



SOIL AND WATER CONSERVATION TECHNIQUES IN BURKINA FASO



Location: Central Plateau, Burkina Faso

Since the early 1980s, farmers in the northern part of Burkina Faso's Central Plateau have made significant investments in low-cost soil and water conservation techniques. These techniques greatly improved agricultural, social, economic and ecological conditions and reversed declining agricultural yields, migration, poverty, and environmental degradation.

CHALLENGE

Burkina Faso has few natural resources and a weak industrial base. Approximately 90 percent of the population is engaged in subsistence agriculture. Food insecurity is commonplace in many parts of the country.¹

During the 1960s, Burkina Faso's rainfall averaged 700 mm/year. Along with other countries in West Africa's Sahel, the country was hit by a series of droughts in the 1970s and 1980s. Between 1982 and 1986, rainfall was reduced by nearly 50 percent to an average of only 381 mm/year.²

The northern part of the Central Plateau was particularly hard-hit. By the early 1980s, the region was characterized by falling ground-water levels, low and declining cereal yields, expanding cultivation onto poor quality agriculture lands, loss of natural vegetative cover, high rates of soil erosion and significant human migration from rural villages. This water crisis significantly affected women, who had to walk approximately eight kilometers each day to collect water. Farm families were devastated. A study by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) found that between 1981 and 1986, sorghum and millet yields averaged only 293 and 232 kg per hectare (ha), respectively; previous averages were between 400-600 kg/ha. In the village of Oualaga, 14 out of 18 (78 percent) households experienced repeated food deficits.

By the time the droughts occurred, much of the major forests had already been cut down, leaving only perennial shrubs and marginal land for cultivation. The drive to expand agriculture for increased food production destroyed native vegetation and accelerated soil erosion. These difficult conditions compelled many farm families to relocate to urban centers or other rural areas with higher annual rainfall. In five of the twelve villages studied by ICRISAT, the population declines between 1975 and 1985 were attributed to out-migration. Many women, already burdened by water and firewood collection duties, were left by husbands seeking paid work in other areas.

RESPONSE

Farmers and NGOs launched a number of initiatives to improve soil fertility, control runoff, and reforest degraded natural areas. When initial experiments proved successful,³ donor agencies and NGOs designed a range of soil and water conservation (SWC) projects for larger-scale implementation; these were based on simple and effective techniques that were farmer-approved and designed to rehabilitate the land's productive capacity. At the government's request, NGOs implemented three

simple SWC techniques aimed at rehabilitating the land's productive capacity: contour stone bunds, improved traditional planting pits and rock dams for gully rehabilitation.

In 1980, Ouahigouya farmers began using traditional planting pits—zai—to rehabilitate barren and highly degraded soils. Farmers increased the zai dimensions and added organic matter during the dry season to increase productivity. In 1979, Oxfam introduced a four-year agroforestry project in the Yatenga region, stressing the use of stone lines, or “bunds” on contour lines, a simple technique for water-harvesting that was capable of stabilizing soil and improving productivity by reducing erosion. Farmers also used level permeable rock dams—long, low dams of loose stone used to rehabilitate eroded gullies. This technique was so successful in the village of Rissam that hundreds of rock dams were built region-wide.

SWC techniques relied heavily on farmers' labor though donors paid for trucks to transport stones. Since the mid-1980s, some 2,000 tons of stone were transported to villages. From 1985 to 2002, at least 100,000 hectares in the region were treated with contour stone bunds and an estimated \$200 million was invested in labor, transport, and technical support.

RESULTS

A comparative study of twelve villages evaluated how SWC techniques were implemented between 1985 and 2002. In nine test villages, 25 to 50 percent of all cultivated land received one or more SWC techniques; three were control villages. To quantify the impact of SWC, the study utilized the following methods to develop three primary data sets:

1. **Participatory Rural Appraisal (PRA):**⁴ Each village was appraised for socioeconomic and natural resource management trends. After analyzing the villagers by wealth—rich, average, poor—249 farm households were selected to receive questionnaires.
2. **Imagery and Transects:** Land use evolution between 1968 and 2002 was also measured by comparing transect images of three terroirs⁵ taken during three different time periods: CORONA satellite photos from 1968; aerial photos taken between 1981 and 1984; and aerial photos from June 2002. A vegetation transect (a linear survey of the diversity and abundance of natural vegetation) was made in each of the twelve villages using a remote sensing team that analyzed time-series imagery from these three distinct periods. The remote sensing team analyzed map changes in vegetation, land use, and the spread of SWC (see Figure 1).
3. **Survey:** A broader qualitative survey was conducted in 59 villages to identify local perspectives on the availability of water before and after SWC interventions.



Vegetable garden. © Juliette Martin-Prével

Zai is a technique used by farmers in Northern Burkina Faso. It is a ‘plant-pit’ system – a plant-pit with a diameter of 20-40 cms and a depth of 10-20 cms. Pits are dug during the dry season from November to May. The number of Zai pits per hectare varies from 12,000 to 25,000. After pits are dug, organic matter is added and after the first rainfall, the matter is covered with a thin layer of soil and the seeds placed in the middle of the pit. It fulfills three functions: soil conservation, water conservation and erosion control for encrusted soils.

Using the above methodology, the long-term study produced the following findings:

Improved Economic Security & Social Stability: With the introduction of SWC techniques in the 1980s, farmers achieved higher average yields of both millet and sorghum. Average yields ranged between 600 to 700 kg/ha—50-60 percent higher than in the 1980s—but were still poor compared with other agro-pastoral regions due to low soil quality conditions. Although the increased yield did in fact corresponded with improved rainfall, analysis showed that average cereal yields in SWC villages were 793 kg/ha compared to 611 kg/ha in control villages.

Rural poverty was reduced by as much as 50 percent in villages with SWC compared to control villages, where poverty increased. Farmers adopting SWC had higher cereal yields, which decreased their need to purchase food and boosted their income; villagers invested in livestock, built houses and accumulated other assets.

SWC improvements also contributed to population growth in some villages. In contrast to the 1975-1985 period, which was characterized by massive migration, the 1985 to 1996 timeframe saw a 25 percent regional population growth. In the village of Ranawa, which lost 25 percent of its population between 1975 and 1985, no families left following the construction of stone bunds in 1984 and many returned due to the improved environmental conditions.

Rising Water Tables: The SWC techniques conserve rainfall by decreasing runoff and increasing rainwater infiltration. Since SWC introduction, most villages saw ground water table levels rise by five meters or more. Although there was higher rainfall in the 1990s, researchers attribute the higher ground water levels to increased rainfall infiltration and reduced runoff. In all but two of the 59 villages surveyed, well water levels increased immediately with the introduction of SWC—even during drought years. Researchers noted that despite increasing water demand from higher human and animal populations, water availability actually improved. This has facilitated the creation of irrigated gardens around wells and significantly reduced the labor burden on women.

Enhanced Biodiversity: The use of SWC techniques on cultivated fields has also produced a greater number of trees on farmers' fields when compared to the late 1980s and early 1990s. Although increased rainfall played a critical role in the tree regeneration, SWC techniques were critical to improving the soil conditions necessary for enhanced tree germination and survival, as trees tend to grow from the soils and seeds trapped by the stone bunds.⁶ Vegetation and crop residues produced under SWC techniques created more livestock forage. Villagers from Bam province reported that abundant perennial grasses and crop residues meant they no longer had to move their herds.

Since SWC investments, ethnic Mossi farmers have become more interested in soil fertility management; many have taken back cattle previously entrusted to the Peulh people to produce manure for their fields; this indicates a shift from extensive to semi-intensive livestock management. In Yatenga, which

Bunds are individual or groups of stones laid on the soil to form lines along the contour of a slope. A contour line is an imaginary line on the ground along which all points are at the same elevation. Thus the stones serve as small retainer walls or “checks,” preventing soil erosion.

“In 1980, only two families had cattle, now all families have cattle. Almost no one had a roof of corrugated iron... just look around you and you'll notice that almost every family has such roofs. All our wells fell dry and for that reason girls from neighboring villages did not want to marry boys from our village. The land where we stand used to be barren, but now it has become productive again and all the trees that you see in these fields have grown since we started to construct bunds.”

– SWC farmer in Ranawa

has the highest population densities in the northern part of the Central Plateau, over 50 percent of farmers applied organic fertilizers to their fields.

Corona satellite images from 1968–2002 (see Figure 1) show that cultivated land dominated many of the *terroirs* with major tracts of intact natural vegetation with dense bush-lands and lower density shrub savannas. The period from 1950–1968 had relatively abundant rainfall. In contrast, photos from the early 1980s show a significant decline in vegetation cover due to the droughts and continued pressure from grazing and firewood harvesting. Researchers evaluated the land use and vegetation in three villages—Ranawa and Rissiam had SWC techniques; Derhogo did not.

In Ranawa's 1,841 hectares *terroir*, the cultivated land grew modestly from 66 percent in 1984 to 71.6 percent in 2002, but the village population more than doubled, indicating successful land use intensification from SWC techniques. Of the 700 hectares area analyzed in Rissiam, very few windbreaks and hedges were visible in 1981. By 2002, 38 percent of the area was treated with stone bunds and rock dams, and the cultivated area expanded from 66 to 72 percent. While the cultivated area grew by six percent, the population grew by 20 percent, further indicating successful agricultural intensification with SWC. In the same time period, dense parkland⁷ under cultivation also grew from 12.3 percent to 15.4 percent, indicating improving environmental conditions for agriculture. In contrast, Derhogo's parkland area declined from 11.2 percent in 1984 to only 3.8 percent in 2002. It also experienced degradation of vegetation cover as well as the continuing spread of gullies, and livestock pressure on the environment (for grazing) was higher than in the two other villages.⁸

SWC also helps regenerate plant species that were diminished or disappearing. Between 1992 and 2002, the appearance of



After he started SWC and zaï land rehabilitation in 1985, Ousseni Kindo's field went from having only one tree to having more than hundred baobabs and other trees. Left picture shows Ousseni Kindo's field in 1988 and right picture shows the same field in 2008. © IFPRI

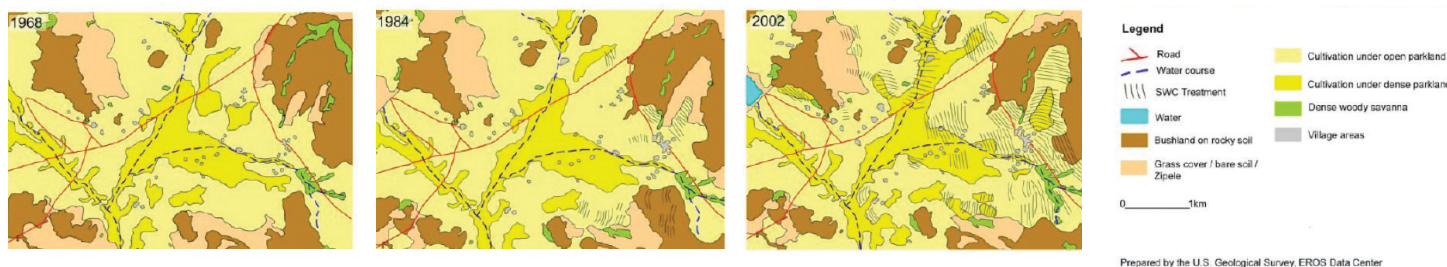
both persistent and reappearing species has grown with the aid of SWC. Of the persistent species, 61 percent are found on the SWC-treated fields, whereas only 39 percent occur on fields without SWC. Of the reappearing species, 81 percent are found in fields treated with SWC, whereas only 19 percent are found in fields without SWC.

More recent observations indicate that farmers who had implemented zaï and SWC techniques on their fields in the 1980s keep reaping the benefits of such work on their land.

Ousseni Kindo, a local farmer, had only one tree on his almost barren land in 1988 (the field rehabilitation started in 1985). By constructing stone bunds and digging zaï, Mr. Kindo had more than one hundred baobab trees and other useful trees on his field in 2008 (see photos above).⁹

The introduction of SWC techniques in Burkina Faso led to enhanced productivity, economic security, population stability, enhanced biodiversity, and improved water tables. SWC techniques can be expanded to other areas of sub-Saharan Africa; they represent viable interventions for farmers seeking to improve their incomes and food security while conserving natural resources and building a more resilient ecologically-sound form of agriculture.

Figure 1: Corona Satellite images from Ranawa Terroir, 1968–2002



This case study was produced by the Oakland Institute. It is copublished by the Oakland Institute and the Alliance for Food Sovereignty in Africa (AFSA). A full set of case studies can be found at www.oaklandinstitute.org and www.afsafrica.org.

ENDNOTES

- ¹ CIA. *World FactBook: Burkina Faso*. <https://www.cia.gov/library/publications/the-world-factbook/geos/uv.html> (accessed September 24, 2014).
- ² Unless otherwise indicated, all data is derived from Reij, C., Tappan, G. and A. Belemvire. "Changing land management practices and vegetation on the Central Plateau of Burkina Faso (1968-2002)." *Journal of Arid Environments*, 63 no. 3, (2005): 642-659.
- ³ Pastakia, Christopher M.R. and Arne Jensen. "The rapid impact assessment matrix (RIAM) for EIA." *Environmental Impact Assessment Review* 18, no. 5 (1998): 461-482.
- ⁴ Chambers, Robert. "The origins and practice of participatory rural appraisal." *World Development*, 22, no. 7 (1994): 953-969.
- ⁵ Terroir is the territorial lands of a village that constitute the individual study areas.
- ⁶ Reij, C., Tappan G. and M. Smale. *Agroenvironmental Transformation in the Sahel, Another Kind of "Green Revolution."* IFPRI Discussion Paper 00914, 2009. <http://www.ifpri.org/sites/default/files/publications/ifpridp00914.pdf> (accessed October 31, 2010).
- ⁷ Parklands are defined as landscapes in which mature trees occur scattered in cultivated or recently fallowed fields.
- ⁸ Reij, C., Tappan G. and M. Smale. *Op. Cit.*
- ⁹ *Ibid.*

FRONT PAGE PHOTO:

Farmer in his field. © Juliette Martin-Prével

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