History and impacts of dryland restoration in Yatenga, Burkina Faso

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"A better integration of dryland agriculture and livestock became possible only after the emergence of land restoration."

Introduction

Between 1977 and 1987, the French geographer Jean-Yves Marchal wrote about rapid demographic growth, the expansion of agriculture into marginal land, low and declining crop yields, and the destruction of vegetation in the ancient Yatenga region. These effects were also characteristic of the entire northern part of the densely populated Central Plateau of Burkina Faso. In addition, falling groundwater levels forced villagers to deepen their wells almost annually, and many wells dried up at the end of the rainy season. This caused substantial hardship, especially for women, who were responsible for supplying water for their families.

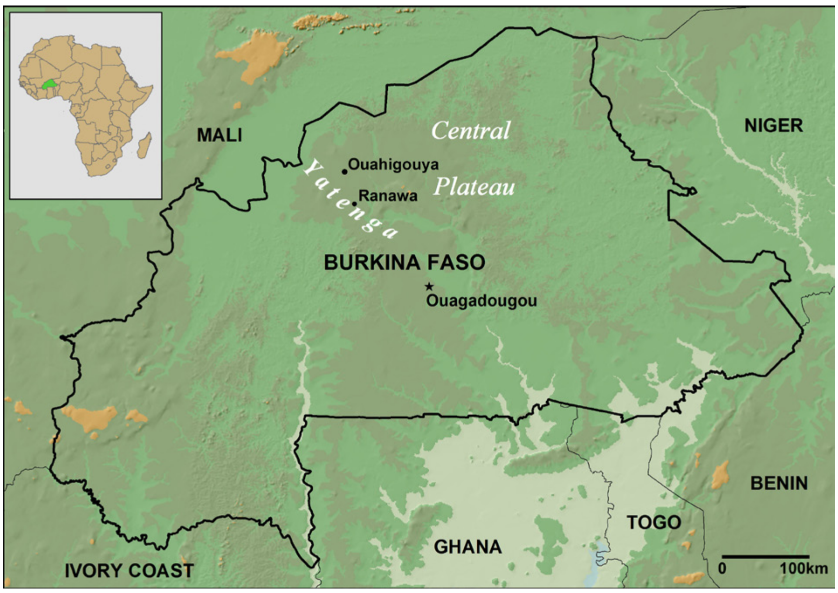
The huge environmental and agricultural crisis of the 1970s and early 1980s triggered a reaction from farmers and NGO staff that led to some of the technical breakthroughs in restoration. This article presents restoration techniques used over a 35 year period in the village of Ranawa in Yatenga, and their socio-economic, environmental and livelihood impacts. See Figure 1.

The first restoration projects in Burkina Faso

Marchal (1979) analyzed the failure of the first large-scale restoration project in Burkina Faso, implemented in Yatenga from 1962 to 1965. Funded by the European Development Fund, the *Groupement Européen de Restauration des Sols* used machinery to construct soil bunds over 120,000 ha, following all technical protocols. But these were not maintained by the "beneficiaries" and some people even destroyed them, with Marchal remarking that this project treated land as if people did not live there, since local famers were not involved.

The project was perceived as such a failure that it took almost 15 years before another donor, the World Bank, decided to invest in restoration through the Rural Development Fund. This project also constructed soil bunds, but on village farmland; however, although it used a more participatory approach, the project soon ran into similar problems. Then, around 1985, the

Figure 1. General terrain map of Burkina Faso showing locations of the Central Plateau, the ancient region of Yatenga in the western part of the plateau, and the village of Ranawa.



approach shifted from constructing soil bunds to building contour stone bunds, tested in the early 1980s by an OXFAM-funded agroforestry project in Yatenga. Farmers were keen to adopt contour stone bunds, sometimes in combination with improved traditional planting pits (*zaï*), because they require less maintenance than soil bunds, and farmers saw improved crop yields when harvesting runoff from a slope.

Reactions in the 1980s to the agricultural and environmental crisis

In 1980, no one really knew what to do to reverse the processes of land degradation on Burkina Faso's Central Plateau. But farmers and NGO technicians began to experiment with a range of restoration techniques, and produced several technical breakthroughs (Reij et al. 2005). This includes a widely-published story that around 1980, a farmer in Yatenga region, Yacouba Sawadogo, began experimenting with a traditional technique called *zaï* to restore degraded land. *Zaï* are small planting pits dug into bare and crusted soils at the start of the rainy season. His innovation was that he made the planting pits bigger so that they could contain more water, dug them during the dry season, and added manure to concentrate water and soil fertility in each spot. This technique has since been used to restore tens of thousands of hectares in Yatenga and elsewhere in the Central Plateau as well as in parts of Niger.

Farmers used to put stones in lines on their fields to control runoff or to mark plot boundaries. In the early 1980s, an OXFAM-funded agroforestry project started to improve this technique by putting stone lines along contours, and by improving the construction of the lines, which increased their efficiency in slowing runoff and increasing rainfall infiltration. The project also trained villagers in the use of a simple technique to enable them to determine contour lines themselves; this technique has spread widely on the Central Plateau.

Until the emergence of improved *zaï* pits and contour stone bunds, projects considered that runoff caused erosion, so field teams always tried to divert runoff away from cultivated fields. The main objective of *zaï* pits and contour stone bunds was different: not to reduce erosion, but to harvest rainfall and runoff to increase the water available for crops. This makes sense in drylands, where years of adequate rainfall alternate with years of low and irregular rainfall. Soil and water conservation handbooks explain that work should start at the highest point of a slope and work downwards, to help avoid the destruction of conservation works from erosive runoff. But farmers in Yatenga ignored such handbooks; they first constructed contour stone bunds in their fields at the lowest points to harvest the most runoff, and gradually worked their way up the slopes.

Farmers in Yatenga and in other parts of the Central Plateau rapidly adopted *zaï* pits and contour stone bunds, even though these techniques required a considerable investment in labour for construction. There is limited published data on how much land has been restored using these techniques, but 300,000 ha was estimated to have been restored to productivity in the Central Plateau alone (Ouédraogo 2005).

What explains the rapid adoption of these techniques? What kinds of impacts do they generate? An important impact of *zaï* pits is that they help to restore very degraded land whose productivity is otherwise close to zero. In areas with high population densities, such as Yatenga (100+ inhabitants per km^2), where there is considerable pressure on available resources, the possibility to expand farmland is very attractive to family farmers.

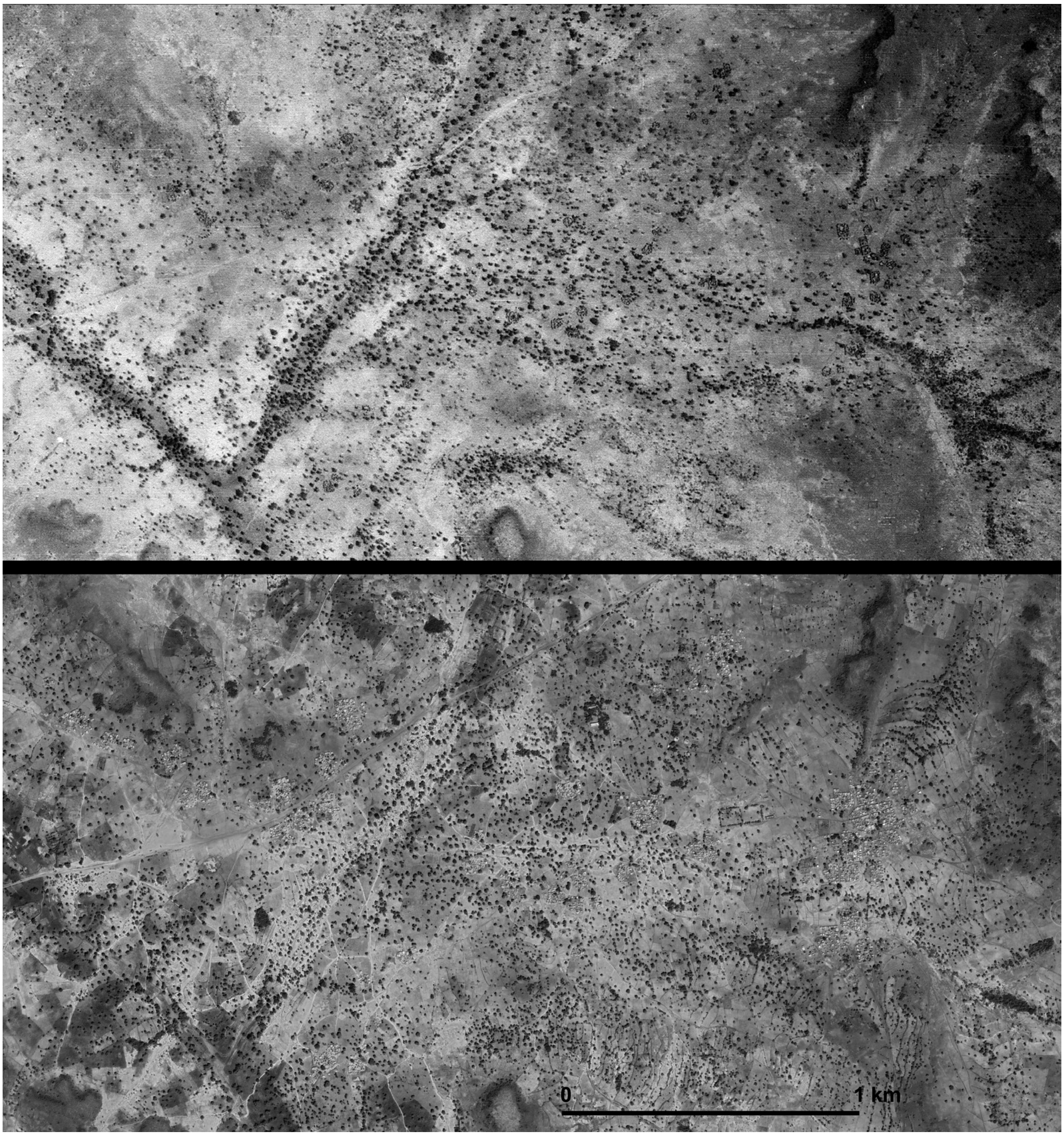
The multiple impacts of restoration in Ranawa (1984–2020)

During the long October-to-June dry season, women always had to walk long distances to fetch water, and most families also endured significant food shortages during this period. Between 1975 and 1985, one-quarter of Ranawa's people left; most migrated to southwestern Burkina Faso, with higher rainfall and more fertile soils. But during the dry season of 1983–84, the OXFAM-funded agroforestry project introduced *zaï* pits and contour stone bunds and continued its support for several years.

Land use

The introduction of restoration techniques in 1984 led to a village-wide transformation of land use and vegetation, illustrated in aerial and satellite images taken in 1984 and 2019 of 820 ha of the Ranawa *terroir* (traditional land area), almost all of which was cultivated (Figure 2). Standard visual image analysis was used to identify and measure areas where stone bunds were present, and to quantify tree cover. In 1984, there was 12% tree cover, and 11% of the area was treated with contour stone bunds. This increased to 19% tree cover and 56% under bunds by 2019. This level of tree cover is quite high: two to five times greater than in regions well known for farmer managed natural regeneration, including southern Niger and Mali (Reij et al. 2009). Stone bunds slow run-off and increase infiltration, with highly visible and positive impacts on tree regeneration, and the linear patterns show that they are a major factor in increasing tree cover (Figure 2).

Figure 2. The Ranawa *terroir* landscape in 1984 (top) and 2019 (bottom), both in the dry season. Note the increase in overall tree cover, with growing villages visible, and linear features representing stone bunds. Sources: Institut Géographique du Burkina Faso (top); Google Earth (bottom)

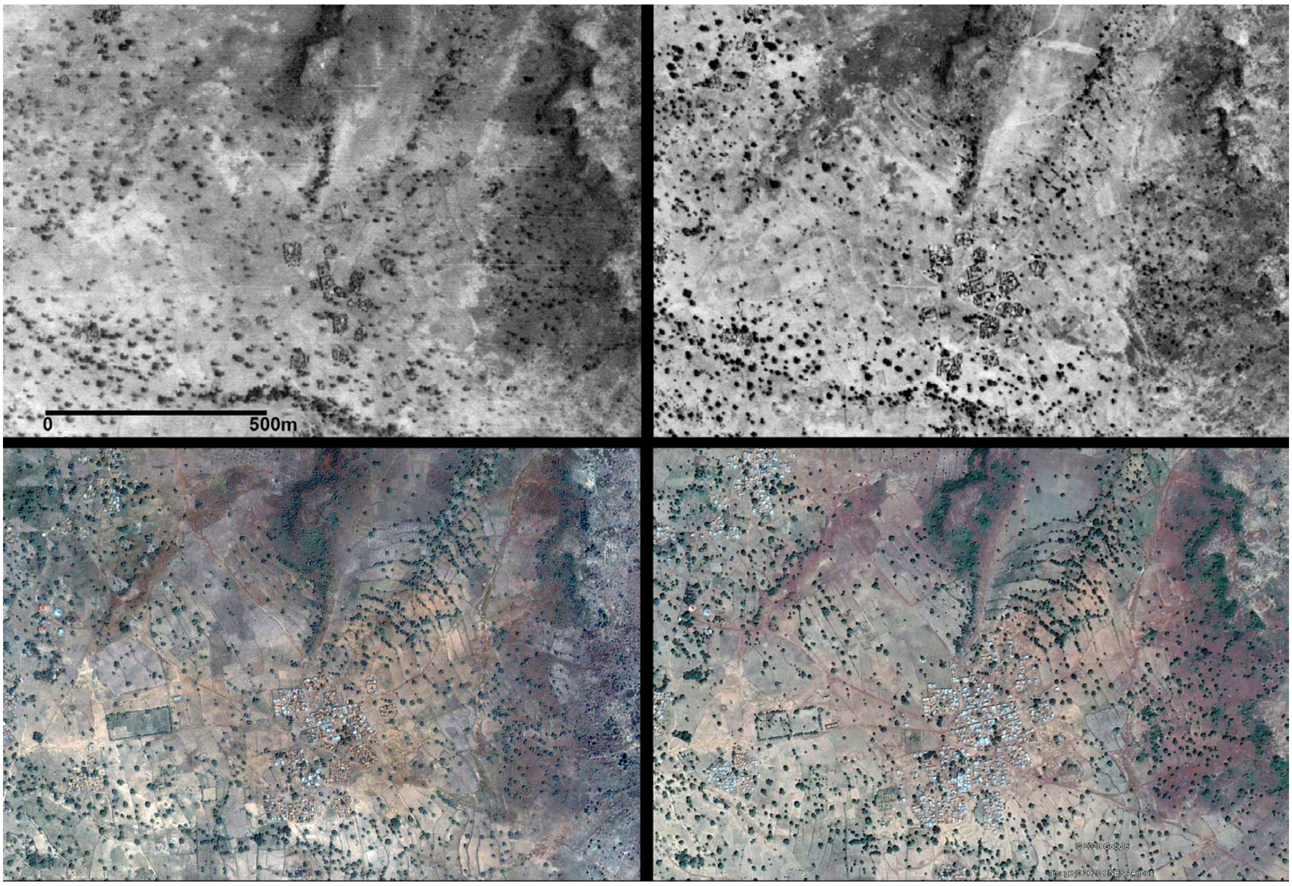


The parkland pattern near Ranawa also changed over time. In 1984, dense tree cover tended to concentrate along seasonal water courses and low-lying areas. But by 2019, parklands had become much more widespread over all land uses and areas, with the spread of trees correlated with the increase in land treated with stone bunds. Many fields that were treeless in 1984 were transformed into dense agroforest parkland by 2019. In June 2020, villagers confirmed that on-farm tree densities were still increasing and that trees were producing more fruit, fodder and fuel on restored land than those on adjacent fields. See Figure 3.

Groundwater recharge

Before 1984, all the wells in Ranawa dried up at the end of the rainy season, but in even though this was followed by a drought year, some wells retained water a few months into the dry season. In the following years, the situation improved quickly. A survey in 2002 showed that all wells in the village continued to retain water for the entire year, and in June 2020, this was still the case. A new development is that several families have dug wells on their own farmsteads. Villagers attribute the increase in water not to greater rainfall, but to the contour stone bunds and *zaï* pits. People in other villages who invested in restoration also reported an increase in water levels in their wells. This increase in water occurs only in restored areas or immediately downslope, whereas if rainfall was a decisive factor, wells upslope of restored areas should also see a rise in water levels. Given the lack of water in Ranawa before 1985, vegetable gardens were not an option. Today the village has six vegetable gardens that have been developed around wells (exploited by mixed groups of men and women) and at least seven irrigated gardens owned by individuals.

Figure 3. A time series over 35 years in northeastern Ranawa, all dry season: 1984 (upper left), 1996 (upper right), 2002 (lower left) and 2019 (lower right). Sources: Institut Géographique du Burkina Faso (top); Google Earth (bottom).



Rehabilitated agroforest landscape in Ranawa (2008); this land was barren in 1984. Photo: Chris Reij.

Crop yields

There are no data for cereal yields in Ranawa, but from the village of Somyaga, 40 km to the north, which is similar in terms of rainfall and soil conditions, there was a huge difference in yields between a control plot where no restoration techniques or manure were used, and plots treated with stone bunds, *zaï* pits or half-moons (small earth embankments in the shape of a semi-circle); see Table 1. In June 2020, the perception of villagers was that most are food secure during the entire year and households generally eat three meals a day; this was not the case before 1985, and now some people even produce a surplus for sale.

Table 1: Impacts of restoration techniques on sorghum yields (kg/ha) in Somyaga village over 3 years.

	2016		2017		2018	
	718 mm rainfall		625 mm rainfall		889 mm rainfall	
	grain	stover	grain	stover	grain	stover
control plot	128	706	54	324	262	1,047
stone bunds	769	1,857	612	1,628	952	2,008
zaï pits	1,384	3,156	1,046	2,947	1,489	3,917
half-moons	1,521	3,485	1,312	3,006	1,634	4,022

Note: 5 tonnes per hectare of organic matter were applied to all treatments except control plots.
Source: Sawadogo and Serme (2020)

Livestock management

Before 1985 most smallholders kept some goats or sheep, but only a few owned any cattle. Today every household has cattle and most keep their livestock tethered, a huge change from the past when free grazing was the norm. Enclosing livestock became possible because more crop residues and tree foliage were available as fodder, and this in turn increased manure availability, to help maintain or improve soil fertility. Villagers also more clearly see that livestock are part of a holistic system, where animals support agriculture through manure and draft power for tillage, and agriculture supports livestock through fodder. In 1980, agronomists emphasized the need to better integrate agriculture and livestock, but this did not happen. It was only after the emergence of land restoration techniques that integration became rational and possible.

Soil fertility

Traditionally, farmers applied most available manure on plots closest to their homesteads (*champs de case*) with the highest crop yields. Less manure was used on village fields (*champs de village*) and none at all in more remote bush fields (*champs de brousse*). However, most restoration investments were applied to bush fields and this is where farmers began to concentrate manure. In recent years, the highest crop yields were on bush fields, surpassing those on homestead plots.

Demographic dynamics

Ranawa lost 25% of its population between 1975 and 1985, but its population doubled between 1985 and 1996. Since the start of restoration in 1984 not a single family has left the village, and many who had left and settled elsewhere chose to return, since productivity and possibilities had significantly improved. More than half of the 20 participants who met the authors in June 2020 to discuss the current situation in the village were among those who had returned.

Conclusions

Since the mid-1980s, the positive impacts of these simple, cost-efficient water harvesting techniques have become clear, following their increasingly widespread adoption. Their use has allowed smallholders to reverse land degradation, improve soil fertility, sustainably increase crop production, achieve food security, and create more productive, diverse and resilient farming systems. At the same time, groundwater is recharged, improving access to drinking water for the entire year, and creating opportunities for irrigated vegetable gardening around wells.

The people of Ranawa faced an existential crisis in 1984, but today they are less poor, better fed, better clothed, and better housed. Every family in the village now has the cash to invest in at least one mobile phone, indicating that they are also better connected. Would this transformation have been possible without their efforts to restore the productive capacity of their village lands?

The combination of planting pits and contour stone bunds has helped to effectively restore degraded land in the village of Ranawa and in many more villages in the northern part of Burkina Faso's Central Plateau. How scalable are these techniques? The construction of contour stone bunds obviously requires the presence of stones close to the farmland. The *zaï* planting pits function well in conditions of 400–800 mm rainfall. Rainfall below 400 mm would require much bigger pits to hold more water and rainfall greater than 800 mm risks drowning the crops in the pits. *Zaï* pits have also been used to restore degraded land that is flat and has a hard crust.

As the construction of contour stone bunds and the digging of planting pits require an important investment in labour, they are usually found in areas with high population densities (30+ persons per km^2). In 1989, 13 farmers from Illela district (Tahoua Region) in Niger visited Yatenga region, and on their return, began to experiment with planting pits. Thereafter, planting pits were widely adopted in that part of Niger (see case study in this issue: Post-project impacts of restoring degraded land in Tahoua, Niger). Planting pits and contour stone bunds are simple water harvesting techniques that do not require massive investment, and have the potential for scaling to other dryland areas across the Sahel and the Horn of Africa where the conditions mentioned above are met.

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Cover photo: Ousseni Kindo and his millet harvest on once barren land, restored using zaï pits, contour stone bunds and FMNR. Photo: Chris Reij

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