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Bocage hedge at the Filly pilot farm. Photo: Terre Verte

Wégoubri, an innovative agroforestry solution for rain-fed agriculture in the Sahel

Nassirou Yarbanga

Introduction

The degradation of the Sahelian rural environment has worsened over the last few decades, particularly as a result of local agricultural practices, endangering rural populations. In response to this challenge, the NGO Terre Verte was set up in 1989 to support the Guiè pilot farm, located around 60 km north of Ouagadougou in Burkina Faso (Baudin 2017).

"Sahelian bocage has made it possible to reshape rural areas and create a new living and working environment."

The NGO is promoting bocage (hedged farmland, or *wégoubri* in Moré), a rural development concept practised by the Guiè pilot farm in the 1990s and subsequently adopted by other Burkina Faso pilot farms (Filly, Goèma, Barga and Tougo) belonging to inter-village associations. A pilot farm relies on six technical teams supervised by a director (see Table 1). The pilot farm is the linchpin in implementing the bocage concept in an area.

Aerial view of the Tankouri bocage in Guiè. Photo: Terre Verte

A bocage is defined as a rural landscape of meadows and/or fields surrounded by living hedges that form a continuous network — a "linear forest" where trees, crops and livestock are combined.

In the Sahel, the primary purpose of hedges is to store rainwater during the monsoon season (mainly June to September). The hedges, combined with bunds (embankments), reduce runoff and soil erosion, and encourage biodiversity in this very fragile environment. The hedges also help to address the problems associated with extensive agriculture, which is still widely practised in the Sahel, particularly overgrazing and roaming by animals, slash-and-burn farming and excessive cutting of firewood.

Bocage areas are created at the request of landowners. They are organized with customary co-ownership, comprising individual plots and common land, managed by a land-owning group of beneficiaries. The result is a restored environment where agriculture is no longer synonymous with erosion, where livestock farming is no longer synonymous with overgrazing, and where trees and shrubs are integrated into agriculture. The principles of agroforestry are fully integrated in this new farming practice.

The increase in yields achieved after only a few years of soil restoration appears to be a real solution to the degradation of Sahelian environments and is helping to improve the living conditions of farmers and the rural population as a whole.

The Guiè pilot farm

The bocage of the Guiè pilot farm has been implemented to incorporate three components: experimentation with new bio-ecological farming and rural development techniques (applied research), training, and advice and support for the farmers involved.

Experimentation with new techniques was based on processes already used in the region, in particular earth bunds, to which was added hedges and water reservoirs. The living hedges alone proved insufficient to stem the damage to vegetation and crops by roaming cattle. Fencing was therefore essential to supplement the enclosure effect of the hedge. The "mixed hedge" therefore combines wire fencing with the shrubs of the living hedge (*Cassia sieberiana, Combretum micranthum, Diospyros mespiliformis*). The different species are produced by the nursery section of the pilot farm using several techniques, including nursery sowing, layering, grafting and cuttings, depending on the requirements of the species. Through these various processes, the nursery contributes to the maintenance of local species, the return of species thought to be extinct and the adaptation of new species to local environmental conditions. In order to ensure the development of bocage areas on a large scale, the pilot farms have developed the technique of

direct sowing of shrubs, which consists of planting the seeds in trenches in the bocage (i.e., not in the nursery) and then watering them until the first rains.

Training in these new techniques was provided by taking on young apprentices on the farms and by holding sessions in the fields for adults. Participants were also encouraged to learn about other agro-environmental experiences in Burkina Faso and neighbouring countries, and even in Europe, where ancient bocages offer a wealth of lessons.

Bocage development is used to **advise and support farmers** to practise sustainable agriculture. After studying the site to be developed and drawing up the project, the beneficiaries clear the necessary paths, which are marked by the pilot farm's technicians. The site is managed on the principle of "paid labour-intensive work" (*travaux à haute intensité de main d'œuvre*). This system makes it possible to involve rural populations in major works that are usually entrusted to mechanized companies, in particular for the construction of earth bunds and the digging of ponds. Paid contract workers acquire real know-how, and all sections of the working population (young people, men and women) are involved. This approach is part of the support for the region's socioeconomic development and is financed by technical and financial partners.

Once completed, the bocage area is managed by a customary land-owning group, which is responsible for maintaining the common areas and ensuring compliance with the three basic rules for preserving the Sahelian environment: control of livestock, of fire and of wood cutting.

The three work components are organized in six sections, each with a team supervised by a director (Table 1).

Table 1. Sections of work

Nursery	• testing new plants and new horticultural techniques • producing the plants needed for planting • meeting the needs of local populations • safeguarding local species that have become rare
Livestock farming	• experimentation with rational grazing (control of grassland and fallow land, making hay and silage) • improving herd management • support for farmers with grazing fallow land
Technical support	• training, technical support and monitoring and evaluation for farmers in the use of bocage areas • development of new expertise
Agricultural equipment	• logistical support for work on the pilot farm • development of targeted mechanization to facilitate large-scale tasks
Land management unit	• creation of bocage areas, rain gardens, *bullis* (large water reservoirs) and rural tree-lined roads • site surveys • supervision of labour-intensive paid work • fencing and reforestation
Bocage maintenance	• development of environmental management skills (tree pruning and maintenance) • maintenance of hedges and roadside trees

***Combretum micranthum* (*randga*) plant in nursery, Filly pilot farm. Photo: Terre Verte**

The concept of the bocage

The principle behind the management of bocage areas is that of "informal co-ownership" organized around the beneficiaries' customary land use and comprising individual plots and common areas. The precise legal status of this type of rural co-ownership has yet to be worked out.

Commons

The commons are the areas and structures that are the responsibility of everyone; they form the physical foundations of the bocage, from the outside in:

1. The firebreak — a cleared perimeter zone that surrounds the entire area and protects it from the ever-present risk of fire during the long dry season (October to May).
2. The mixed hedge — made up of a wire fence between two lines of shrubs, which blocks access to the cultivated fields by roaming livestock.
3. The openings — four "cattle grids" to prevent livestock from accessing to the site and allow only pedestrians and bicycles, with a main gate that gives access to livestock and tractors.
4. The main and secondary paths serving each plot, with each plot comprising four fields.
5. A *bulli* (large reservoir) to collect water from the paths and help water the livestock.
6. Plots, some of which are shared (woods, pastures, communal fields).

Related facilities (diversion channels, large *bullis*) are sometimes required upstream of the site to protect it from runoff from undeveloped areas.

Individual plots

These plots benefit from the advantages of the commons in improving agriculture and livestock farming, while preserving individual ownership. Each owner receives one plot of 2.56 ha (160 x 160 m), divided into four fields, each 0.64 ha (160 x 40 m), depending on the slope of the land.

Each field is accessed by a path and surrounded by double protection: an earthen bund and a hedge. At the lowest point of the field is a small pond (*banka*) to infiltrate excess runoff water. Along the edges of each field are large trees next to a strip of grass, two metres wide, to slow runoff and limit erosion.

The integrated organization of the commons and individual plots provides an excellent approach for working, enabling yields two to three times higher than traditional yields, in sustainably productive conditions.

Zaï cultivation

Zaï cultivation is a traditional cereal-growing technique, originating in Yatenga Province in the northwestern region of Burkina Faso; it involves concentrating water and nutrients around a cultivated plant. During the dry season, *zaï* (pits) 30 cm in diameter and 15 to 20 cm deep are dug. As soon as the first rains fall in May-June, which

are insufficient for irrigation, compost is placed in the *zaï*, covered with a small quantity of soil, and the cereal (millet, sorghum or maize) is sown.

By concentrating the water, soil and compost, this technique allows early planting of crops, which can then take full advantage of the monsoon and withstand the short dry spells between rains.

This technique also helps to regenerate the soil and restore degraded land, while producing a good harvest even in the first year. It is also a way of ensuring that the crop will provide enough to live on, whatever the vagaries of the weather. At Guiè, good results were obtained with an annual rainfall of just 428 mm! However, a lack of compost remains an obstacle to the development of *zaï*. In some cases, large quantities of compost have been obtained thanks to livestock farming with crop rotation; during the dry season, this includes a fallow area grazed by the animals and protected by a solar-powered electric fence.

Trees in the bocage

In the Sahelian environment, where there is a long dry season, the presence of trees in the bocage is essential to encourage biodiversity. The majority of trees and shrubs have fertilizing functions, thanks to their roots and the decomposition of biomass. Acacias, for example, help to enrich the soil through symbiotic root associations with nitrogen-fixing bacteria. They can also help to desalinate soils, unclog crushed soils and fix loose soils, while their decomposed foliage produces good compost. In addition, as the biomass produced by trees decomposes, it encourages the proliferation of microfauna, which helps to increase the soil's agronomic potential. This biomass provides mulch for the fields and protects the soil from splash erosion (the impact of raindrops).

Thanks to the trees in the bocage, a natural ecosystem is gradually being reconstituted, encouraging biodiversity. The bocage creates a microclimate favourable to flora and fauna. Evapotranspiration from tree vegetation emits water vapour, which helps to recharge clouds and maintain rainfall.

The trees in the bocage provide many other services, but the most important is the maintenance of the bocage. After a few years, hedges become rows of trees or shrubs that produce large quantities of firewood and fodder. Fast-growing trees need to be trimmed and pruned (every three years, in March–April, for hedges that are five to ten years old), to allow the hedge to thicken and to facilitate the growth of other species. Maintained in this way, hedges remain productive and continue to provide environmental and productive services.

The fruits of several of these tree species are part of the diet of local populations. For example, the seeds of *Acacia macrostachya* (*zamné*, or *kardga*, an endangered species

Close-up of a field within the bocage, Guiè. Photo: Terre Verte

Trimmed mixed hedge, Filly pilot farm. Photo: Terre Verte

commonly planted in hedges), are a favourite food at major ceremonies in urban areas. *Parkia biglobosa* (*néré*, planted preferentially as a line in the centre of fields), has highly prized fruits (powdered, eaten directly or its seeds transformed into *soumbala*). *Sclerocarya birrea* (*nobga*) grows mainly on the edges of ponds and produces fruit whose juice and nuts are highly prized. These few examples illustrate that the bocage plays a very important role in the conservation of these species, which are regularly collected in the natural environment and may be on the verge of extinction.

The leaves and roots of several species are part of the medical practices and cultural traditions of local societies. *Néré* is used to combat female sterility, ulcers and stomach aches; the leaves of *Combretum micranthum* (*randga*) are used to treat hepatitis; the roots of *Cassia sieberiana* (*koubrissaka*) are used to treat stomach aches. The fibrous outer bark of *Piliostigma reticulatum* (*bangandé*) is used to make *secco* (fences), mats and beehives.

Testimony from a family farmer of the Zamtaoko bocage in Filly, on biodiversity and increasing resources (source: Terre Verte 2021: 13; translated from French):

> *"As I said earlier, this land was really unproductive! Some 36 years ago, the land was ploughed with a tractor and andropogon transplanted to cover it with grass, but the work was a failure! The andropogon couldn't last a year and died before the first rains of the following rainy season. When this area was being developed, we used to say in our hearts that simple bunds and ponds couldn't bring this land back to life. If only these developers had known that other actors who preceded them had used greater resources than this without succeeding, they wouldn't be bothering with such works. But I'm personally amazed by what I see now! Valuable plants like andropogon, shrubs and trees here, I'm really amazed! Come along and let me show you some extraordinary things. I have a lot of red-flowered kapok trees (*Bombax costatum*), which have brought me an average of two 100-kg bags of kapok over the last few years.*
>
> *I also have a lot of andropogon. This has enabled me to make 6 seccos [fences] for my needs and to sell 30 bundles of this andropogon, which brought me CFA 28,500 (West African francs)/EUR 43.*
>
> *Many species that had disappeared from these areas have reappeared in my fields and are a real treasure for me. There's lamboèga (*Capparis corymbosa*), andga (*Vitex doniana*), the tamarind tree (*Tamarindus indica*), bangandé (*Piliostigma reticulatum*), wèdga (*Saba senegalensis*), tipoèga (*Bauhinia rufescens*) and even termite mounds!..."*

The spread of bocage

Sahelian bocage has made it possible to reshape rural areas and create a new living and working environment, ensuring high and diversified production and promoting biodiversity in a pleasant landscape.

The experimental plots in the Guiè/Tankouri bocage, after a four-year rotation (sorghum in *zaï*/grazed fallow/groundnuts-sesame-bean-bissap/millet-beans), achieved sorghum yields of 2.7 tonnes in 2006 and 3.2 tonnes in 2007: two to three times the yields achieved by the best farmers in the region!

Developing a hedged bocage costs between EUR 600 and 800 per hectare (ha), and increasing sorghum yields is valued at EUR 150 to 300 per ha, less EUR 50 per ha for mechanizing the zaï. A farmer would therefore be able to make a profit of around EUR 100 to 250 per ha cultivated with cereals each year. It is conceivable that this sum could be used to repay a loan to finance a hedge. However, a financial return of this kind is out of the question for the time being, as the changes in attitudes and farming practices that it would entail are taking place very slowly. The NGO Terre Verte remains fully committed to creating new hedged farmland and training farmers, however, in order to demonstrate its effectiveness and profitability. To date, 1,581 ha have been developed, benefiting 541 families.

Conclusions

Any action in the context of the environment must take place over time and be confined to a well-defined area, in order to gain in-depth knowledge of the problems and to implement effective solutions. This is what the NGO Terre Verte is trying to do through its pilot bocage farms in the Sahel. Its teams are at the service of the farmers, helping them to restore their living environment by adapting agroforestry techniques to local agriculture, within a bocage area that enables them to increase their resources while promoting biodiversity.

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Author affiliation

Nassirou Yarbanga, Director of the Barga Pilot Farm, Yatenga Province/Burkina Faso (info@eauterreverdure.org)

A farmer proudly shows off his trees in the bocage area of Filly. Photo: Terre Verte