Building Resilience to Climate Change through Farmer-managed Natural Regeneration in Niger and Land Rehabilitation in Burkina Faso

Global climate change scenarios strongly suggest that drylands in West Africa are likely to become more arid. Changes in rainfall distribution could result in additional stress on agricultural production in these areas. This case study examines adaptation measures that have been implemented in the Sahel region since the 1980s. These include farmer-managed natural regeneration (FMNR), a very simple practice whereby existing vegetation on degraded land is identified, managed and protected. Woody species can regenerate naturally in those areas where top soil contains stocks of seeds or where there are underground root systems. In Burkina Faso, efforts have been implemented to rehabilitate barren crusted land using contour bunds and improved planting pits. These simple techniques have served to increase the volume of water available to crops, and farmers who have invested in these techniques have also improved soil fertility management.

Improvements in the rural landscape have enabled hundreds of thousands of households living on US$2 or less a day to diversify their sources of livelihoods and increase their incomes, thereby strengthening their resilience. They have also played a critical role in addressing chronic hunger among families at the mercy of unpredictable harvests. FMNR has had an enormously empowering effect on farmers.

Keywords: climate change adaptation, dryland, grazing land, drought, trees, farmer-managed natural regeneration (FMNR), Sahel

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FOREWORD FOR THE ELAN CASE STUDIES

The Ecosystem and Livelihoods Adaptation Network (ELAN) is a global network working to enhance poor and marginalized people's resilience to the impacts of climate change. To do so, ELAN promotes an integrated approach to adaptation, defined as *adaptation planning and action that adheres both to human rights-based principles and principles of ecosystem sustainability, recognizing their co-dependent roles in successfully managing climate variability and long-term change*.

ELAN has developed a series of case studies on adaptation practices whose design and implementation approximate aspects of this integrated approach. The ELAN case studies showcase how nature-based adaptation can offer benefits to communities. They also demonstrate the complexity of pursuing a truly integrated approach to climate change adaptation and highlight elements of adaptation projects that lend themselves to an integrated approach. It is our aim that this enhanced understanding of an integrated approach may contribute to learning, knowledge exchange and capacity building, and in particular help practitioners to design and implement future adaptation projects that enhance poor and marginalized populations' capacity to adapt.

The research process consisted of examination of hundreds of projects and consultation with a diverse range of project managers. The selected ELAN case studies constitute the best available practices and approaches of projects that combine nature-based solutions with community benefits. Case studies represent a broad geographic scope and ecosystems. They are drawn from Africa, Latin America and Asia.

Ecosystem and rights-based integrated adaptation

Adaptation projects based on an integrated approach should meet the following criteria in the project design and implementation:

- Promotion of livelihoods resilience;
- Disaster risk reduction to minimize the impacts of hazards, particularly on the most vulnerable households and individuals;
- Capacity strengthening of local civil society and government institutions so that they can more effectively support community, household and individual adaptation efforts;
- Advocacy and social mobilisation to address the underlying causes of vulnerability including poor governance, degraded ecosystems, inequitable control and access to resources, limited access to basic services, discrimination and other social injustices;
- Sustainable management, conservation, protection and restoration of ecosystems and biodiversity in order to maintain the multiple benefits provided by the ecosystems' goods and services.

What can we learn from the ELAN case studies?

An important lesson learned from the research process is that projects that fully embody an integrated approach to adaptation are few and far between. Indeed, despite extensive research, case studies that met all the above-mentioned criteria for an integrated approach and adhered to both human rights-based principles and principles of ecosystem sustainability could not be found. Why not?

First, the complexity of ecosystem goods and services and their links to climate change were often ill-considered during project design and implementation. Often a community-based adaptation project may simply entail community-based natural resource management – which is not the same as adopting a truly ecosystem management approach. In other cases the proposed measures had no real foundation in climate change. Finally, most projects focused on restoring or conserving ecosystems under a *static* climate, rather than on finding ways of preserving ecosystems to help people adapt in the context of a *changing* climate, posing the project's long-term sustainability at risk.

Second, ensuring that adaptation policy and practice promote human rights-based principles was often not straightforward. Although most projects were designed to increase community resilience to climate risks and deliver additional benefits to local livelihoods through nature-based solutions, only a few addressed the underlying causes of vulnerability and pursued true empowerment of vulnerable groups. In other cases, projects intending to promote a rights-based approach supported the rights of some community members but not others. For example, while the

importance of involving women in adaptation initiatives was often underscored, efforts to address the special needs of other vulnerable groups (such as the elderly, the disabled, or children) were not always prominent components of the projects, particularly during the implementation phase.

Third, the ELAN case studies demonstrate the complexity of pursuing a truly integrated approach to climate change adaptation. While there are many projects that prioritized the promotion of human rights through community-based adaptation practices, environmental sustainability was not always equally guaranteed. At the same time, an ecosystem-based adaptation project may not always seek to ensure that the rights of the poorest and most vulnerable members of society are protected.

These and other lessons learned make an important contribution to generating and exchanging knowledge on integrated adaptation approaches. In addition, the case studies help to underscore the challenge and importance of integrating the full range of rights-based and ecosystem-based responses to climate change. An enhanced understanding of the complex interplay between these principles – informed in part by these case studies – can help move us towards the goal of protecting the ecosystems that play a vital role in ensuring that poor and marginalized populations can manage and adapt to climate variability and change.

INTRODUCTION

Environmental context

Drylands are ecosystems characterized by a lack of water spatially and temporally. They include cultivated lands, scrublands, shrublands, grasslands, savannahs, semi-deserts and true deserts. In these landscapes, water scarcity limits production of crops, forage, and wood and other ecosystem services. The Sahel has been identified as one of the areas most vulnerable to increased drought in a warming climate. While rains have been relatively good in recent years (except 2004), the long-term projections point to longer and more frequent droughts across the region as global temperatures rise (IPCC, 2007).

This case study* examines adaptation measures implemented in the West African Sahel region with a focus on South Niger and the Central Plateau of Burkina Faso since the 1980s. The inhabitants of these regions are farmers, essentially living from production of millet and sorghum as well as livestock. The adaptation strategies featured in this study increase resilience to climate change impacts in drylands ecosystems, which are increasingly vulnerable to droughts, irregular rainfall and soil erosion. In drylands, farmers depending on the soil are very vulnerable as well. The rural communities managed to increase their resilience by restoring their soil leading to better cereal yields as well as new alternative livelihoods to agriculture. To attain these goals, they pursued three types of activities: farmer-managed natural regeneration, improved planting pits and contour stone bunds.

Key definition

Farmer-managed natural regeneration (FMNR) involves supporting the regeneration of trees and their sustainable management to produce sustainable supplies of fuelwood as well as non-timber products such as edible seeds and leaves. Natural regeneration of woody species can occur where the top soil contains a stock of seeds or where it has an underground root system. Similarly, it is also possible where livestock manure and bird droppings contain seeds that easily germinate. FMNR has been implemented over an area of 5 million ha in some densely populated parts of Niger. In Burkina Faso, the emphasis has been on water conservation through rehabilitation of barren crusted land using contour bunds and improved planting pits. These simple techniques have increased the volume of water available to crops while farmers who have invested in them have also achieved improved soil fertility management.

In the absence of effective natural resource management approaches in the Sahel region, there is an increased threat that future famines could match the devastating scale of those of the 1970s, and that desertification of fragile lands may accelerate. Yet development experts and intermediary organizations are hoping that region-wide expansion of farmer-managed natural regeneration (FMNR) and other land management programmes will help the region increase its resilience in the face of a changing climate (WRI, 2008). In the 30 years since farmers and practitioners in non-governmental organizations (NGOs) have begun land rehabilitation with improved soil and water conservation techniques, evaluations have been regularly conducted. In light of the results, experts still advocate such measures in dryland ecosystems today.

Vulnerability

The Sahel has been plagued by droughts throughout the 20th century and before. The 1982–84 drought was followed by persistent dryness which lasted until 1993. Precipitations increased between 1994 and 2003, but remained sensibly lower than the 1930-1965 average (Anyamba and Tucker, 2005). The impacts of these changes in the climate have been very severe. The 1968–73 drought, in particular, resulted in numerous deaths. The result was an acute human and environmental crisis (Reij *et al*., 2009). Average sorghum and millet yields decreased, and a majority of farming

* This case study has been based mainly on work carried out by the World Resources Institute (WRI, 2008) and a case study (Reij *et al*., 2009) carried out for the International Food Policy Research Institute (IFPRI), supported by a Consultative Group on International Agriculture Research (CGIAR), for the project "Millions Fed: Proven Successes in Agricultural Development". WRI works with business partners, governments and civil society to tackle today's most urgent environmental challenges (see www.wri.org). IFPRI seeks sustainable solutions to end hunger and poverty and is one of 15 centres supported by the Consultative Group on International Agricultural Research (CGIAR), an alliance of 64 governments, private foundations, and international and regional organizations (see www.ifpri.org).

households suffered annual food deficits of 50 percent or more (Broekhuyse, 1983). Meanwhile, the barren land surface area on the Central Plateau of Burkina Faso continued to expand.

The loss of trees and soil degradation which increased the local population's vulnerability to drought was induced by a complex scheme of historical and socio-economic factors. The mean population growth in the case study areas has increased since the beginning of the 20th century. More specifically, the demographic pressure on the land has greatly increased since the 1960s. This population growth, combined with other factors such as an increase in extensive agriculture covering larger areas of land with a trend to cereal quasi-monocultures since the 1970s led to increased deforestation. Increased areas of agricultural land also resulted in a decrease in fallow time (or even the abandonment of the practice) and less manure per surface area (as the number of cattle remained the same), leading to soil degradation and erosion (Marchal, 1985). Useful tree species were lost and little natural regeneration occurred. In the Maradi region of Niger, wind erosion left the soil completely barren. As a result, both ecosystems and communities grew increasingly vulnerable to drought. (Raynaut, 1987 and 1997).

Men migrated, looking for labour, causing profound disgregation in the local social structure (Monimart, 1989). In some villages, as much as a quarter of the families migrated to Ivory Coast or to higher rainfall areas in Burkina Faso, between 1975 and 1985 only. In the early 1980s, groundwater levels in the Central Plateau dropped an estimated 50–100 cm per year (Reij, 1983). Wells and boreholes dried up immediately after the end of the rainy season and had to be deepened.

Stakeholders

- **Local:** The practices featured in this case study are principally community driven. Farmers are the primary stakeholders involved in implementation of FMNR, *Zai* (planting pits) and contour stone bunds. In the past, promotion of these practices was often done by charismatic individuals (Haggblade and Hazel, 2009) rather than being based on the efficiency of the measures. Today, as these innovations often require collective action for wide implementation, farmer groups and village associations play an increasingly important role.
- **National:** Government policy and supporting public investment have also been important. The strong push by the Burkinabé government from the mid-1980s to increase awareness of environmental problems and their solutions proved very useful as an incentive (Reij and Steeds, 2003). Infrastructure investments reduced transport costs and supported commercialization of farm and tree products (Reij *et al*., 2005; Reij and Smaling, 2007).
- **International:** Since the mid 1980s, all major donors and projects in Burkina Faso have promoted contour stone bunds or *Zai* or both (e.g. Dutch and German funding, IFAD and World Bank projects, etc.). At the request of the Burkina Faso government, many NGOs have intervened in the northern part of the Central Plateau, one of the poorest and most degraded regions of the country (Reij *et al*., 2005). In Niger, the widespread adoption of FMNR was similarly facilitated by the governments and NGOs (WRI, 2008).

Access rights to natural resources

In order to promote sound ecosystem management practices it is important to understand the land regulation system.

Until the 1970s in Niger, French colonial rules on access to land and trees were maintained. All natural resources, including trees, were State property. After decolonization, new forestry rules and measures were imposed and strictly applied by the State without consulting the local population. This regime generated frustration amongst the population leading to illegal collection and refusal to apply conservation measures. Added to the recurrent droughts between 1970 and 1984 and existing human pressures, Niger had to consider a new environmental policy. With the Commitment of Maradi in 1984 a new era of environmental management began, centred on stronger conservation policy and population involvement. However, the State soon realized that incentives to preserve trees would not be strong enough if trees were to remain State property. Consequently a new forest regime was developed, and today private ownership of trees is a right. It is of interest to note that this law, passed in 2004 but already in practice before this, also stipulates that a contribution to forest conservation and regeneration is an obligation (Niger, 2004).

ADAPTATION STRATEGIES

Strategy 1: Increase resilience of the population to drought by improving soil management for agriculture

a. Farmer-managed natural regeneration (FMNR) in Niger

The concept is very simple. In general, naturally regenerated seedlings continue to grow even in degraded soils, although they are either collected for firewood or chewed by livestock. Young saplings need protection for two to three years. Farmer-managed natural regeneration is a simple technique that can be implemented by all farmers to protect the small sprouts so that they can contribute to soil regeneration while at the same time yielding other benefits.

The first stage in FMNR involves selective land clearance for crop planting. In the past, farmers would clear the land completely and remove all tree stumps and roots. With FMNR, farmers select those tree stumps with sprouts – or the sprouts themselves, depending on the values of the species for food (nutritious fruits and leaves), fuel, or fodder. The farmers then remove superfluous stems and side branches from each stump, leaving only the straightest and tallest one, which they then prune and protect.

In order to regenerate, tree species rely on diverse systems: some of them have robust stumps or roots, which can sprout in degraded soils; others have seeds that remain dormant in soil seed banks until an external event (such as a rainfall) allows them to grow; others have their seeds distributed in bird droppings or livestock manure.

b. Improved planting pits (*Zai*)

In 1980 several farmers close to Ouahigouya, the capital of Yatenga Province in the northern region of Burkina Faso, began 'innovating out of despair'. They began to experiment with planting pits (also known as *Zai*), a technique used for many years by farmers elsewhere in the Sahel (Reij *et al*., 2005). Planting pits or *Zai* consist of pits dug into the surface of the soil, which are then filled with moisture and nutrients and then used for planting. As part of their experimentation, farmers dug a grid of increasingly large pits across rock-hard, impermeable farmland plots. (Ouedraogo and Sawadogo, 2001; Kaboré and Reij, 2004).

Planting pits help improve soil fertility:

- They capture windblown soil and organic matter;
- Termites feed on the pits' organic matter, making nutrient more available to the plant roots. Also, they dig channels that increase the soil porosity, permeability and water retention capacity. (Ouedraogo and Sawadogo, 2001).
- As they are filled with manure and urea, they help increase the low phosphorous and potassium content of the surrounding soils.

Less obvious advantages of planting pits also exist (Kaboré and Reij, 2004):

- Thanks to land rehabilitation, farmers can cultivate previously unproductive areas, obtaining cereal (millet and sorghum) yields of between 300 and 1,500 kg/ha/yr, depending on the level of precipitations.
- They retain humidity, allowing plants to survive dry spells that prove fatal to many cultivations in other plots. The higher water content in the pits' soil also helps enhance the performance of chemical fertilizers, making fertilization way more cost-effective.
- Early experience shows that rehabilitated fields are less vulnerable to infestation by Striga hermonthica (an indigenous parasitic plant) and other weeds. Planting pits therefore help reduce the need for weeding. As they are prepared during the dry season, they do not require farmers to wait until the rains arrive to plough the land.

Planting pits can be used both to cultivate cereals and to grow trees. Many seeds contained in the manure and compost used to fill the pits blossom spontaneously, and farmers often protect sprouting trees and shrubs in order to diversify their agricultural system. Some farmers deliberately plant seeds of desirable tree species, effectively using *Zai* for reforestation practices.

c. Contour stone bunds

Contour stone bunding uses stones laid out along the contours of the land to reduce rainwater runoff and encourage infiltration of water into the land. The stones are typically laid out in long lines with a base of 35-40 cm reaching a height of about 25 cm, which allow runoff to spread evenly through the field and trickle through the small gaps between the stones. Water carries eroded soil, bits of dead plants, and manure and other organic matter from the catchment area, helping to improve the soil.

Stone bunds were first pioneered at the end of the 1970s. Before their introduction, much of the manure applied by farmers washed away during the first rains; stone contour lines help retain it on fields. Initially, their efficiency was limited by sub-optimal spacing and placement of stones. After an initial testing period from 1979–82, the technique was improved by placing the stone lines along the contours of the land. It is a technique that is still widely used today. Farmers sometimes started downslope rather than starting at higher points in the catchment area and working downslope. To remedy this, a simple technique was developed using a hosepipe water level which farmers could use to identify the contour lines and hence where to place the stones. Water tube levels cost about US$6, they are efficient, quick to master and easy to use. (Wright, 1985).

Strategy 2: Improve food security and create additional benefits for the communities

a. Firewood

Pruning tree branches allows for firewood production. Already during the first year of implementation, families practicing FMNR can harvest light firewood. From the second year on, the harvest is good enough to generate some extra-income on local markets. (Rinaudo, 2004). Firewood sales generate revenues from US$6 to $20 per year in the village of Ara Safoua and $30 to $120 in the village of Gaounawa. A 1999 study indicates that families from 100 Maradi villages sold about US$600,000 worth of wood between 1985 and 1997 only (SIM, 1999, cited by Rinaudo, 2004). Residents of villages with land rehabilitation projects have reported a sensible decrease in poverty as a result of the implementation of FMNR practices (Abdoulaye and Ibro, 2006).

b. Improved soil quality

Droppings and manure from animals attracted to the presence of the trees help fertilize the soil. As the fields enjoy protection from the elements, farmers do not have to sow more than once, which extends the growing season (Rinaudo, 2004). Such benefits are even more pronounced if the farmers' action is collective, as demonstrated by the experiences of villages in the Maradi and Zinder regions.

According to 400 farmers interviewed (Larwanou *et al*., 2006), trees generate multiple benefits. They act as windbreaks, reducing wind speed. In the past, crops had to be replanted multiple times after being covered by wind-blown sand; farmers in protected farmland typically only need to plant once. Vegetation also reduces evaporation, by enhancing water infiltration and soil retention (Winterbottom, *pers. comm.* in WRI, 2008). Tree litter increases the organic matter content of the soil. Termites digest the litter and the network of holes they dig increases the absorption of rainfall. Some species (such as *Faidherbia albida*) are able to fix Nitrogen in the soil, although this capacity is less apparent in the trees early years.

Thanks to water harvesting techniques, like *Zai* and contour stone bunds, sorghum yields have increased by 20-85% and millet yields by 15 to 50% (Amoukou, 2006). In some FMNR-practicing communities millet yields seem to have doubled (Tougiani *et al*., 2008). Growth in yields accounts both for increased food security, as crops can be stored as a protection measure against the threat of shortages during the dry season, and for increased income, as surplus produce can be sold in local markets or exported to Nigeria (Reij, 2006).

c. Non-timber products

Trees also provide fodder for livestock, and can be harvested for edible leaves and seedpods, which can be stored for consumption in times of hardship (Rinaudo, 2004). The trees growing in the parkland system of West Africa produce at least a six-month supply of fodder for on-farm livestock. In addition, they also provide firewood, fruit and medicinal products for home consumption or cash sales.

In the Aguié district of Maradi Maerua crassifolia,, a common scrubland tree, is harvested for its leaves, which are rich in vitamin A (Reij, *pers. comm.* in WRI, 2008). The edible leaves of a single baobab tree (*Adansonia*) can be sold for U $20-40, depending on the size of the crown (Larwanou and Adam 2008). Considering that farms can have an average of 50 baobab trees per hectare, total profits could amount to US$1,000/ha/year, about three times the total annual income of large parts of the population (calculation based on Larwanou *et al*. 2006; Winterbottom, *pers. comm.* 2007 in WRI, 2008).

In the Maradi region, FMNR practices have also allowed to developed new profitable activities, such as beekeeping (Burns, *pers. comm.* in WRI, 2008).

d. Marginalized people

The re-greening movement has introduced especially important benefits for some of the poorest members of Nigerian society—women in particular (Larwanou *et al*., 2006). Indeed, gathering fuelwood is now a sensibly less time-consuming activity (Boubacar *et al*., 2005). Furthermore, there is a strong case for arguing that women have actually gained greater benefits from FMNR than their male counterparts, despite being traditionally excluded from resource management decisions (Tougiani *et al*., 2008)

Achieving the best results from re-vegetation not only requires sound tree management (annual pruning), but also requires ongoing protection of trees against illegal wood cutting. Tree husbandry has increasingly become a task for women, as a growing number of men migrate to urban areas during the dry season looking for a salary (Wentling, *pers. comm.* in WRI, 2008).

Women are also responsible for selling leaves and fruits in the local markets, while men usually deal with fuel and poles. Research has shown that some women could earn up to US$210/year by selling the leaves from regenerated baobabs, flowers of the kapok (*Ceiba pentandra*) and fruit of shea nut (*Vitellaria paradoxa*) and locust bean (*Parkia biglobosa*) (Sawagado *et al*. 2001).

Other material benefits derive from the possibility of using their own harvested wood for cooking, without having to buy it on the local market (USAID *et al*., 2005). Increased soil fertility allows for the cultivation of an array of cash crops, such as onions, tomatoes, sesame, and hibiscus; while increased fodder availability makes investment in livestock (mainly sheep and goats) a profitable enterprise (BBC, 2006; Reij, 2006).

As women tend to use savings to meet household needs, incomes produced through FMNR practices translate into better education for the children and increased food supply for the whole family.

FMNR therefore produces a series of new income opportunities, expanding and diversifying the rural economy. It has proved effective in reducing the need for rural-urban migration of young men, allowing for preservation of social values and structure (Larwanou *et al*., 2006). The growing fuelwood production has also allowed to spare some destruction to Niger's shrinking forests (Winterbottom, *pers. comm.* in WRI, 2008).

RESULTS

Table 1 presents a summary of the impacts of land rehabilitation on the Central Plateau of Burkina Faso and FMNR in Niger (from Reij *et al*., 2009).

FMNR practices have enabled hundreds of thousands of households to increase their incomes and diversify their livelihoods. As a result, poor rural households now enjoy better living conditions, both in normal times and during dry spells or when harvests fail. Vulnerability reduction also has a powerful empowering effects on the farmer themselves, as it reveals them that poverty and climate can be tackled just by relying on their own capacities (McGahuey, *pers. comm.* in WRI, 2008).

Monitoring and Evaluation

FMNR practices adopted by farming communities in Niger and Burkina Faso have been evaluated to investigate their economic and ecological viability. Their real extent has only been revealed when aerial photography and satellite imagery have been made available. The high longevity and wide propagation of the initiatives these analysis suggest are good indicators of the sustainability of FMNR measures.

Other assessments were based on farmers' perceptions or statements, but a rigorous analysis of the systemic effects of FMNR measures is still missing. One of the biggest challenges is the complexity and extent of the impacts, that involve short- and long-term effects on soil, water, animal and vegetal species distribution in wide geographic areas. The aggregate benefits to local communities are certainly significant, especially if compared to the low investments that were required to introduce the innovations. Moreover, the bulk of the total costs was borne by communities and NGOs, without requiring excessive exposure of public budgets (Reij *et al*., 2009).

Another challenge for the evaluation processes is the lack of a standard model of planting pit. Farmers have dug and filled more or less pits, and of different sizes, according to their possibilities and necessities, making it problematic to objectively measure their impacts on cultivation (Hien and Ouedraogo, 2001).

Indicator	Land rehabilitation in Burkina Faso	FMNR in Niger
Area concerned	200,000 to 300,000 ha	5,000,000 ha
Average costs/ha	US$200 (project cost + labour investment by families)	US$50 (household labour spent on protection)
Changes in crop yields	+ 400 kg/ha	+ 100 kg/ha
Additional cereal production/ year	80,000 to 120,000 tons	50,000 tons
Impact on food security (annual per capita cereal requirement of 200kg/ha)	0.4 to 0.6 million people (population of 14.8 million in 2007)	2.5 million people (Population of 14.2 million in 2007)
Number of farm households involved	140,000 to 200,000	1.25 million
Impact on local groundwater recharge	5 metres or more	-
Increase in number of on-farm trees	Significant, but no reliable estimate	Over 200 million (all age classes)
Average volume of wood (m^2/ ha)	15 m^2/ha without SWC* 28 m^2/ha with SWC	-
Average above ground biomass (tons/ha)	-	4.5 tons/ha (study southeast of Zinder)

Table 1: Summary of Impact of Land Rehabilitation

CONCLUSION

Pits and contour stone bund techniques

Digging, filling and maintaining planting pits are labour intensive activities, which require farmers to resort to family members or hired labour. Combined interventions with pits and contour stone bunds require even higher labour investments. As richer farmers are more likely to be able to hire labourers to implement such measures, while poorer ones can only rehabilitate their land by small, slow steps, FMNR can potentially become a factor in increasing existing economic inequalities (Reij *et al*., 2009).

Farmer-managed natural regeneration technique

In FMNR projects in southern Niger, guaranteeing land access rights of farmers involved in tree regeneration projects has been crucial (Larwanou *et al*., 2006) to ensure sound management of the dryland ecosystem. When the FMNR

project was first developed, farmers did not own the trees on their own land (Rinaudo, 2004). Traditionally, free access to and exploitation of trees was accepted, even on otherwise private property, and a code of silence protected those who had felled trees, as their exposure was considered anti-social. Under this institutional and cultural setting there was no incentive to protect trees. Breaking the tradition required much advocacy work and a shift in local by-laws and justice administration. Eventually, the population started considering illegitimate tree exploitation as a form of theft.

In 2004, with the support of the Maradi Forestry Department, and of international bodies such as USAID, project staff managed to promote a new legislation that granted farmers who protected trees on their land the right to exploit them economically without fear of getting fined. As a consequence, trees became real cash crops, whose products could be easily sold on local markets, and farmers were incentived to protect and cultivate them. Over time, local rules and codes also evolved, thanks to the collaborative action by village and district chiefs. Favourable national legislation and enthusiastic consensus at the local level were two essential factors in the rapid spread of FMNR practices (Rinaudo, 2008).

The modified institutional setting also made rural people more aware of the ongoing ecological crisis, pushing many to take on development activities (Bretaudeau *et al*., *pers. comm.* in Reij *et al*., 2009). Scaling up of FMNR requires forestry legislation that gives farmers an exclusive right to the trees on their cultivated fields. Equally important in creating the incentive for change is the transfer of land rights and authority to local communities and letting them control access to and use of natural resources.

Despite the success, some challenges still exist. The restoration of formerly abandoned land often generates litigations, as property rights and natural resources grow increasingly valuable assets, especially where land regeneration is widely practiced (Winterbottom, *pers. comm.* in WRI, 2008). Special attention is needed in order to guarantee equitable access to the benefits of FMNR for the most vulnerable - landless peasants, nomadic herders, women (Tougiani *et al*., 2008). In particular, herders seem to suffer negative impacts from the implementation of FMNR practices, as farmers prefer to keep livestock in their farms to have direct access to manure, and therefore entrust them less cattle. On the other hand, herders can sell manure to the farmers (Reij *et al*., 2009). Potentially negative impacts of FMNR also include an increase in pests and competition between trees and crops for nutrients and sunlight. Cutting down of trees that had grown too dense has been documented in Dan Saga, a village in the Maradi region (Reij *et al*., 2009).

As climate scenarios indicate that the region will suffer more and more intense dry spells and droughts over the next decades, tree regeneration initiatives offer a sustainable solution for increasing the resilience of ecosystems and communities in the West-African drylands (Harris, 2007; IPCC, 2007). Despite the wide implementation of such practices, though, half of Niger's children remain undernourished (INS and MII, 2007), and it is not realistic to envisage that FMNR alone will be able to sustain the increase in agricultural production that Sahelian countries need to meet food and livelihoods needs of their growing population (McGahuey, *pers. comm.* in WRI, 2008). Nonetheless, land regeneration can be regarded as as excellent tool for increasing land productivity, especially for poor farmers, that has widely proved its capacity of providing them with diverse and sustainable rural livelihoods, drastically improving their living conditions. (WRI, 2008).

FMNR has several advantages which make it replicable: it is cheap, it produces firewood and fodder quite quickly, it is simple to implement—no experts are needed, it can be scaled up quite quickly and the protection and management of trees are the responsibility of farmers, which means there are no recurrent costs to governments.

FMNR is not only practiced in Niger, but also in Mali, Burkina Faso and Senegal. A growing number of organizations are trying to expand farmer-led re-greening to different countries in and outside Africa (for example in Ethiopia, Chad, Tanzania, Myanmar and Indonesia).

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Recommended videos

Some excellent explanations about FMNR with Tony Rinaudo can be seen at:

Farmer Managed Natural Regeneration (FMNR): A good news story for a deforested and degraded world (World Vision Australia, 2008). Online at: http://www.youtube.com/watch?v=E9DpptI4QGY

FMNR in Niger (Part 1, 1990). Online at: http://www.youtube.com/watch?v=ZyJc3vPqOx8

FMNR in Niger (Part 2, 1990). Online at: http://www.youtube.com/watch?v=wVAZjX5rwHw&feature=related

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