



Parklands with fodder trees: a Fulbe response to environmental and social changes

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Abstract

This paper discusses the meaning of a land-use type called agricultural parkland typical of the savannah landscape in sub-Saharan Africa. It focuses on particular parklands located in south western Burkina-Faso where fodder trees are preserved by Fulbe pastoralists and lopped to feed their cattle. This resource use pattern challenges the conventional view of pastoralists in respect to mobility, environment and tree uses on the one hand, and to agriculture on the other hand. Indeed, this land use type challenges the idea of ethnic specialisation of agriculture and pastoral production systems in West Africa. In addition, these parklands represent an integration of cattle raising and agriculture and an intensification of the production systems in a context of increasing population and competition to access to land. The creation of the parklands is recent and several factors could be retained to explain its origin, such as the Fulbe sedentarity, the restricted access to resources for outsiders Fulbe in southern villages of Burkina-Faso, their skill in agricultural practices. The parkland sustainability and the adoption of this innovation by other agropastoralists need to be further investigated. © 2003 Elsevier Ltd. All rights reserved.

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Introduction

The mobility of pastoralists in Africa has been perceived as having both positive and negative impacts on the uses of natural resources (Lewis, 1975; Monod, 1975a, b; Scoones, 1995; Toupet, 1975). On one hand, the mobility of pastoralists is characterised by sporadic livestock grazing which allows for the regeneration of the grazed vegetation (Behnke, Scoones, & Kerven, 1993; Dupire, 1996; Gulliver,

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Map 1. Location of the villages and movements of Fulbe.

1955; Stenning, 1959). On the other hand, mobility has been shown to encourage the overuse and misuse of natural resources (Allan, 1965). Since colonial times, agricultural politics and development programmes have tended to adopt the last argument and therefore the mobility of nomads and pastoralists has been restricted, effectively encouraging their sedentarisation. Such an approach was aimed at the intensification of production systems for a 'better' land-use as well as control over people and means of production (Bernus & Boutrais, 1994). In addition to political parameters, other factors have reduced the mobility of pastoralists during recent decades, including the establishment of national borders, population increase leading to increased competition for access to land, access to services for both human and animal health in main villages, and the development of markets.

Firstly, this paper challenges the conventional view of the relationship between pastoralists, mobility and environment from the examination of their use of trees. In West Africa, since colonial times, the dominant narrative concerning the uses of trees by pastoralists is that they exploit them in the bush, destroy them and encourage deforestation (Fairhead & Leach, 1996, 1998; Bassett & Boutrais, 2000). Indeed, pastoralists have been accused of encouraging the processes of desertification and deforestation by high stock densities and the overgrazing of savannah grasslands (Mace, 1991). Nevertheless, we identified practices of tree management in a perspective of sustainable land-use within a context of the Fulbe sedentarity in the south west part of Burkina-Faso. This management is done in a land-use type called 'parkland' created by the Fulbe pastoralists in the village land of Kourouma (Map 1). Trees in agricultural land are a common feature of the Sahelian and Sudanian landscape in West Africa, and this land-use type is called parkland. The trees are maintained after clearing bush or fallow land. Typical species to be preserved include *Vittelaria paradoxa*¹,

¹ Shea-butter tree.

Parkia biglobosa and *Faidherbia albida*. In contrast, the other types of parklands are less well documented. The parklands observed in Kourouma are peculiar for three main reasons: they have been created by the Fulbe pastoralists; fodder tree species such as *Azvelia africana*, *Pterocarpus erinaceus* and *K. senegalensis* are preserved in addition to *V. paradoxa*, and the density of trees is particularly high compared to other parklands. We will investigate the social and environmental conditions for parkland establishment.

Secondly, the parkland land-use pattern challenges the conventional view of the relation of pastoralists to agriculture and questions the idea of ethnic-based specialisation of agriculture and pastoral production system in West Africa. The Fulbe encountered in south west Burkina-Faso not only show skills and knowledge in cattle raising but also a specific practice of agriculture and an associated knowledge of farming. The parklands with fodder trees can be considered as an innovation in the Fulbe pastoral production system. This land-use pattern allows for the integration of agriculture practices and cattle raising practices in combination with the management of trees that generally grow in tree- and shrub-savannahs. The parklands in Kourouma lead us to reconsider the nature of agricultural practice within pastoralists' groups and the capacity of these groups to adapt and innovate in the field of agriculture.

Finally, as a third part, the parkland innovation will be discussed from Boserup's arguments. Parklands are a result of an intensification of the Fulbe production system. The agropastoral practices of Fulbe pastoralists living in west Burkina-Faso have changed during the process of their sedentarisation. Following Boserup (1965), who argued that increased population pressure leads to intensification and innovations in agriculture techniques, we will indicate how the Fulbe pastoralists have adapted their production system by integrating agricultural practices and cattle raising in a more intensive way. This process of adaptation was a response to forage scarcity and labour shortage. The preservation of trees within fields helps to prevent land degradation and guarantees a better conservation of soil fertility. In this respect, parklands could be considered as a sustainable land-use.

This discussion will be based mainly on a comparative analysis of local practices in three villages of the western part of Burkina-Faso: Barani in the north, Kourouma close to Bobo-Dioulasso where parklands were observed, and Ouangolodougou adjacent to the border with Ivory Coast (cf. Map 1). Together, these three villages are representative of the migration during the 20th century of the Fulbe pastoralists from the north to the more distant southern pastures and will aid an understanding of the conditions of change in their relation to environment and trees and innovation in agropastoral practices found in Kourouma.

Environmental context and historical elements pertaining to the Fulbe

The Fulbe, a Fulfulde-speaking people, are found in Sahelo-Sudanian Africa in a region extending from Senegal to Cameroon. They are designated in English by the term Fula or Fulani, and in French by Peuls. The Fulbe form a heterogeneous pas-

toralist group and while some of them have adopted a nomadic life whereas others have a fixed residence (Bierschenk & Le Meur, 1997). The Fulbe observed in the south western villages of Burkina-Faso fit into the latter category. They are itinerant and agropastoralist, most of them cultivating their own fields. Although the Fulbe have a permanent residential base, they may move to another location for several reasons: to find water and pasture for cattle, to access human health or veterinary services, to be closer to a market, or due to conflicts with autochthonous² groups.

Before colonisation, the Fulbe launched holy wars (Jihads), encouraged the spread of Islam within West Africa, conquered territories and established kingdoms. They have been settled in the north of Burkina-Faso, in the Barani area, since the 16th century (Diallo, 1994). The area was previously occupied by Bobo people from whom they took the power over land and resources. Since then, the Fulbe living in Barani and the surrounding area designated themselves as Fulbe Boobolaaße, meaning 'Fulbe from the Bobo country'³. In the early 20th century, veterinary services were propagated by colonisation and this allowed cattle numbers to increase and cattle owners started to go further south to find new pastures (Benoit, 1979; Quéant & de Rouville, 1969). As a consequence, they settled in villages in the south western part of Burkina-Faso and also migrated to regions north of the Ivory Coast. Most of the Fulbe living in south western part of Burkina-Faso are Fulbe Boobolaaße. However, some of the Fulbe pastoralists arrived more recently from the Central Plateau called the Mossi country (the pays Mossi). The droughts that occurred in the Sahel in 1973–1974 and 1984 accelerated the migration of the Fulbe from the *pays* Mossi towards the south. Four thousand one hundred and eighty-nine inhabitants lived in Barani village in 1996. The population density in Barani *département* is approximately 25 inhabitants/km².⁴

The first Fulbe who arrived in Kourouma were from the Barani region. According to the village chief, they started to arrive in 1920 but the main settlement dates back to the 1950s. The Fulbe from the *pays* Mossi arrived more recently, during the last 15 years and settled in a different hamlet to the Fulbe Boobolaaße. The Fulbe represent a tiny part of the Kourouma population, around 2%. The native population in Kourouma is the Senoufo⁵ and this group has control over the land

² The group considered as autochthonous or natives has not generally occupied the place since for ever, but it is considered now by the others as the first who has settled in the location. Movements of population were frequent in the past under the pressure of wars between empires, the Jihad run by often the Fulbe and later under the influence of colonial power. The Senoufo Nanergué dominated the area around Kourouma (KénéDougou) in the 19th century, removing the control over land from the Bolon. The Gouin settled in Ouangolodougou by the end of the 18th century and early 19th century.

³ The Bobo country: 'pays Bobo'. 'Pays' is a common term in French literature to designate the area occupied by a specific ethnic group.

⁴ The number of inhabitants come from census available at the 'préfecture'.

⁵ Also named Senoufo. In Kourouma, they are *Sénoufo Nanergué*.

resources. The recently arrived Mossi now represent an important proportion of the Kourouma population⁶ (30%). The population of Kourouma in 1996 was 5057 inhabitants for a density of 33 inhabitants/km².

The village of Ouangolodougou, located further south near the border with the Ivory Coast, has also received significant inflows of migrants. The Fulbe Boobolaabe arrived here during the 1990s. Most of the Fulbe living there have returned from the Ivory Coast. They represent about 10% of the village population which consists mostly of the Jola⁷; the natives are the Gouin who still keep control over land (Petit, 2000). In Ouangolodougou, the density was 90 persons/km² in the village area with 2445 inhabitants the same year. If we considered the territory of Diéfoula that includes the area of the gazetted forest, the density is much lower (three persons/km²). Ouangolodougou is the village where the population increase is the greatest.

The tenure management in the villages depends on the village chief and the land chief⁸. Both generally belong to the group considered as native: the Senufo in Kourouma and the Gouin in Ouangolodougou. The autochthonous group has the customary authority over land. The Fulbe, considered as outsiders, allochthonous to the villages located in south west Burkina-Faso, are answerable to the village chief and the land chief decides where they can settle. In most cases, the Fulbe have settled in the non-occupied wooded periphery of village lands.

The three villages belong to the Sudan climatic zone, with annual rainfall varying from a mean average of 900 mm in Barani, 1000 mm in Kourouma and reaching 1100 mm in Ouangolodougou. The landscape is savannah modified by agricultural and pastoral uses. In Barani, millet and peanuts are cultivated. In contrast, Kourouma is part of the cotton zone. Most of the fields produce cotton, maize and sorghum, grown for subsistence and sale purposes. Kourouma farmers benefit from their proximity to Bobo-Dioulasso, the country's second town, where they can sell cereal crops. Cultivator's fields are often parklands with Shea-butter (*V. paradoxa*) trees, and these trees are typically scattered throughout the area. In Ouangolodougou, agricultural systems are expanding and changing. For many years, the area was well known for its production of yams. Nowadays, cotton cultivation tends to dominate. Agriculture is still mainly manual with a labour intensive farming technique with hand hoe (*daba*). In addition to agricultural activities, farmers raise livestock by extensive grazing on fields, fallow land and savannahs. In 1997, cattle owned by the Fulbe represented 50% of the village livestock in Barani (2600 heads of cattle⁹), 28% in Kourouma (7100 heads of cattle), and 95% in Ouangolodougou (8500 heads of cattle).

⁶ The relationships between the Senufo and the Mossi are quite tense: I was the witness of an open conflict in January 1998. Violent oppositions between young Senufo and Mossi people lasted 1 week and required the intervention of the authorities of the province to overcome the conflict.

⁷ Also named Dioula.

⁸ 'Chef de terre'.

⁹ An inventory of livestock was performed in each village during fieldwork in 1998.

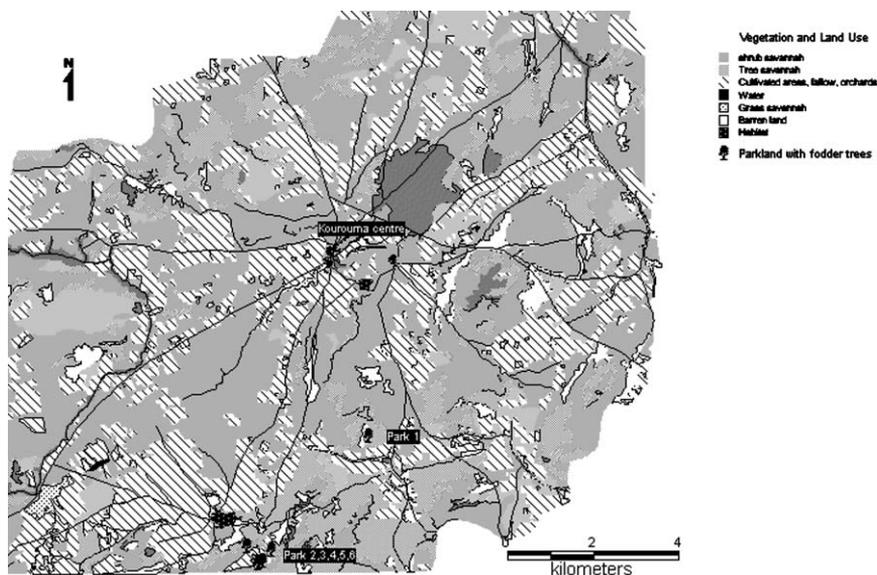
Materials and methods

We conducted observational work over 15 months (1997–1998), adopting a comparative approach. The Fulbe living in these three biogeographical regions outlined above formed the basis of a systematic comparison of raising practices and uses of trees.

Different methods of investigation were adopted: participant observation, interviews, systematic observation and inventories. Over periods of between 1 and 3 weeks in the villages and participating in local life, different kinds of interviews were conducted mainly with the Fulbe and the other social groups. At the beginning, the interviews consisted of opened questions, the objective was to initiate a discussion in which the interviewees could feel at ease. However, the interviews were supported by a question list and dealt with topics such as the family movement, the herd and its conduct, the evolution of forage resources and changes of the environment, management of trees, and the relations between social groups. Interviews lasted between 30 min and 2 h. A hundred people, mainly the family heads, were interviewed in this way. The interviews were reported on forms with additional information about interviewee's attitude during the interview and the interview's circumstances. Systematic inquiries were addressed to every family to collect quantitative data about livestock number. Oral information from interviews was compared with systematic observations. Observations concerning the methods employed to tend cattle and the use of fodder trees in the three villages were made.

Systematic observations were made on the phenology of fodder trees located in the area of the villages. By following daily herders with the use of a Global Positioning System and repeating this work over the course of dry and rainy seasons, the different strategies for using the available natural resources employed by herders were analysed. The cartography of the cattle paths was used to interpret the herders' comments. Crucial factors determining the herdsmen's practices were identified. In the areas studied, aerial photos were available dating back to the 1950s and these were used to analyse land-use change over the last 40 years and to create a dynamic cartography.

In Kourouma, parklands managed by Fulbe agropastoralists were identified. Parklands with fodder trees were not observed in Barani and Ouangolodougou. Consequently, the reasons why the Kourouma area constituted an appropriate context for preserving trees in parklands as farmers usually do were investigated. An inventory of the village land and mapping were carried out. Six parklands were found within an area of 15,400 ha. All six regions are located in the periphery of the village's territory (Map 2). Surveys were conducted with the owners of the fields who were the Fulbe from the *pays* Bobo and from the *pays* Mossi. A detailed inventory of the structure (height, diameter, density) and species composition was conducted in one of the parklands, in association with interviews dealing with the management practices of the parkland.



Map 2. Location of parklands with fodder trees in Kourouma land.

The management of fodder trees by the Fulbe in parklands

Parklands in West Africa

Parklands are a dominant feature of the West African landscape and are often described as an integral part of agricultural production systems. They are cultivated spaces where trees are scattered and there are interactions between the permanent trees and the crops cultivated underneath (Marchal, 1983; Péliissier, 1966). It is an old land-use type referred to by travellers such as René Caillé and Mungo Park¹⁰ during their journey through West Africa in the 19th century (Pullan, 1974). A variety of terms have been used to describe parklands such as savannah park, fallow savannah-with-standards, farmed parkland, agricultural park, agroforestry parklands and, in French, *parc arboré* and *parc agroforestier*. The parkland is generally characterised by the dominant tree species. In parkland, there are generally different tree species but some such as *V. paradoxa*, *F. albida* are dominant and typical of parkland throughout West Africa. The trees are preserved when the land is cleared. They provide edible fruits, nutritious leaves used in food or given to livestock during the dry season, gum and wood. Parkland with *Prosopis africana*

¹⁰ They reported the preservation of Shea-butter in fields, for example around Segou Mungo Park described the agricultural practices with the following words: “These trees grow in abundance all over this part of Bambarra. They are not planted by the natives, but are found growing naturally in the woods; and, in clearing wood land for cultivation, every tree is cut down but the Shea” (Marsters-Ferguson, 2000).

associated with *Terminalia macroptera*, *Anogeissus leiocarpus*, *Hyphaene thebaica* are cultivated by the Musey in the north of Cameroon (Bernard, 1996). These trees provide fodder, wood, dye, leaves for making baskets, etc. Parklands with *Acacia senegal* from which gum arabic is extracted are observed in Sudan and Senegal, parklands with *Ficus* sp. occurred in Chad, parklands with *Elaeis guineensis* are a typical land-use of the Bassa region, around Yaoundé, in Cameroon. Parklands with *V. paradoxa* associated with *P. biglobosa* were described as a land-use created by several ethnic groups who considered themselves to be agriculturalists in Benin (Boffa, 1991), in Mali (Bagnoud et al., 1995), and in Burkina-Faso (Lahuec, 1980). In the north of Burkina-Faso, we observed parklands with *Balanites aegyptiaca* of which fruits are eaten and leaves can be used as fodder and parklands with *Adansonia digitata*. Parklands with *Borassus* sp. occurred in the western part. Parklands with *Tamarindus indica* were described by Marchal (1983) in northern Burkina-Faso. The pod pulp of *T. indica* is made into drink. Generally speaking, the parkland surfaces tend to decrease over the last decades, this is attributed to a general trend of the abandonment of permanently cultivated fields located close to the village centre.

Parkland establishment by the Fulbe in Kourouma

Parklands typology

In the Kourouma area, the original vegetation is tree-savannah. The main species are for herbaceous plants: *Loudetia togoensis*, *Sporobolus festivus*, *Andropogon ascinodis*; for ligneous plants, *Gardenia erubescens*, *Pericopsis laxiflora*, *Piliostigma* sp., *T. macroptera* (Chevallier, 1994). The savannah landscape has been modified by both agricultural and pastoral uses.

In the Kourouma village land, there are three kinds of parklands¹¹: *F. albida* parklands located at the periphery of the main habitat area and managed by the Senufo; *V. paradoxa* and *P. biglobosa* parklands as the main land-use of the village land managed by both the Senufo and the Mossi and parklands with fodder trees typically created by Fulbe.

In Kourouma, parklands with *F. albida* permanently cultivated by the Senufo are located close to the village. Parklands with *F. albida* are generally given as examples of the integration between agriculture and cattle raising. This parkland is often seen as typical of livestock-keeping ethnic groups such as the Sérér in Senegal (Pélissier, 1980; Lericollais, 1989), or the Fulbe, Masa and Tupuri in North Cameroon who develop parklands with *F. albida* associated with *Ziziphus mauritiana* and *Khaya grandifolia* (Bernard, 1996; Seignobos, 1996). Pélissier (1980) indicated that this parkland is closely linked to cattle herds present in field areas during the dry season. Fruits of *F. albida* are consumed during the dry season by the cattle

¹¹ Present research observation. In addition, I noted a close land-use pattern where *K. senegalensis* trees are scattered and that could be confused with parklands. In fact, it is a plantation of *K. senegalensis* dating back to colonial times. The pattern of trees revealed an ancient plantation. The plot is grazed, but trees are not pollarded.

and the branches of trees are lopped for this purpose. Cattle in the parkland provide a source of manure.

Furthermore, at a distance of 2–3 km from the village centre, parklands with *V. paradoxa* and *P. biglobosa* and fallow lands can also be observed. Around the Fulbe encampments located in the south of the Kourouma land, there are other parklands where, in addition to *V. paradoxa*, fodder trees are preserved. The density of trees is much higher in parklands with fodder trees. In contrast, the density of *V. paradoxa* becomes very low in fields planted with cotton. The parkland with fodder trees is determined by livestock-keeping and can be related by its cattle feeding use to *F. albida* parklands. The species selected in parklands are linked to the kind of land-use. In Kourouma, *V. paradoxa* and *P. biglobosa* are linked to an agricultural land-use that generally includes a fallow period. *F. albida* can be attributed to a permanent agropastoral land-use. The combination of fodder species in Fulbe fields is related to intensive land cultivation and livestock raising, the manure provided by the cattle maintains the soil fertility and allows permanent cultivation to take place.

Agropastoral parkland location, structure and composition

Parklands with fodder trees or agropastoral parklands are located at the village periphery, where small fields and bush are mixed. This area matches the boundary zone between the neighbouring villages of Kabala and Fananga. The nature of the control over the parkland by the land master of these two villages is not very clear. One parkland is located near the village land of Kabala and five other fields in the southern part of the Kourouma village that are controlled by the neighbouring village of Fananga. Map 2 presents the vegetation and land-use of Kourouma land (Forgiarini, 1999) and locates the parklands observed.

The dominant species of these parklands are fodder trees such as *A. africana*, *K. senegalensis*, *Pterocarpus erinaceus* in addition to *V. paradoxa* and *P. biglobosa* which are generally kept in farmers' fields. *A. africana*, *K. senegalensis* and *Pterocarpus erinaceus* leaves are consumed as forage by cattle. *A. africana* and *Pterocarpus erinaceus* leaves are the preferred fodder for cattle whereas *K. senegalensis* is less palatable. The herders say : “The leaves of *Kahi* are bitter but they keep cows in good health, herders have to accustom cattle when they are young to eat *Kahi*”. *A. africana*, *lingahi* in Fulfulde, is a species of dry forest, or forest galleries. Its fruit are consumed by fauna. The foliage of *A. africana* is considered by herders as the best browse. The wood is of high quality and the species has an agronomic interest because it is a leguminous plant (Geerling, 1982). *K. senegalensis* is a local species and its wood is good for cabinet making. Its leaves fall during the dry season but are immediately replaced. *Pterocarpus erinaceus*, or ‘*bani*’ in Fulfulde, can adapt to poor soils, and its leaves are considered nutritious forage in the literature. The timber is of a yellowish colour and also hard which makes it one of the best timbers for cabinet making (Maydell, 1983).

One of the parklands, where *A. africana* was the dominant species was inventoried. In this field which used to be sown with millet, all trees are pollarded, indicating a repeated use of the leaves. The pollarding intensity in this field is very high,

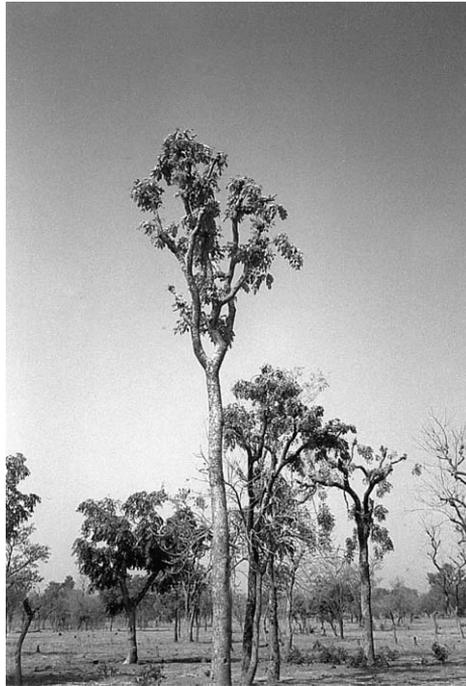


Photo 1. Parkland with *A. africana*.

almost every branch was cut (cf. [Photo 1](#)). In the five other parklands, *V. paradoxa* trees are numerous and other forage trees such as *Pterocarpus erinaceus* and *K. senegalensis* are as numerous as *A. africana*. They are slightly lopped. *V. paradoxa* trees are generally preserved for the nuts from which a local butter is prepared and added to food preparation. The fruits are eaten by both people and livestock. I noticed that cattle browse *V. paradoxa* trees.

The *A. africana* parkland sample is 1.2 ha in size with a density of 37 *A. africana*-trees/hectare. The other species encountered in the sample are listed in [Table 1](#) and the contribution of the main species of the park is presented in [Fig. 1](#). The overall density including trees whose diameter is larger than 10 cm is 93 trees/hectare. The distribution of diameter classes, ranging from 10 cm to more than 50 cm, is given in [Fig. 2](#). On average, *A. africana* trees are 9 m high and 31 cm in diameter ([Figs. 1 and 2](#)).

The *A. africana* parkland density is higher than that quoted in recent studies in the case of other Shea-butter (*V. paradoxa*) tree parklands seen in the same area. In the province of Tui in southwestern Burkina-Faso, [Gray \(1999: p. 339\)](#) found a density of trees per hectare by village from 10 to 18. [Lericollais \(1989\)](#) gave a density of 10.7 trees/hectare in 1965, falling to 8.3 trees/hectare in 1985. In Nigeria, according to [Cline-Cole et al. \(1990, quoted in Boffa, 2002\)](#), the density of trees, in a region with a high population density, increased from 12.9 to 15.2 between 1972

Table 1

List of ligneous species presence in the *Afzelia africana* parkland^a

<i>Acacia dudgeoni</i>
<i>Acacia sieberiana</i>
<i>Afzelia africana</i>
<i>Annona senegalensis</i>
<i>Detarium microcarpum</i>
<i>Detarium microcarpum</i>
<i>Diospyros mespiliformis</i>
<i>Guiera senegalensis</i>
<i>Isobertinia doka</i>
<i>Khaya senegalensis</i>
<i>Lannea acida</i>
<i>Lannea microcarpa</i>
<i>Parinari curatellifolia</i>
<i>Parkia biglobosa</i>
<i>Pericopsis laxiflora</i>
<i>Pterocarpus erinaceus</i>
<i>Terminalia laxiflora</i>
<i>Trichilia emetica</i>
<i>Vitellaria paradoxa</i>

^a Inventory done by S. Petit and M. Diallo (1998).

and 1981. In the Ivory Coast, Bernard gave 12–15 trees/hectare, and Bagnoud et al. (1995) reported a density of 9–17 trees/hectare. Several authors have demonstrated that the density of trees in fields are decreasing with the use of ploughs, tractors and fertilizers and the increasing importance of cash crop cultivation such as cotton (Lericollais, 1989; Ouedraogo, 1994; Sturm, 1998). Indeed, the density of tree observed in parklands by earlier authors was higher. Pullan (1974) reviewed local studies of parklands in Africa and gave a range of 10–90 trees/hectare. The highest density is found in parklands with palm trees. Pélissier (1966) linked the highest density of *F. albida* (50/hectare) to the oldest parklands and to the oldest Sérér agropastoralist occupation.

Species' composition and parkland structure seem to be typical for the Fulbe farming systems in these situations.

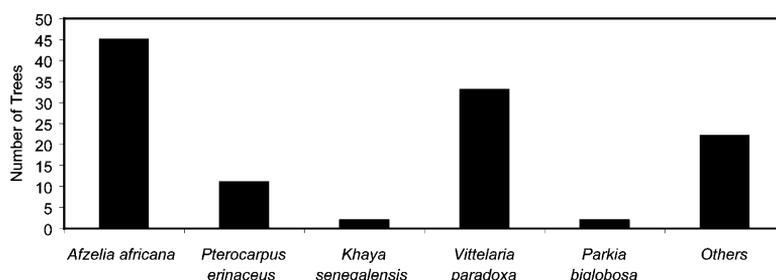


Fig. 1. Contribution of the main species (diameter > 10 cm) in the parkland. Inventory done by S. Petit and M. Diallo (1998).

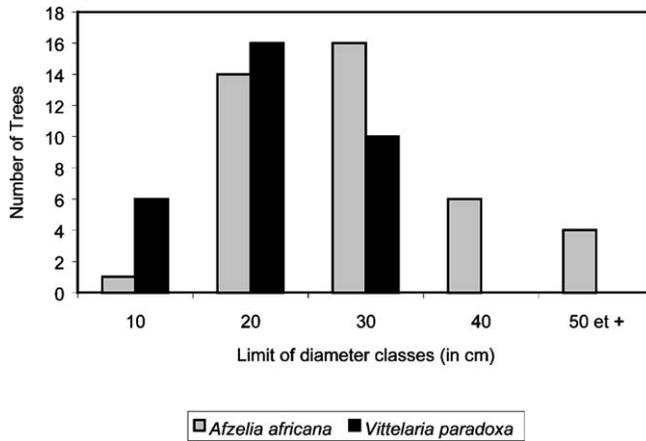


Fig. 2. Distribution of diameter classes. Inventory done by Petit and Diallo (1998).

Management of agropastoral parkland by the Fulbe

The *A. africana* parkland was managed by a Fulbe herder, A. Sangare, who originated from the Bobo north west region of Burkina-Faso. He arrived in Kourouma in 1989, and cleared the bush to cultivate millet, but he maintained the useful trees. Canopies of this tree do not shade crops because most of them are pollarded (Photo 1). During the dry season, herds graze in the parkland. They are also fed with foliage from lopped trees, and cattle provide manure to the soil. In 1998, A. Sangare left Kourouma, and as a result the field was abandoned and remained uncultivated during the following season. The origin of the other parklands is similar to the *A. africana* park. Fulbe coming from the Central Plateau settled in the southern part of Kourouma in 1989, 1990 and 1995 and reproduced a similar land-management pattern. It can be assumed that the parkland innovation initiated by the first settler in 1989 was imitated, by later Fulbe immigrants between 1989 and 1995.

Pollarding trees for fodder

In the three locations (Kourouma, Barani, Ouangolodougou), Fulbe pastoralists use tree fodder to feed their cattle during the dry season. In Ouangolodougou, they use the same species as in Kourouma: *A. africana*, *K. senegalensis*, *Pterocarpus erinaceus*. In Barani, they use in addition *Pterocarpus lucens*, *Terminalia* sp., *B. aegyptiaca*, etc. They pollard the trees in order to give the leaves to cattle, but lopping branches seems to be practised less here than in Kourouma. Tree fodder is frequently used especially at the end of the dry season and can represent as much as 70% of the pasture time. *A. africana* trees are highly pollarded whereas in the others trees tend to be only slightly pollarded. In contrast, in Ouangolodougou, most of the herds have moved away to find pasture further south, in the northern territory of the Ivory Coast. If there are few cattle close to the residential base during the dry season, they are fed with fodder cropped in savannah. In order to obtain

tree fodder, the herders climb the tree and fore-shorten the branches. Generally, the branches cut are of a diameter from 1 to 3 cm maximum. They spend 10–20 min (30 min in exceptional circumstances) in the tops of the trees lopping branches. This practice is very dangerous for herders, and during the fieldwork one herder died after falling from the tree and other similar accidents were reported to us (Petit & Mallet, 2001). I noticed different kinds of pollarding techniques (Petit, 2000). In Barani, branches at the top are cut whereas in the south they are often left uncut.

The Fulbe access and representation of pollarded trees

A. africana and *Pterocarpus erinaceus* are bush trees. They are often lopped in the savannah area by the Fulbe. The case of *K. senegalensis* is more peculiar. *K. senegalensis* was planted during colonial times in plots and along the roadside. This tree species is associated with restrictions and the Fulbe will not pollard such trees growing along roadsides or in small plots. However, it can be found in the savannah area and might be pollarded by herders. The tree resources are not individually appropriated in savannah areas. However, branches that have been cut and fallen onto the soil are the property of the herder who climbed and lopped the tree. According to interviews, the rules for tree use are the same for both the bush and the parkland. According to the Fulbe who cultivate forage parklands, every herder can enter their field and lop tree branches. However, the introduction of forage trees in the field may have changed the Fulbe representations of trees such as *A. africana* and *Pterocarpus erinaceus*. While trees located in the uncultivated bush (*ladde* in Fulfulde) can shelter djinn spirits, *A. africana* trees within the fields are not believed to be inhabited by spirits. Trees found in fields are included in the familiar area of the encampment called *wuro* in Fulfulde. According to an old Fulbe informant, it is generally believed that spirits prefer old and uncut trees.

Environmental and social conditions for the management of trees by the Fulbe

The presence of fodder trees preserved, used and managed in the fields belonging to the Fulbe challenges the conventional view of the pastoralists destroying trees and not capable of resources management because of their mobility. According to informants, the practice of pollarding trees that was restricted to drought years in the past has become a yearly practice because of the forage resources and pasture shortage. However, the reasons why pastoralists preserve trees in their fields needs to be clarified. By comparison with the Fulbe situation in Barani and Ouangolodougou villages, two main reasons for managing fodder trees in fields were retained. The first one is the shortage in family labour that reduces the mobility of the herd and the second one is the restricted access to land and forage resources for Fulbe settling in southern Burkina-Faso.

Labour shortage and limited herd movement

The Fulbe in Kourouma are quite poor families compared to Senufo landowners or Fulbe families in Ouangolodougou. In Barani and Kourouma, the family is scattered because economical constraints force young men to leave the family to

support themselves independently. In Kourouma, the Fulbe do not have enough money to pay hired herders to tend cattle or farmers to cultivate their field. Consequently, old men and children are involved in production activities. In Kourouma, families cultivating parklands own about 50 cattle or less.

In Barani, the herds are equal or smaller in size but labour is not scarce for land cultivation. Usually, the Fulbe have maintained a relation of labour exchange with the Rimaiße people who were their captives beforehand. The Fulbe in Ouangolodougou have more flexibility in labour access because they can hire labour for their field cultivation and for herding. Moreover, the family is larger than in the other villages: the brothers and sons of herdsmen can stay with the family head and raise part of the herd given to them. Then the Fulbe of Ouangolodougou practised a more mobile way of raising cattle. They frequently move their herds tended by young men over long distances in search for more fodder. The mobility of herds especially bush herds is much higher than herds from Kourouma. The Fulbe distinguish the milk herd from the bush herd (Bassett, 1986; Bocqu  n  , 1993; Bonfiglioli, 1988; Boutrais, 1995). The milk herd is kept close to the home territory to provide milk on a regular basis and the bush herd is itinerant. In Ouangolougou, during the dry season, the milk herd and the bush herd are taken far from the village in to wetter areas. In some families, only women stay in the concession during the dry season when men tend cattle herds in more humid locations. As one woman noted in an interview: ‘we have no milk not even a drop’.

Labour was identified as an influential factor on the herdsmen’s practices¹² (Petit, 2000). Because of a shortage in labour and a restricted mobility of herds, the Fulbe herder in Kourouma have to keep the herd in the closest area to the settlement, and that could explain partly why they preserved trees around their home. The solution chosen by Ouangolodougou pastoralists to address the shortage of resources is mobility, whereas in Kourouma the parkland allows the Fulbe to maintain a herd with the family all year round as it has been described in *F. albida* parklands managed by the Serer in Senegal (Lericollais, 1989; P  lissier, 1966). The shortage of forage and the restricted access to land could be the another reason at the origin of the Fulbe parklands.

A restricted access to land and forage resources for the outsiders Fulbe

The Fulbe are a sedentary group rather than a nomadic group, even if they move from one village to another after several years. Interviews reveal that the Fulbe in Kourouma have been settled there for an average of 8–9 years¹³ and desire to stay there. In Ouangolodougou, the mean sedentarity is about 5 years and most of them have spent several years in Ivory Coast.

In Barani, the Fulbe have the right over the land and the water because they conquered it from the Bobo natives in the 16th century. Consequently, during the dry season, their cattle wander in millet fields whoever they belong to. Some cattle

¹² Factor identification by the factorial analysis of correspondence for herders tending practices.

¹³ After interviewing all the families, we calculated an average of the years spent by them in the village.

owners buy cake as feed supplement. In contrast, the Fulbe in Kourouma and Ouangolodougou, being allochthonous, do not have secure rights on the land. When the Fulbe arrive in a village, they have to solicit permission to settle and clear the land from the land chief and village chief, who attribute a non-occupied land for cultivation however the grazing area remains not clearly defined.

One of the most important sources of forage during the dry season is the crop residue found in fields. From a spatial analysis of cattle paths, we deduced that autochthonous farmers who cultivate most of the land keep crop residues in order to feed their own cattle. In Kourouma, Fulbe herds generally cannot graze crop residues in Senufo fields which occupy a high percentage of the village land. Senufo peasants owning large cattle herds are the Fulbe hosts: they have the power over the land and forbid Fulbe herders from tending cattle in their fields during the dry season (Petit & Diallo, 2001). The same fields at the beginning of the humid season, when grass is abundant, can be grazed by anybody's herd. During the dry season, Fulbe herders have only two main alternatives: move their herd further south or feed them with tree fodder. Foliage is an important nutritional component for cattle. It should be noted that the lopping of branches is difficult and dangerous work that herders may abandon if they have other forage resources during the dry season. The access to tree forage can be also restricted by Senufo natives. The Fulbe reported to me cases where the Senufo natives who are also hunters forbade them to cut trees in bush areas. The Fulbe have probably seen the necessity to keep those precious trees in their own farmland where the Senufo cannot reasonably interfere in areas that they have already allowed them to cultivate. It is probable that the rights on the land cultivated by the Fulbe are secure enough in Kourouma to manage trees.

Control over pastures changes over the course of the seasons according to tacitly accepted rules. Access to water points during the dry season is even more constrained in Kourouma. The Fulbe have to use their own wells or ask and pay for using Senufo or Mossi's wells.

The practice of agriculture in the Fulbe group

The Fulbe ethnic label is often used to categorise the group as 'pure pastoralists'. The conventional view is that the Fulbe are traditionally herders whose practices are based on an ancestral and deep knowledge of cattle management and that they are not inclined to practice agriculture. This understanding was based on ethnographical studies and the ideal of the herder who dedicates his life to his herd has become accepted (Benoit, 1979). Furthermore, it was an understanding expressed in some interviews with elderly Fulbe. For example, Hasan Sidibe retraced the changes of way of life of Fulbe Boobolaaße with the following words: "When white people arrived, they told the Fulbe to sit (settle). The Fulbe knew that they could not sit and cultivate the land. So they started to tend cattle herd and sell milk. At this time, it was not raining enough, veterinary surgeons gave a jab to cows and cattle became numerous, the grass had disappeared and so they had to

leave; they went to Tansila, Maho, Ndorola, Kourouma”¹⁴. In his story, Hasan Sidibe omitted to relate those changes to the end of slavery. During the colonial period when local wars and raids were abandoned, Fulbe were obliged to practice by themselves cattle tending and agriculture that was previously performed by the captive Rimaybe. In spite of this and the admitted label of ‘pastoralists’, the Fulbe cultivate the land. Benoit (1979) reported that agriculture has over several decades become part of the way of life of the Fulbe Boobolaafe in Barani area. However, the Fulbe Boobolaafe still attach great importance in defining themselves as pastoralists. Benoit (1979: p. 148) justified the agricultural practice as an economic necessity. He was commenting that if agriculture is combined with cattle raising and the manure used for farming, the Fulbe are not dishonoured. On the contrary, to be obliged to cultivate the land after having lost animals is considered shameful by the Fulbe (Benoit, 1979). Being a pastoralist or a cultivator is not so much a question of daily activities or means of existence but rather a cultural matter maintained through a common language and concerns of self-definition and identity.

The complementarity between agriculture and cattle raising has been historically perceived as exchanges between agriculturalists and pastoralists as different social or ethnic groups with a specialised production system (Horowitz, 1975). We argue that in Kourouma there is no evidence of ethnic-based specialisation in farming and cattle raising activity as demonstrated by Howorth and O’Keefe (1999) in the southern province of Sissili in Burkina-Faso. The opposition between farmers and pastoralists being typically reported as a social opposition, has hidden the integration of both activities in many ethnic groups even if they were frequently separated into farmers and herders. For example, interviews with old Senufo farmers in Kourouma, who are presented in ethnological literature (Holas, 1966) as cultivators showed that the practice of herding is not recent but has been practised over a long period of time. Cattle provide the most efficient means for investing the money from cotton cultivation. The Senufo as well as the Mossi increasingly raise cattle. In the villages studied in Burkina-Faso, the Fulbe like other groups practice agriculture in addition to owning livestock regardless of whether they are labelled as pastoralists or cultivators. The Fulbe are self-sufficient in either millet or maize. They cultivate roughly 1 hectare per family and the high level of cattle manure encourages high harvests. According to interviews in Ouangolodougou sometimes they can also sell part of the crop. Wealthy Fulbe in Ouangolodougou use salaried labour to cultivate their fields or lend their oxes to farmers who in exchange plough their field. In Barani, the Fulbe either cultivate the land themselves or else employ farmers to do this work. In contrast, in Kourouma, the Fulbe dedicate more time to agricultural work. They cultivate by themselves and even sell their labour for ploughing land and rent their oxes. Furthermore, they show a peculiar skill in agricultural practice as they plough a land with a high density of trees. This might have had an influence in establishing parkland. Indeed, the parkland represents a peculiar investment in land cultivation and implies a skill in farming prac-

¹⁴ Hasan Sidibe, Boulemporo, near Barani, 17/09/1997.

tices. The existence of parklands challenges all the more the idea of ethnic specialisation in agriculture and pastoralism.

The transfer of labour between the Fulbe and the other groups is determined by factors other than ethnicity. In Kourouma, co-operative relationships are developed not in the way expected and exchanges of labour are not based on such an ethnic specialisation. The older Fulbe families in the village with two or three generations living together provide labour for agricultural work to the Senufo. Less established families (comprising one generation) and generally more recently settled in the area provide labour for cattle tending. Generally, it is reported that the transfer of labour for agriculture is in the opposite direction. In addition, we met a young Senufo working as herder for a Fulbe. All activity transfers are possible and depend more on the economic situation of the family than the ethnic origin. Generally the poorest people provide the labour for cattle tending.

Agropastoral practices and the management of trees: towards a land-use intensification

In general, the Fulbe system of production is balanced between agriculture and cattle raising in Barani and Kourouma whereas in Ouangolodougou the family economy is mainly based on cattle raising. The size of their herds is on average larger in Ouangolodougou, where the Fulbe may own several hundreds of cattle heads. This reflects the successful change of cattle raising practices adopted when they were in the north of the Ivory Coast. For example, they employ veterinary services. Indeed, in the humid savannah areas, the Fulbe now raise zebu cattle (*Bos indicus*), a type of cattle they used to raise in drier areas. The zebu need vaccinations against trypanosomiasis transmitted by tse-tse fly and veterinary cure to fight other diseases occurring in humid areas.

The advantages of association between agriculture and animal raising have been recognised and it was one of the technical and economic solutions proposed in most rural development projects in Africa¹⁵. The benefits of such an association lie in the intensification of production systems during periods of population growth when more land is required for cultivation and cereal production (Boserup, 1965). The herd provides manure and maintains soil fertility. Field areas also provide livestock fodder (crop residues, ruderal plants) and avoid overgrazing in natural pastures.

Boserup's thesis linked the intensification of production systems and technological innovation with population pressure. The parkland presence in Kourouma seems to confirm that argument. There is a general increase in the village population combined with the migration of Fulbe and Mossi. Both have induced an expansion of agricultural activities. The pressure over land is higher in Kourouma than in Barani. In Ouangolodougou, the population density is higher if the surface

¹⁵ For example in Burkina-Faso: projet de développement rural intégré, projet de gestion des terroirs.

of the village land is retained for the calculation. However, in 1997, the forest reserve located in periphery of the village was already encroached by agricultural cultivation. In addition, cattle herds are also grazing in the gazetted forest territory. In this area, land is still available outside the village land and by a violation of the prevailing national law. In Kourouma and around Kourouma located within the core of the cotton zone, all the arable land is already cultivated and consequently the pressure to access to land is particularly high for the Fulbe outsiders. In that respect, it can be believed that the situation observed in Kourouma matches Boserup's hypothesis. The Fulbe have changed their practices from extensive cattle raising to intensive permanent land-use with a combination of agriculture and tree forage production. Intensification of land-use and permanent cultivation have occurred in a case of population and animal pressure particularly expressed through a restricted access to land and natural resources and towards the Fulbe outsiders.

Conclusion: the parkland sustainability

Parklands are a widespread land-use in West Africa that vary in terms of the species preserved in the fields, the tree density and their management. Fulbe pastoralists settled amongst agricultural and agropastoral population in south west Burkina-Faso, have adopted and modified an existing land-use type, the parklands, to their new conditions. Those parklands are characterised by the fodder tree species preserved in addition to *V. paradoxa*, by its location at the periphery of Fulbe encampments at the border of the village land, by the high density of scattered trees and by the practice of pollarding the trees.

The Fulbe considered as outsiders and not having control over land cannot extend their fields and must therefore adopt an intensive cultivation. Probably conscious of the shortage of forage during the dry season due to a restricted access to crop residues for the Fulbe, some of them have decided to preserve fodder trees in their own fields. However, the establishment of parklands could be also a means to secure the access to land. That hypothesis remains to be further investigated and verified. In that respect, the parklands observed in Kourouma might have a similar origin to the parklands created in the 19th and early 20th century during times of insecurity and described as a typical land-use during instable periods (Sturm, 1998; Pullan, 1974).

'Pure nomad pastoralists' do not exist in south west Burkina-Faso. The involvement of the Fulbe in agricultural practices has been mainly ignored or overly simplified. Contrary to the idea of specialisation of activity based on ethnic origin, the Fulbe who cultivate parklands have a technical skill in land cultivation. They innovate their system of production establishing a balance and an integration between agriculture and cattle raising where the level of soil fertility can be sustained. The parkland is an intensification of land-use through improving land productivity by tree preservation and by input of cattle manure. After investigating the process and conditions of parklands creation in Kourouma, we have taken Boserup's side.

As a new and interesting development of the Fulbe production system, the Kourouma parkland dynamics need to be further studied and their sustainability assessed before envisaging any actions in rural development field. The dynamics of parklands, as previously described for parklands with *F. albida*, follows a general scheme divided in two or three main stages (Pélissier, 1980; Sturm, 1998). The farmer starts clearing the bush but preserves some trees. This first stage is designated as the “rest-park”. The second stage called the “selected-park” consists in selection and pruning of tree species. In a further stage, trees could be replaced by species other than the local flora and that creates an artificial park of which *F. albida* parkland is an example. Parklands in Kourouma are in the so-called first stage. The preservation of regeneration plants and their pruning in Kourouma parklands, as it was described in *F. albida* parklands, was not observed during the fieldwork. Management seems to be restricted to the fore-shortening of tree branches. Cattle, grazing in the parkland or remaining overnight during the dry season, provide manure necessary for maintaining soil fertility. Cultivation in parklands with fodder trees would possibly be permanent.

The dynamics of other parklands such as those with *V. paradoxa* or *Prosopis africana* depends on a cultural rotation and a period of fallow that allows the regeneration of the tree species in the village land area (Bernard, Oualbadet, Ouattara, & Peltier, 1995). The natural regeneration of tree species can occur during a fallow of sufficient duration. Several factors have already been identified as responsible for a rarefaction of tree species and diminution of these parklands: a shorter fallow period, extension of surfaces cleared and cultivated, increasing cultivation using plough with ox traction for which numerous trees are an obstacle. After a fallow period, farmers will clear again the land and select the young trees they would like to preserve. Afterwards, trees scattered in the park will be protected against fire and plant competition. In addition, farmers prune them to facilitate their growth.

There is a lack of ecological knowledge on how the regeneration of tree species such as *A. africana* and *Pterocarpus erinaceus* could be possible in an open space like the parkland or could be possible during a period of fallow. *A. Africana* regeneration and dynamics has only been documented in a natural savannah but not in a agropastoral system. It could be assumed that the parkland dynamics and tree species cultivation in Kourouma parklands will be similar to parklands with *F. albida*. It still needs to be confirmed that parklands dynamics and tree species cultivation in Kourouma would be similar to parklands with *F. albida*. Regular observations on a longer path of time, at least one decade, need to be carried out to analyse the parkland management and the species dynamics. More research is therefore necessary to understand the way in which the parklands could be maintained and retained as a model for a long-term sustainable resource-use pattern.

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