelerated decline could probably be attributed to increased demand for cultivation area and tree products with increasing demographic pressure; drought; and shortened fallows leading to decreased tree regeneration. In the village of Sob, Senegal, the density

of field trees fell from 10.7 trees per hectare in 1965 to 8.3 trees per hectare in 1985 (Lericollais, 1989). Because trees have a long generation time, the lack of young age classes and a severe decline of tree density in parklands should be a warning of a serious risk of degradation of these systems.

However, the decline of parkland cover in semi-arid West Africa is by no means uniform and conceals islands of active parkland regeneration. Such systems, like the rural societies that are responsible for their creation and maintenance, are dynamic and display a high degree of resilience. An illustration is the densely populated (200 people per square kilometre) Kano Close-Settled Zone of Nigeria, where between 1972 and 1981 parkland density rose from 12.9 to 15.2 trees per hectare at one site and from 6.1 to 6.7 trees per hectare at another (Cline-Cole *et al.*, 1990). Despite the high demand for tree products and the stress on the natural resource base caused by the severe droughts of the 1970s, the woody vegetation was not severely depleted, as might have been expected. Instead, the large

*Expansion of a *Borassus aethiopicum* parkland through active regeneration*



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number of small-diameter trees observed was evidence that farmers had been making a spontaneous effort to conserve, regenerate and plant trees in response to commercial opportunities for fuelwood and other tree products.

BIOPHYSICAL DETERMINANTS

Biophysical interactions between trees and crops have shaped the physical configuration of parkland agroforestry and are one of the primary determinants of the way farmers manage trees in their fields. *Faidherbia albida*, one of the most extensively studied parkland species, has a reverse cycle, shedding its leaves during the rainy season, and is generally responsible for a substantial increase of grain yields under its canopy (CIRAD-Forêt, 1996). In contrast, crop performance under species with a more typical cycle such as *Vitellaria paradoxa* and *Parkia biglobosa* is significantly reduced. However, there is also some evidence to the contrary, which has been hypothetically attributed to the positive effect of shade on microclimate, offsetting the decline of photosynthesis (Jonsson, 1995).

Differences in crop yields under crowns of varying sizes and shapes indicate an effect of light competition between crops and trees (Kater, Kante and Budelman, 1992). The possibility of increasing crop yields by increasing their exposure to sunlight is a strong argument for pruning. Experiments on *Cordyla pinnata* in Senegal (Samba, 1997) and *Azadirachta indica* in Burkina Faso (Zoungrana, Yélérou and Hien, 1993) indicate that crop yields under pruned trees are generally higher than under unpruned trees and sometimes higher than in open controls. However, soils under mature parkland tree canopies are generally more fertile than those in the open. The influence of annual pruning on long-term subcanopy

soil fertility as well as on crop, fruit, leaf and wood production of various species will need to be investigated before this technique, which is already practised locally to some extent, can be widely recommended.

Several significant gaps remain in the understanding of how above- and below-ground soil-tree-crop interactions affect the productivity of specific parkland systems (Boffa, 1999). To establish more precise prescriptions for parkland management, research is needed to clarify the role and interactions of factors such as species, tree size, parkland density, latitude and annual rainfall variability.

ECONOMIC INCENTIVES

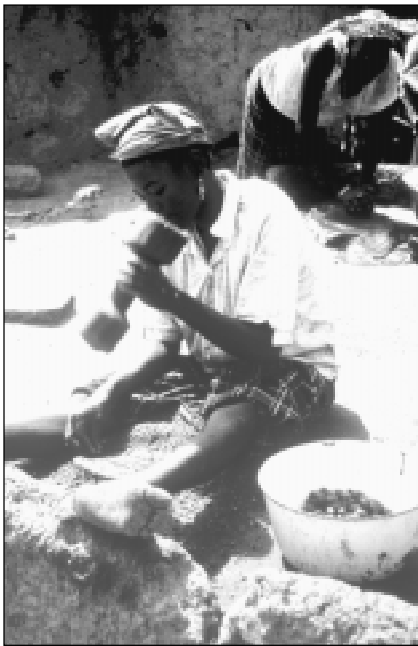
Although the benefit of trees in the overall agricultural system is the primary factor determining whether parkland trees are maintained and planted, evidence shows that when farmers perceive that trees and their products gain in value as a result of increased economic worth, greater demand or declining availability, they are more likely to invest actively in the protection and reproduction of parklands. For instance, *Borassus aethiopum* parklands in the village of Wolokonto, Burkina Faso, are expanding both spatially and in density because of the high income generated from palm wine; 90 percent of *B. aethiopum* trees in these parklands are in an early developmental stage (J. Cassou, D. Depommier and S.J. Ouédraogo, unpublished, 1997).

In contrast, farmers may neglect their tree resources and favour alternative and sometimes competing practices, consumer items and income-earning activities when these yield higher benefits than those involving parkland trees. External parameters such as markets, external pressure on village resources, migration and relations with urban cen-

tres appear to have a strong influence on the relative value of parkland trees. In northern Côte d'Ivoire, management of shea (*Vitellaria paradoxa*) tree densities responds rapidly to changes in the relative prices of its products. When *Vitellaria* nuts or butter sell for high prices, regeneration is promoted. However, if fuelwood prices outstrip those of the tree's other products, trees tend to be felled and sold on the fuelwood market (Louppe and Ouattara, 1997). In areas of northern Uganda, the shea tree is cut for charcoal making in spite of its economic importance as a source of cooking oil. However, where economic incentives and a tradition for conservation of the species exist, trees are maintained and used for oil production (E.T. Masters and A. Puga, unpublished, 1994).

Where traditional products from parkland trees can be substituted by cultivated crops or items purchased at the market, farmers may be less motivated to regenerate parklands. For example, shea butter is often substituted by animal butter in areas of livestock production or by vegetable oils such as groundnut or palm oil favoured by some groups for their less variable annual yields, relative ease of processing and preferred taste. Similarly, fermented *Parkia biglobosa* seeds, which are traditionally consumed as *netétou*, a spicy seasoning, are facing competition from industrially processed stock cubes, which have spread rapidly in urban areas of the Sahel with the help of intense advertising.

A major bottleneck in the production of both shea butter and *netétou* is the high labour intensiveness and low efficiency of traditional techniques for processing the raw material into edible products, as well as the large amounts of water and fuelwood needed. Improving extraction and processing tech-



Women pounding and grinding shea kernels, a labour-intensive process

nologies has therefore been a primary focus of several applied research and development projects focused on these systems.

A variety of presses have been developed by projects working with shea. For example, the press developed by the Shea Project of the Cooperative Office for Voluntary Organizations of Uganda has increased severalfold the capacity of local women's groups to produce high-quality butter in a shorter time.

Similarly, a partnership between the Département des systèmes agro-alimentaires et ruraux of the International Cooperation Centre on Agrarian Research for Development (CIRAD-SAR), the Institut sénégalais de recherche agricole (ISRA) and a local development committee including 45 vil-

lage groups in the Fogny area of Basse Casamance in Senegal has developed a technology to mechanize the seed dehulling and cleaning stages of processing *netétou*.

Parallel to technological improvements, however, commercial opportunities and market systems for parkland products must also be developed or expanded to ensure farmers' lasting participation in parkland conservation and regeneration. This task has been approached in various ways. For example, the Shea Project in Uganda, drawing on social and environmental benefits as well as the unique cosmetic quality of shea butter, has developed a relationship with a natural cosmetics retailer in California which provides a steady international export market. The company offers a high price (double the local price) to the project for high-quality packaged shea butter. This allows women's groups to generate profits rapidly after covering the cost of the press. The project is also focusing on expanding domestic market opportunities, as

shea oil is a popular traditional cooking oil. This includes an initiative to market shea oil in attractively packaged containers in major towns of northern Uganda as well as in Kampala, the capital city. Expansion of the domestic market will reduce the potential risk of increased production flooding local markets. As the domestic market develops, the project plans gradually to hand over postharvest processing, packaging, marketing and distribution of shea products to the private sector (Kisakye *et al.*, 1997).

The *netétou* project in Senegal has also undertaken a study of the commodity system, with the objective of giving women increased bargaining power. Direct-marketing arrangements have been put in place between producer groups in Fogny and organized retailers in Dakar, and links have been established with other rural organizations in the area. In addition, the project has developed several new *netétou* products and packaged them to overcome urban concerns regarding the hygiene

Implications of macroeconomic policy on parkland management: an example from western Senegal

In *Faidherbia albida* parklands in western Senegal, the area planted with groundnut, a cash crop introduced during colonial times, had increased from the 1960s to the mid-1980s, to the detriment of the area under the traditional mix of cereals, cowpea and *F. albida* (Seyler, 1993). Farmers were relying on fertilizers made available at low prices by the State-protected agricultural sector, rather than emphasizing traditional fertility restoration techniques, including *F. albida* parkland agroforestry and manuring. As input prices rose with the removal of subsidies and price controls in the process of state disengagement in the

late 1980s, farmers started reallocating land to cereal production and regenerating *F. albida* as well as other valuable on-farm tree resources.

Although often location specific and not generalizable, research into such relationships may offer positive insights for making informed and balanced decisions and policies for agricultural production with sustainable management of the natural resource base.

of the traditional preparation process. The marketing of *nététou* paste, powder and cubes in sealed, clear plastic bags appears to hold promise for reviving consumption of this traditional food item (Ferre, 1993).

Agroforestry parklands comprise a large variety of species, of which most are multipurpose and yield several products which are marketed at various scales. Therefore, the development of specific parkland commodity markets can be a strong point of leverage for the sustainable management of the systems. It should also be noted that the benefits of trees in farming systems do not all have a market value; indirect use values (environmental functions) and non-use values (cultural, religious and existence values) should not be underestimated.

The market development process will need to be demand driven, promoted step by step and oriented towards the specific needs and value of each commodity. Support will be required from national governments, the business community and international donors. Some of the most salient constraints which will need to be addressed include the improvement of product quality, the establishment of grading systems for major parkland products, the creation and support of information exchange systems for responding to market signals, the development and transfer of efficient and labour-saving processing technologies, the promotion of local use, the processing and packaging of parkland products and the capacity strengthening of local producer groups.

IMPACT OF AGRICULTURAL POLICIES

The agricultural policy environment has strongly influenced the evolution of agroforestry parklands in West Africa. Early agricultural development

models promoted by research, extension, development and commodity parastatal agencies advocated single cropping in geometrically shaped fields devoid of woody cover. Trees, especially of local origin, were ignored or considered as obstacles to animal traction and mechanization or to the development of intensive and productive systems. In some places, financial credit for agriculture was given only if all trees were cleared from fields.

The promotion of cash crops such as cotton, groundnut and maize has often led to parkland degradation. Such crop introductions displace staple crops such as sorghum, millet and cowpea and replace the traditional soil fertility restoration practice of fallowing with the use of chemical fertilizers. In some places, such as in Dolekaha, northern Côte d'Ivoire, the development of cotton and maize production and the associated use of chemical fertilizers may have allowed extended cultivation intervals and thus favoured the growth of local *Vitellaria paradoxa* and *Parkia biglobosa* parklands (Bernard, Ouattara and Peltier, 1996). However, since fallowing is the main practice responsible for tree regeneration, its replacement with chemical fertilizers has generally been detrimental to agroforestry parklands.

Moreover, trees are generally eliminated from plots allocated to cash crops, either deliberately or through animal traction. Although draught animals need sufficient space to manoeuvre and superficial tree roots can impede the progress of ploughs, animal traction need not be incompatible with parkland agroforestry. Tree densities are usually lower on farms that use animal traction, but can still be fairly high. For instance, in the *Vitellaria paradoxa* parklands of Thiougou, a frontier village in southern Burkina Faso, average densities

maintained by farmers using hand cultivation, donkey traction and ox traction were 31, 25 and 21 trees per hectare, respectively (Boffa, 1995).

Greater incorporation of parkland agroforestry in the agenda of agricultural commodity and research and extension agencies is therefore central to the sustainability of parkland systems. With the increasing consideration of the role of trees in sustainable agricultural systems in the 1980s, agricultural extension and development agencies have begun to support the maintenance and regeneration of trees in fields. However, parkland agroforestry has not yet been sufficiently incorporated in the agenda of agricultural commodity agencies.

INFLUENCE OF FOREST POLICIES

National forest policies in the Sahel often do not promote optimal implementation of improved traditional management practices. Colonial and more recent forestry administrations have generally restricted the influence of customary natural resource management authorities at the village level and imposed centralized State control over resource management. A key constraint of Sahelian forest codes for parkland management is that all farmland with trees on it is included in the national forest domain falling under State control, unless the land is registered (McLain, 1992). In practice, however, farmers almost never register their land, because they are generally not well informed and registration is costly. Thus many restrictions intended to protect forest trees are inappropriately applied to trees on farms and fallows. For instance, farmers are required to obtain permits for cutting and pruning of parkland trees or transporting tree products. Forest services also keep a list of protected species, most of which are com-

monly found in parklands, which cannot be felled, uprooted or debranched. As a result, farmers have been prevented from carrying out basic management activities such as thinning, removal of old or dead trees, parasite control, coppicing and pruning, which are crucial to optimizing their land use systems. Unable to manage them, farmers may be reluctant to plant trees and may choose to eliminate them as they regenerate.

In addition, forest codes are often poorly understood by rural people and forest agents alike. Faced with a lack of human and financial resources, most forest services are unable to enforce regulations properly and individual agents often interpret obscure permit requirements to their own benefit in order to supplement their meagre salaries. Although several recent policy revisions go some way towards recognizing farmers' rights on agricultural lands they traditionally control, major changes in forest administration and legislation are still necessary.

State forest policies have been superimposed on indigenous tenure systems which have traditionally regulated access to and use of parkland and forest resources both at the community and individual levels, particularly for resources of high value. For example, the *ganlegre* custom applied by land priests (traditional religious figures in charge of land issues) in Burkina Faso prohibits the harvest of *Vitellaria paradoxa* nuts before complete maturity, and traditional ceremonies are conducted by village chiefs to open the harvest season of *Parkia biglobosa* pods. Such customary arrangements help ensure equal access, reduce protection costs, minimize intracommunity conflicts and promote sustainable use. Some traditional management institutions, threatened by new socio-economic influences, have

receded, but others are resilient and have adapted to current conditions. Communities' institutional capacities to maintain, adopt and construct tenure arrangements are a major reason for optimism about the future of agroforestry parklands, and should be increasingly recognized and supported.

Within these community management regimes, more individual tree tenure systems, mostly based on farmers' rights to land, further control the access to and the use of specific parkland resources. These systems may have some constraints – for example, it may be difficult for secondary right holders to plant trees on loaned land – but they are also highly flexible and are subject to renegotiation according to evolving economic and social needs.

Where tenure arrangements are secure and unambiguous, parklands have the greatest chance of reproduction. Therefore, forestry extension and development personnel need to develop a detailed understanding of local land and tree tenure dynamics and to help local people negotiate clearly articulated and mutually appropriate agreements regarding land and tree rights.

CONCLUSIONS

Research on agroforestry parklands has shown that they are a rational land use system developed by farmers over many generations to diversify production for subsistence and for income generation, as well as to minimize environmental risks related to the high climatic variability in the region. Their importance for sustainable livelihoods, particularly for vulnerable groups in society, and their significance as a rich pool of genetic diversity are increasingly recognized by the policy-making and research community. This has prompted a growing interest in promoting their conservation and in further improving

their management to increase the benefits they provide to rural communities. Significant advances in parkland management will require further emphasis on the devolution of management responsibilities at the local level, management-oriented biophysical research, a stronger agroforestry focus in agricultural policy and extension services and the promotion of markets and improved processing of parkland products. ♦



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