Successful Adaptation Strategies and Measures in West Africa

Traditions and Innovations for Sustainable Land Management

Euphorbia hedges in Niger (Source: Agrhymet, 2013)

Summary

Synthesis

Already handicapped by increasing land pressure and continued land degradation, West African farmers face an additional challenge: to adapt their farming practices to climate changes.

In West Africa, these changes should lead to increased water stress, the extension of arid areas and, ultimately, lower crop yields (IPCC, 2013).

Cereal yields are expected to fall by 10 to 15% by 2025, while 20% of the population is already structurally vulnerable and food crises are regular (CILSS, 2013).

The situation is difficult, but simple and effective techniques can be implemented to adapt farming practices.

This means that, with few resources, the farmer may be able to improve its yields, while preserving its natural capital (the soil), and taking into account the future climate changes in West Africa.

This involves making the best use of agricultural water, using collection techniques that aim at maintaining as long as possible the water in the fields.

It also means combatting erosion due to the wind or heavy rains, introducing physical barriers in the fields.

Finally, this implies to better manage physical and chemical soils properties, in order to maintain or restore their fertility.

These techniques must be implemented in a complementary manner.

Despite having shown very good results at plot level, their widespread adoption remains a challenge for West Africa.

Restoration costs of degraded land in the CILSS/ECOWAS countries demonstrate the importance of this challenge: up to 100 million US$ per country (CILSS, 2013).

Introduction

The first section presents water collection techniques relatively simple to implement, which aim both at increasing yields and restoring degraded soils.

The second section presents agroforestry techniques based on assisted natural regeneration and reforestation, and recalls the importance of trees and shrubs in farming systems.

The third section explains why the proposed technical should be implemented in complementarity, as part of land use plans at village level.

Finally, this note concludes on the possible policy options for a change of scale of these techniques, in order to have a significant impact on food security in West Africa.

Simple and effective techniques can be implemented to adapt farming practices.

Their widespread adoption remains a challenge in terms of spatial planning in West Africa.

It is essential to consider the complementarity of these different techniques to improve the physical and chemical characteristics of the soils.

IREMLCD = Regional Initiative for the Global Environment and to Combat Desertification in Sahel

1. Water Collection Techniques

1.1. Zaï

The zaï is a traditional technique used by grain farmers to concentrate water and nutrients around the crop sown in a hole. Its agroforestry variant is also applicable in the context of reforestation.

In the dry season, holes of 30 cm in diameter and 15 to 20 cm in depth are dug into the ground. Organic matter (compost) is then poured into and covered with soil. Sowing is done at the time of the first rains.

Water and compost are thus concentrated for the benefit of each seedling, which promotes their rooting and initial growth (Network of Chambers of Agriculture of Niger - RECA, 2011).

A mulch can be added around the hole to better retain moisture in the soil.

This technique requires few inputs. In cases where tillage is very difficult, a first pass with a special plough (Dephino) facilitates hole digging. Compost can be easily produced from cropping residues or livestock (dry cow dungs). Stubble residues can be used for mulching.

Figure 1 – Field ready for sowing, with zaï and stone barriers (Source: SOS Sahel, 2013)

In the North of Burkina-Faso, farmers using the zaï technique were able to increase their cereal yields from 400 kg/ha to about 800 kg/ha (Sawadogo, 2006).

In addition to restoring degraded lands, this simple technique would thus allow to double crop yields, while contributing to food security in West Africa (WRI, 2013).

1.2. Stone Barriers

The stone barrier is an anti-erosion technique that promotes the collection of water and solid particles (nutrients, fine silt, etc.) in the cultivated plots. The spacing between two curves is such that the height difference between two successive lines is approximately 30 cm.

Farmers using this technique have seen the return of herbaceous and woody species in their fields, such as the desert date palm (*Balanites aegyptiaca*), the marula (*Sclerocarya birrea*), the African ebony (*Diospyros mespiliformis*) or acacias (SOS Sahel, 2008).

The vegetation helps to hold the soil thanks to its root system and to enrich it thanks to the decomposition of leaves and the fixation of atmospheric nitrogen in the case of legumes.

Figure 2 – Stone barriers around a sorghum field (Source: SOS Sahel, 2008)

Crop yields therefore increase in the fields delimited with stone barriers (+40% according to the IREMLCD). Yields increases are even greater when stone barriers are combined with another soil and water conservation techniques, such as zaï or use of organic manure for example (+100% according to the IREMLCD). These techniques have enabled to recover very degraded soils, such as *zipella*.

It is essential to consider the complementarity of these different techniques to improve the physical and chemical characteristics of soils.

1.3. Half-Moons

A half-moon is a sort of “bowl” dug into the ground, following a semicircle. Water and solid particles (nutrients, fine silt, etc.) accumulate in the bowl and form a substrate which favours the growth of seedlings. The outer bead may be reinforced with stones.

Half-moons are often arranged in staggered rows on the plot, in order to maximise water collection and reduce the effects of erosion.

A density of 300 half-moons/ha is recommended. On a line, half-moons are placed 8 m from centre to centre, and the line spacing is 4 m (RECA, 2013).

The interior of the bowl is the "gap" or "tank". It must be dug at 20-30 cm depth, in order to break the hardened earth's crust.

In this more porous soil, the roots find favourable conditions for their growth and seeds blown by the wind are trapped.

During the rainy season, water will seep deep in the reservoirs, increasing water reserve and reducing runoff. Seedlings then develop a strong and deep root system that promotes their survival during the next dry season and allow reaching 1 t/ha. This technique is more successful with sorghum than millet, which fears waterlogging (RECA, 2013).

Figure 3 – Half-moons in Niger (Source: CILSS, 2014)

1.4. Irrigation in Oasis

In Kanem (North of Lake Chad), several water drawing techniques have been tested by market gardeners' groups: traditional well or "shaduf", manual or animal pumping, solar pumping, etc.

In the "wadis" (inter-dune depressions with a shallow water table - <7 m - found on the shores of the Lake Chad and even further), the most interesting technique is probably the manual drilling coupled with a motor pump (FAO, 2012).

Small diameter drilling (6-8 cm) thus allows accessing to the aquifer in the wadis and practicing small-scale gardening: tomato, okra, onion, pepper, etc.

PVC pipes connected to the pump facilitate the suction, discharge, and distribution of water in the plot. It is estimated that a pump of 15 to 25 m3/h provides irrigation for 1 to 2 ha on average.

In Kanem, this technique allowed for a rapid expansion of irrigated areas, with tangible socio-economic impacts - nutrition, income, etc.

By reducing the over-irrigation and improving the maintenance of motor pumps, larger areas could be cultivated (FAO, 2012).

2. Agroforestry Techniques

2.1. Trees and Agriculture

Agroforestry is a set of practices aiming at integrating (or re-integrating) and managing trees or shrubs in farming systems, whether in combination with annual or perennial crops or in rangelands.

These techniques can be applied in the Sahel zone or the Sudano-Guinean zone, provided the woody species are adapted to local farming systems.

Not only trees produce wood and non-wood products (leaves, oils, resins, etc.), but they also play an important role in maintaining and improving soil fertility, watershed protection, carbon storage, and biodiversity maintenance.

The presence of shrubs like *Guiera senegalensis* and *Combretum spp*. also promotes microbial activity in the soils during the dry season (WRI, 2013).

Trees can be regenerated in various ways in the agro-pastoral landscapes: assisted natural regeneration, planting, wind barriers, etc.

2.2. Assisted Natural Regeneration

This is a traditional activity, although not practiced by all. It consists in identifying some valuable young trees in the fields and protecting them.

It can involve various key species such as, e.g. *Piliostigma reticulatum* in Burkina-Faso, the doum palm and *Faidherbia albida* in Niger, the Palmyra palm in Senegal, etc.

During the preparation of the field or at the time of cattle grazing, existing trees and shrubs can be "banked" in order to protect them from fire, machete or animals.

Figure 4 – Farming system with Baobab trees and *Faidherbia albida* in the North of Burkina-Faso (Source: Agrhymet, 2014)

2.3. Reforestation

Live fences are useful to delineate a plot, to protect it from wandering animals, or to protect crops from the wind (SOS Sahel, 2013). They can be set up through assisted natural regeneration.

In "corridor" plantations, trees and crops are planted in alternated lines. In Zambia, the use of legumes such as *Faidherbia albida* has allowed tripling maize yields (WRI, 2013).

The Green Earth Association and its Guié farm in Burkina-Faso was a pioneer in the development of "Sahelian bocage".

In the wadis of Kanem, the use of motor pumps to reach the shallow aquifer allowed for a rapid expansion of irrigated areas (FAO, 2012).

Agroforestry techniques can be applied in the Sahel zone or the Sudano-Guinean zone, provided the woody species are adapted to local farming systems.

In Burkina-Faso, the joint implementation of zaï and stone barriers allowed reaching cereal yields of around 900 kg/ha, 100 kg/ha more than for the sole zaï (Sawadogo, 2006).

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Figure 5 – Corridor plantations in Guinean zone after pruning of acacias (Source: SalvaTerra, 2013)

Finally, pure plantations are used to form an orchard or to produce timber (SOS Sahel, 2013).

For example, in the early years of a teak plantation (*Tectona grandis*) in the Sudano-Guinean or Guinean zone, tubers (cassava, yams,...) can be cultivated between the rows of trees, till the canopy closure in the following 2-3 years.

2.4. Small fallows

It consists in cultivating pieces of land from 30 to 60 m interspersed with vegetable strips of about five meters, which reduce wind erosion from 70% to 80% (RECA, 2013).

The first year, a band of five meters is left intact. The grass accumulates in the rainy season, as well as fine solid particles in the dry season (nutrients, silt wind, etc.).

The following year, the band is cultivated, and another band of five meters, adjacent to the first one, is arranged in the direction of the dry season wind.

The third year, these two bands are cultivated and a third band is prepared, and so on in subsequent years. Increased yields theoretically compensate for the loss of cultivated land.

This technique, easy to implement, however requires to be understood by all land users - workers, farmers, etc. - to prevent the bands from being torn off during the year (RECA, 2013).

3. Perspectives

3.1. Complementarity of Techniques

Many studies highlight the complementarity of the techniques presented above (SOS Sahel, 2008; SOS Sahel, 2013; RECA, 2013 (1); RECA, 2013 (2); WRI, 2013; BERNOUX and CHEVALLIER, 2013; CILLS, 2014, etc.).

For example, in Northern Burkina-Faso, the joint implementation of zaï, assisted natural regeneration, and stone barriers has allowed doubling the yields of rainfed sorghum (1,500 kg/ha vs 700 kg/ha without anything) (CILSS, 2014).

The concept of climate smart agriculture (producing more while mitigating climate change and adapting to it) put these techniques forward.

3.2. Land Use Planning at Village Level

In the traditional land tenure system, cropping areas are scattered throughout the village land. It is then very difficult to protect the plots against cattle and other hazards (fire, strong winds, etc.).

The absence of individual property does not encourage the farmer to invest time and resources in soil restoration techniques. Ad hoc solutions are needed to overcome these constraints (RECA, 2011).

The "bocage perimeter" aims at concentrating cropping plots in a defined and secure area, within the village land. Various collective investments are made there: live fences, stone barriers, ponds for water collection, etc. Costs are shared between users of the perimeter.

Each farmer cultivates one or more plots, following a crop rotation, which helps to maintain soil fertility (RECA, 2011).

3.3. Change of Scale

According to the WRI (2013), some strategies are promising to change scale and have a significant impact:

- Improving information, communication, and awareness-creation;
- Support policy and institutional reforms and capacity building;
- Support integrated landscape management;
- Strengthen the engagement of the private sector;
- Provide direct subsidies to farmers.

The challenge of the change of scale is huge in West Africa: climate changes threaten agriculture and should lower cereal yields by 10 to 15% by 2025, while 20% of West African populations are already structurally vulnerable and food crises are regular (2010 and 2012 to name only the last) (CILSS, 2013).

To illustrate that, the sole restoration costs of degraded land in the CILSS/ECOWAS countries would amount up to 100 million US$ per country (ibid).