

WÉGOUBRI, the sahelian bocage: an integrate approach for environment preservation and social development in sahelian agriculture (Burkina Faso)

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Abstract. The NGO Terre Verte pursues the realisation of bocage perimeters (wégoubri in the mooré language) in Burkina Faso. They are an innovative concept of rural development that has been established in the 1990s in the experimental farm of Guiè and is now adopted in other experimental farms in Burkina Faso.

The deterioration of the rural landscape in the Sahel region has worsened in the last decades, endangering local populations. The creation of bocage perimeters in this rural landscape is a way to remediate problems linked to overly extensive agriculture.

Through a holistic approach to the problem, the experimental farm of Guiè has been able to integrate environmental preservation into the Sahel agriculture thanks to three axes of intervention: applied research, education and direct help to the peasants. An experimental farm relies on five technical teams, each supervised by a coordinator.

The concept is based on the creation of bocage perimeters in a mixed propriety regime, comprising individually owned plots and common grounds, managed by an association of beneficiaries. The result is a restored environment, in which agriculture is no longer tantamount to erosion and livestock farming to overgrazing, where trees and bushes are harmoniously integrated into the environment.

The increase in agricultural yields observed after a few years of soil restoration leads to the conclusion that those projects will be economically viable. A system of credits for farmers could allow the implementation of such a system, which represents the only solution for the millions of hectares of degraded soil in the Sahel region.

1 Introduction

The Sahel zone in western Africa consists of nine countries, according to the UN-AFO: Burkina Faso, Cap-Verde, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, Senegal and Tchad. Those nine countries are all characterised by an extremely low human development index and severe environmental problems, mainly drought and desertification.

The population, wildlife and flora of the Sahel region have been accustomed to the occurrence of drought years for a long time. This is part of the climatic features of the Sahel. However, since the late 1970s, this episodic characteristic of the climate has become chronic. On average, precipitations

have decreased by 25% in the Sahel region over the last 30 years (IPCC, 2001).

Humans are however partly responsible for the advancing desertification. They cause serious damage to the environment through bushfires, uncontrolled tree cutting, soil degradation through “mining” agriculture and overgrazing by stray animals. It is estimated that land degradation is due to 14% to removal of vegetation, to 13% to overexploitation of agricultural land, to 49% to overgrazing and to 24% to bad agricultural practices (ECA, 2006). Due to the impacts of overgrazing, deforestation, desertification and soil degradation, dust storms have dramatically increased and the Sahel region has become a larger dust source than the Sahara desert (N’Tchayi et al., 1997).

There are important negative consequences of the desertification, such as water scarcity, the disappearance of flora and fauna, famines and the impoverishment of rural communities



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Figure 1. Air view of the bocage perimeter of Tankouri at Guiè.

(UNEP, 2004; IPCC, 2001; Adger, 2002). More than half of the population of Africa depends on agriculture. This is also the case of the Sahel region. Almost half of all cultural land in Africa is located in arid and semi-desertic areas, to which the Sahel region belongs. On average in Africa, 65% of agricultural lands and 30% of pasture land is suffering from degradation, particularly in vulnerable regions such as the Sahel region (ECA, 2006). In the middle term, 600 000 km² of agricultural land may change from a moderate hydric stress to a severe hydric stress (UNFCCC, 2006). Between 1993 and 2002, it is estimated that over 136.6 millions people have been affected by climatic events in Africa. The great drought in the Sudan-Sahel region from 1968 to 1973 has severely affected 250 000 people and led to the loss of 12 million cattle (Tarhule and Agneau, 2003).

Much uncertainty exists in long-term predictions of the future of west-african climate. According to certain models, the climate of the Sahel and Sahara may become wetter and vegetative cover increase by up to 10% (Brooks, 2005; Maynard et al., 2002; Claussen et al., 2003). Other models predict a decline in precipitations and a strong interdecadal variability (Hulme, 2001). Due to the strong coupling between vegetation and precipitation in the climate models, these results will however very strongly depend on the human impact on vegetation in the Sahel zone.

As a response to climate change and drought in the Sahel region, several approaches have been tested, mainly based on the protection of young plants from overgrazing and the assisted regrowth of natural ecosystems (newTree, 2008; CREA, 2006). In Niger, 250 000 ha of degraded land could be made fertile again (CRESA, 2006). The distribution of more efficient stoves and solar stoves is another measure aimed at reducing domestic wood consumption and thus deforestation (newTree, 2008). However, the approach adopted by Terre Verte and its farms acknowledges that changes in land-use change and agricultural methods are the key to a successful adaptation to climate change and a reversal of the desertification process at the scale of the Sahel region.



Figure 2. Regions where are located the 2 experimental farms.

2 Projet description

Created in 1989, the pilot farm of Guiè (FPG) devotes itself to restoring degraded soils of this area through several techniques that converge on a renewal of the agricultural system by creating a bocage.

A bocage (*wegoubri* in Mossi language) can be defined as a rural landscape of meadows and/or fields with live fences. A bocage is a balanced milieu created by man where trees, crops and pastures are combined and biodiversity is preserved. In the Sahel, the first vocation of a bocage is to control water where it falls through the establishment of rock lines, pools and live fences to reduce the erosive action of rainwater and maintain biodiversity in an extremely fragile milieu.

The Guiè experimental farm was established between 1990 and 1995 with the support of the Terre Verte (Green earth) NGO, created in France in 1989, in order to solve problems related to environmental degradation through the bocage concept. Since 2001, Terre Verte has extended its concept to two other experimental farms in Burkina Faso, in Filly in the Yatenga region and in Goema in the Sanmatenga region (Fig. 2). Through these projects, Terre Verte tries to create pools of operational know-how in the rural environment of the Sahel region.

The pilot farms do not have a limited lifetime. Their primary goal is the management of rural spaces followed by the introduction of a viable agricultural system. They then become providers of services such as mechanized works and commercialisation of agricultural products, to the local agricultural community.

The farms remain in the hands of the local communities. Terre Verte provides financial, technical and material support to the farms in order to help them integrate all aspects of local rural development within a wider perspective, as lined out in the Agenda 21 philosophy.

2.1 Approach

Based on a great freedom of initiative and on sustainable development, the pilot farm of Guiè has adopted 3 axes of

Table 1. The three research axes as applied to the five sections of the experimental farm.

Sections	Missions	Creation date	Number of permanent volunteers	Particularities
Nursery	<ul style="list-style-type: none"> – Experiment with new plants and new horticultural techniques. – Produce plants necessary for the bocage. – Save species that have become rare. – Develop knowledge of environmental management (tree coppicing & maintenance) 	1990	4	80% of raised species are local.
Breeding	<ul style="list-style-type: none"> – Experiment with rational grazing (control meadows and fallow, preparation of hay and silage). – Develop better herd management. 	1990	3	Experimentations are essentially carried out on the herd and the Guiè farm.
Technical supervision	<ul style="list-style-type: none"> – Manage the learning of young people aged 14 to 18 in the Guiè farm. – Train adults in testing fields. – Organise the annual agricultural competition (Ruralies). – Support farmers technically in the use bocage perimeters. 	2000	1	It aims at developing new skills in rural areas.
Farming equipment	<ul style="list-style-type: none"> – Logistical support for the Guiè farm work. – Develop targeted mechanisation of agriculture. 	2001	1	The objective is to facilitate the most difficult tasks of agriculture.
Land management committees	<ul style="list-style-type: none"> – Ensure that bocage perimeters are implemented 	1998	7	This committee includes all relevant people from the other sections concerned with the aim of the Guiè farm: the creation of the bocage.

development for the 5 sections of the farm (nursery, breeding, technical supervision, farming equipment, land management committee), in order to achieve the establishment of the sahelian bocage (*wegoubri*).

1. **Experimenting with new techniques:** For the testing of new technologies, we capitalized on traditional knowledge and practices of the region, such as earth dykes and added bocage techniques (ponds, hedges). These techniques were improved and developed through research performed at the Guiè farm. Thus, the degradation of hedge seedlings by stray livestock was halted by the establishment of wire netting and the sustainability of this fence was made possible by the development of the system of mixed hedge, a fence combining wire netting with a hedge of *Cassia sieberiana* and *Diospyros mespiliformis*.
2. **Training and direct support to farmers:** The training of people in these new techniques was carried out through the internship of young people in the farm and

training in the fields for adults. Our technicians and some particularly involved farmers were encouraged to discover other agro-ecologic experiences, in Burkina Faso, in neighbouring countries and even in Europe, where there are old bocage landscapes rich in lessons on agricultural techniques and on respect for the environment.

3. **Development of sustainable agriculture through direct support to farmers:** The third axis is aimed at developing sustainable agriculture through direct support to farmers, primarily for the development of bocage. The first organised activity is the study of the site to be managed. Then, once the project is under way, beneficiaries clear the paths which are necessary for the measurements performed by our engineers. The development of the site itself is performed by a paid workforce in a high intensity regime. This ensures the involvement of the rural people in major operations that are usually entrusted to mechanized companies (earth dykes, ponds). On top of stimulating the

socio-economic development of the region, particularly with respect to young men and women employed, this strategy allows contractors who are assigned the various tasks of structural work to acquire the know-how necessary for this type of work. Once completed, the bocage perimeter is managed by a landowner consortium whose aim is to maintain common spaces and to ensure the respect of three basic rules of preservation of the Sahelian environment, namely controlling livestock, fire and tree cutting.

These three axes of development can be found on the Guïè farm as well as the new farms in the other provinces of Burkina Faso (Filly et Goema).

Table 1 shows the organisation of the experimental farm. In each of the five sections of the farm, a team of permanent volunteers, led by a section coordinator, applies the various aspects of the three axes of development.

2.2 The guïè bocage perimeters

The principle of bocage field management is an informal co-ownership based on the landowner group involved. The bocage is composed of individual plots and common grounds.

Common grounds are the basis of a bocage perimeter; they consist of the following elements, describe in Fig. 3 (from the outside to the inside).

1. The firebreak that surrounds the whole area and protects against fire risk still present in the savannah.
2. The mixed fence that bar the road to wandering livestock. It consists of a goat-proof fence in the middle of two rows of shrubs.
3. Entrances allow access to the site. 4 doors allow access to bicycles and pedestrians; a main gate is used for cattle and tractors.
4. The main and secondary roads allow access to each field.
5. An enclosure for night is established in the middle of the perimeter, as well as a hut for shepherds in order to keep animals within the perimeter during the rainy season: in the daytime animals stay in fallows with electric fence and at night in the wire-fenced enclosure, still under the supervision of the shepherds.
6. A bulli (large pool) stocks water from neighbouring paths for watering cattle.

The plots combine the advantages of common spaces, namely the improvement of agriculture and breeding, while preserving private property, important to farmers.

Each owner receives a piece of land of 2.25 ha (150×150 m) divided into 3 plots of 0.75 ha each

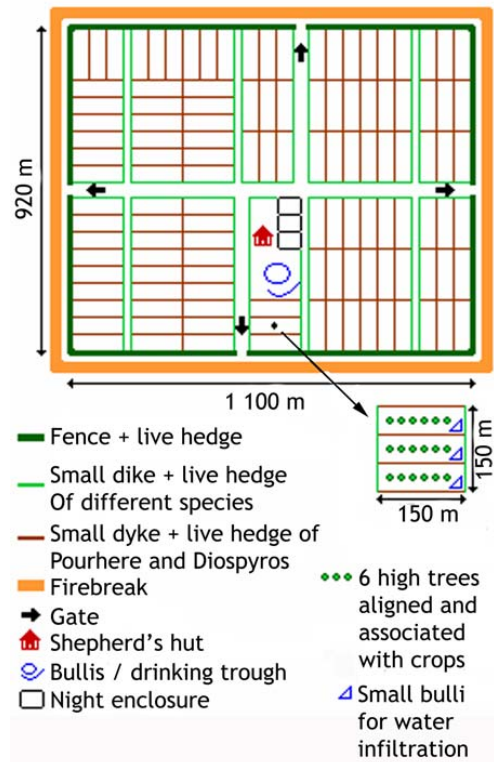


Figure 3. Layout of a 100 hectare bocage.

(150×50 m). This allows him to adapt to land slope changes by pivoting the direction of the plots to the inside of the square formed by the piece of land.

Figure 4 shows a cross-section of a bocage plot. Each field is accessible through a path and is surrounded by a double protection, an earth dyke coupled with a hedge. A small pond for the infiltration (bâka) of surplus rainwater is implemented at the low point of the field.

The result is the collection of all rainwater without erosion. We even collect water from paths. This provides an excellent working environment for farmers, who are able to obtain high yields on a sustainable basis. Trees are planted in line with the axis of the field so as not to impede harnessed or mechanised farming activities. The use of zai techniques helps to regenerate soils before preserving them through crop rotation that includes fallow pasture with an electric fence, and the grazing of animals in the fields after harvest thanks to the use of a solar electric fence adapted to the dry season consisting of two wires 20 to 30 inches from each other, one live and the other one acting as earth (Fig. 5).

2.3 The Zai technique

The Zai is a traditional technique for raising grain originating in the north-west of Burkina Faso (*Yatenga region*). The technique consists in concentrating water and nutrients

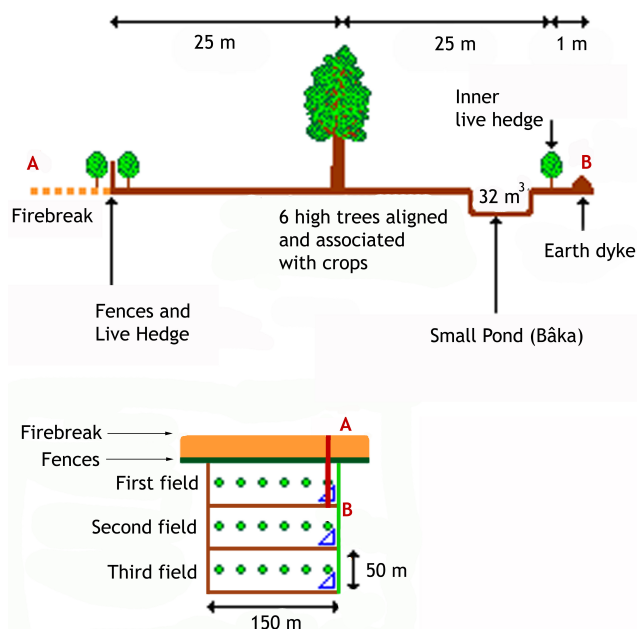


Figure 4. Cross-section of a bocage.

around the plant by digging holes 30 cm in diameter and 15 to 20 cm depth during the dry season. Ripe compost is deposited in the wholes and covered by a small quantity of earth around which the grains (mil, sorgho or corn) will be seeded during the rainy season from may to June, during which precipitations are often insufficient.

By concentrating water and compost, this technique allows to seed corps early in the season, so that they can fully profit from the monsoon season and are able to withstand drought episodes. The main impediment to the establishment of Zaïs is the lack of compost, which a rational practice of livestock farming can provide.

This technique allows to restore degraded land while providing good yields from the first year on. It is thus an insurance of livelihood, regardless of the hazards of climate. In 2001, we had good results although precipitations reached only 428 mm.

AZN develops this technique in the Guiè region. Several educative trips to the Yatenga region have been organized. Each year in November, a contest is organised for the best plot amongst the farmers of the ten villages of the AZN.

3 Results

The effort undertaken at the Guiè farm has allowed to reshaped the rural space, insuring a more diversified and increased production and at the same time providing a more agreeable work and living environment. After a 4 year rotation, production in the experimental plots of the bocage perimeter of Guiè/Tankouri was 27 quintals of sorghum in 2006 and 32 quintals in 2007, which is two to three times



Figure 5. Grazing during the dry season.

the yields achieved by the most performing farmers of the region.

Beyond all social and environmental considerations, the Guiè bocage concept is also economically viable. The establishment of a bocage perimeter costs about 500 Euro per hectare. The increase in yields can be valued at 150 to 300 Euro per hectare per year. Including costs of about 50 Euro for the mechanization of the zaï and the farmer's needs to increase their available income, each cultivated hectare could generate a net surplus of about 100 Euro which will allow the farmer to reimburse the credit taken in order to set up the bocage perimeter.

Other results achieved by the experimental farm lie in the development of agricultural techniques and promotion of biodiversity. It has developed new plants and contributed to the preservation of local species which are becoming rare. Table 2 gives an overview of the species produced at the farm. 80% of those species are local species. Techniques for rational grazing have been developed, such as the control of meadows and fallows and the preparation of hays and silage.

Herding has been improved by better herd management.

Through the conservation of biodiversity, especially local species, the retention of rainwater, even from roads and paths and the reduction of erosion, the environmental capital has been significantly increased and the risk of desertification lowered. The increase in quality of living in this improved environment is perceived by all families and volunteers participating in the project.

Finally, the project has contributed to the development of human skills and institutional capacities. Several permanent volunteers have worked at the farm. Young people aged 14 to 18, have worked and learnt at the Guiè farm. Adults have been trained during fields testing and received technical support pertaining to the use of bocage perimeters. Rural

Table 2. Species produced at the Guiè experimental farm.

Linnean name	Current name (mooré or french)	Number of plants produced	Use
<i>Cassia sieberiana</i>	Kombrissaka	28 376	Mixed living hedges
<i>Combretum micranthum</i>	Kinkeliba	1 789	
<i>Tamarindus indica</i>	Tamarind tree	117	Axes of the fields
<i>Adansonia digitata</i>	Baobab	68	
<i>Parkia biglobosa</i>	Néré	270	
<i>Acacia albida</i>	Zaanga	441	
<i>Senna singueana</i>	Kassinisenega	309	Simple living hedges
<i>Acacia macrostachya</i>	Zamenga	120	
<i>Jatropha curcas</i>	Pourguère	270	
<i>Azadirachta indica</i>	Neem or nim	180	Roadsides
<i>Cassia siamea</i>	Cassia	240	
<i>Eucalyptus camaldulensis</i>	Eucalyptus	680	
<i>Khaya senegalensis</i>	Cailcédrat	801	
<i>Thevetia neriifolia</i>	Thevetia	248	Sold as decorative and garden plants
<i>Leucaena leucocephala</i>	Leucaena	256	
<i>Anacardium occidentale</i>	Anacardier	115	
<i>Carica papaya</i>	Papaya tree	227	
Total		34 507	

communities have been involved in the project, amongst others via the annual agricultural competition. Terre Verte has enabled the transfer of technology, through logistical support for the Guiè farm work (Fig. 6) and the development of a targeted mechanisation of agriculture. The establishment of a land management committee has strengthened the institutional capacity of the communities to manage land development and agriculture.

4 Discussion

To this day, 524 ha of bocage could be established across five villages (*Guiè, Douré, Doanghin, Cissé-Yargho and Filly*). They regroup 188 families. Project participants have developed an acceptance for the approaches and techniques necessary to profit from the benefits of this rural “new deal”.

Overall, the techniques adopted by the experimental farms are straightforward and easy to acquire for the participant farmers. The biggest hurdle to overcome is the change in mentality needed to embrace this new approach. Many farmers limit themselves to the preservation of property value and the fenced protection of crops without exploring all possibilities offered by the bocage perimeter, such as products from the living hedges and a sustainable soil management, which contribute to an increase in production.

A great achievement of the project is that, starting from an extensively degraded environment, which many considered hopeless, viable farms could nevertheless be developed.

**Figure 6.** Pilot farm of Guiè August 2007.

The technical problems which were encountered could all be solved within a relatively short time frame of four or five years by adapting our methods and by profiting from the initiative of project participants.

On the financial side, the problem is the initial investment of about 500 Euro per hectare needed to create the bocage perimeter. Over a few years however, the bocage provides a more secure and greatly improved revenue to the farmers. The encouraging results observed to date will have to be validated over a longer time frame to make a better assessment of the economic benefits of the bocage approach. In this

area as well, the major obstacle proves to be the mentality of farmers, rather than the availability of financing. We are convinced that financing for projects like these with proven results are readily available, especially since we do not limit ourselves to a particular time frame. However, farmers have been accustomed to direct and unconditional financial assistance and have to be convinced that the present approach is well-founded and will produce better results, despite the larger initial efforts required.

5 Conclusions

Through this project, we could redraw the countryside and create a new landscape characterised by a better harmony between man and nature and a higher quality of life for its inhabitants, due to a more environmentally friendly rural development, a better conservation and development of biodiversity and a higher and more diverse productivity. Farmers work in a new environment, which will enable them to acquire the knowledge to work with new plants and varieties. Two aspects still need to be mastered in future: being able to act with sufficient magnitude and ensuring the maintenance of live fences.

Any intervention in the field of environment in a given space must allow for sufficient time in order to explore in depth the understanding of the problems encountered in the resolution of environmental problems. This is what we aim to do with our experimental farms in the Sahel region.

In the future, we aim at developing the present farms, further exploring the techniques put in place, as well as establishing new farms in order to have a real impact on the Sahel region. We have had numerous visitors from other parts of Burkina Faso and other countries of the Sahel region, who have observed with great interest what is being achieved in our experimental farms.

We believe that our “oasis” will only have a future if the Sahel region has one! The problem of desertification can only be addressed if the entire environment is considered and action is taken on a large scope. Too many projects address only one or two aspects of this problem. Our approach aims at being inclusive. We believe that despite the undeniable initial effort, in terms of resources, work and changes in mentalities required from the communities, the results amply justify this investment over the long term.

Notes: All our work is described in the film “WÉGOUBRI” available to the format DVD PAL by postal mail or on the website www.azn-guie-burkina.org

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