



THE QUIET REVOLUTION

How Niger's farmers are re-greening the croplands of the Sahel





The World Agroforestry Centre (ICRAF) is one of the Centres of the CGIAR Consortium. ICRAF's headquarters are in Nairobi, Kenya, with five regional offices located in India, Indonesia, Kenya, Peru and Cameroon. We conduct research in 28 other countries in Africa, Asia and Latin America.

Our vision is a rural transformation in the developing world as smallholder households increase their use of trees in agricultural landscapes to improve food security, nutrition, income, health, shelter, social cohesion, energy resources and environmental sustainability.

The Centre's mission is to generate science-based knowledge about the diverse roles that trees play in agricultural landscapes, and to use its research to advance policies and practices, and their implementation that benefit the poor and the environment.

The World Agroforestry Centre is guided by the broad development challenges pursued by the CGIAR. These include poverty alleviation that entails enhanced food security and health, improved productivity with lower environmental, and social costs, and resilience in the face of climate change and other external shocks.



A typical parkland landscape at the end of the harvest season in southern Niger.

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Front cover: Women pounding millet in the shade of a *Faidherbia* tree to the south of Zinder.

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Foreword

Until recently, Niger has tended to make headlines for all the wrong reasons. One of the poorest places in the world, with a low life expectancy, high infant mortality and meagre public services, it has suffered from frequent droughts, crop failures and malnutrition.

However, there is good news too. During the past 20 or so years, farmers in two regions on the southern fringes of the Sahara have been responsible for the re-greening of approximately 5 million ha of once degraded farmland. By encouraging the regeneration of trees and shrubs, tens of thousands of households have helped to restore the environment and improve their own welfare.

This booklet tells this remarkable story from the perspective of local farming families. It also examines the growing body of scientific evidence which makes a compelling case for expanding ‘farmer-managed natural regeneration’ across the Sahelian region. These practices have helped to increase crop yields. They are also providing fodder for livestock, fuelwood, medicines, fruits, cooking oil and much else. A recent study by scientists from the World Agroforestry Centre found that the value of tree products among sampled households amounted to around US\$1000 each per year – a considerable sum of money.

There is increasing evidence that these ‘evergreen’ agricultural practices are a key element in regenerating the long-term quality of the land, and can be the basis for a more resilient climate-smart agriculture in the drylands.





Sahia Kane is president of a women's group which makes oil out of Balanites seeds.

If these re-greening activities are to be replicated elsewhere, we need to understand the drivers of change. One of these has been the transfer of ownership of farmland trees from the state to farmers. There is also clear evidence that projects which put farmers on an equal footing with local government departments and researchers have the greatest chance of success.

We owe a considerable debt of gratitude to a number of organizations who have promoted farmer-managed natural regeneration. We are particularly grateful to the International Fund for Agricultural Development (IFAD). Besides funding some of our research, IFAD has promoted re-greening by farmers in Aguié Department and supported the development of village institutions to manage their new trees. During the coming years, we will accelerate our research on farmer-managed natural regeneration, working in partnership with local government departments, national research organizations, non-governmental organizations and farmers. And we will intensify our support to governments and international and national development organizations across the Sahel and the developing world through the Partnership to Create an EverGreen Agriculture, which is hosted by the World Agroforestry Centre.

Tony Simons
Director General, World Agroforestry Centre
Nairobi



Rabi Saadou of Dan Saga village pruning Combretum glutinosum, a tree which helps to improve soil fertility.

Introduction

“If you’d come to Dan Saga in the early 1980s, you’d have seen how we were struggling,” says Ali Neino. “Every year, we had to sow our crops three or four times, because the wind would blow the seeds away.” This was a virtually treeless landscape and there was nothing to prevent the wind from ripping away soil and seeds.

“Then we began to notice something unusual,” continues Ali. “Many of the migrant workers from here didn’t have time to clean their fields when they returned to sow their crops. And they did much better than us – they only had to sow their seeds once.” This was because the shoots which sprouted from underground roots – the remnants of an ancient forest cleared during the 1960s and ‘70s – were protecting the soil.

This was the villagers’ first experience of an agroforestry practice which became formalised over the coming years and is now known as ‘farmer-managed natural regeneration.’ Instead of treating trees and bushes as imposters, farmers in southern Niger now see them as an essential component of their production systems.

“This practice has totally changed our way of life,” explains another farmer from Dan Saga, Ali Miko. Families have more wood to sell; women spend less time gathering firewood; there is more fodder for livestock; household incomes have risen. “Thirty years ago, there were very few carts in the village. Now almost every family can afford to buy one,” says Ali. Their parents used to carry everything on their heads – grain, manure, fodder, firewood; now, carts drawn by donkeys and oxen do much of the hard work.



Dan Saga farmers Ali Miko, Idi Daouda, Ali Neino and Sakina Mali with Abasse Tougiani (2nd from right).

Many farmers believe natural regeneration has significantly increased crop yields. “If you do it really well, you will get better yields of sorghum and millet,” says Ali Neino. He estimates that before farmer-managed natural regeneration became widespread in Aguié Department, most farmers got meagre yields of around 150 kg of millet per ha. Many now get over 500 kg without even having to use artificial fertilizers. Some are now combining agroforestry with ‘micro-dosing’, the targeted use of small doses of fertilizer, to get yields of up to 1000 kg per ha.

Adam Toudou, a professor in the Faculty of Agronomy at Université Abdou Mounmouni, Niamey, has been tracking the change to the landscape over several decades. He can remember visiting Aguié as a student in the early 1980s. “The only trees you’d see were very big trees, and there were few of them,” he recalls. “It was one of the most degraded areas in southern Niger. Since then, it’s been completely transformed by the farmers.” During recent years, he and his colleagues have noticed that villages which have a long experience of farmer-managed natural regeneration have coped better with drought, and experienced less malnutrition, than those which haven’t adopted the practice.



Most of the research on farmer-managed natural regeneration in Niger has focused on the regions of Maradi and Zinder.

A great success story?

It wasn't until Gray Tappan of the United States Geological Survey compared high-resolution satellite photographs taken in 2005 and 2008 with imagery from earlier times that the true extent of re-greening in southern Niger became apparent. Tappan's research revealed that approximately 5 million ha of once degraded farmland now supported medium to high densities of tree cover in the Maradi and Zinder regions.

However, measuring the precise impact of farmer-managed natural regeneration has proved a considerable challenge. "It's a very complicated system, with so many different variables," says World Agroforestry Centre's Impact Assessment Advisor, Frank Place. "There is a huge variation in terms of the species you find in farmers' fields, the number of trees and their age."

When undertaking a recent study, commissioned by the International Fund for Agricultural Development (IFAD), Place and his colleagues were able to make accurate measurements of



A fine harvest of sorghum in a field with Faidherbia.

field size, the numbers of trees, their species and their age, but they still had to rely on the testimony of farmers when it came to assessing crop output. Farmers do not necessarily think in terms of kilograms; rather they talk in terms of 'measures', frequently using buckets of different sizes.

Despite these challenges, the evidence provided by this and other studies, and by the farmers interviewed for this booklet, is overwhelmingly positive: farmer-managed natural regeneration has provided significant benefits for large numbers of households in the Sahel. However, we should be wary about making generalizations, given the complexity of the subject – the benefits of farmer-managed natural regeneration vary from place to place – and the paucity of good scientific research.

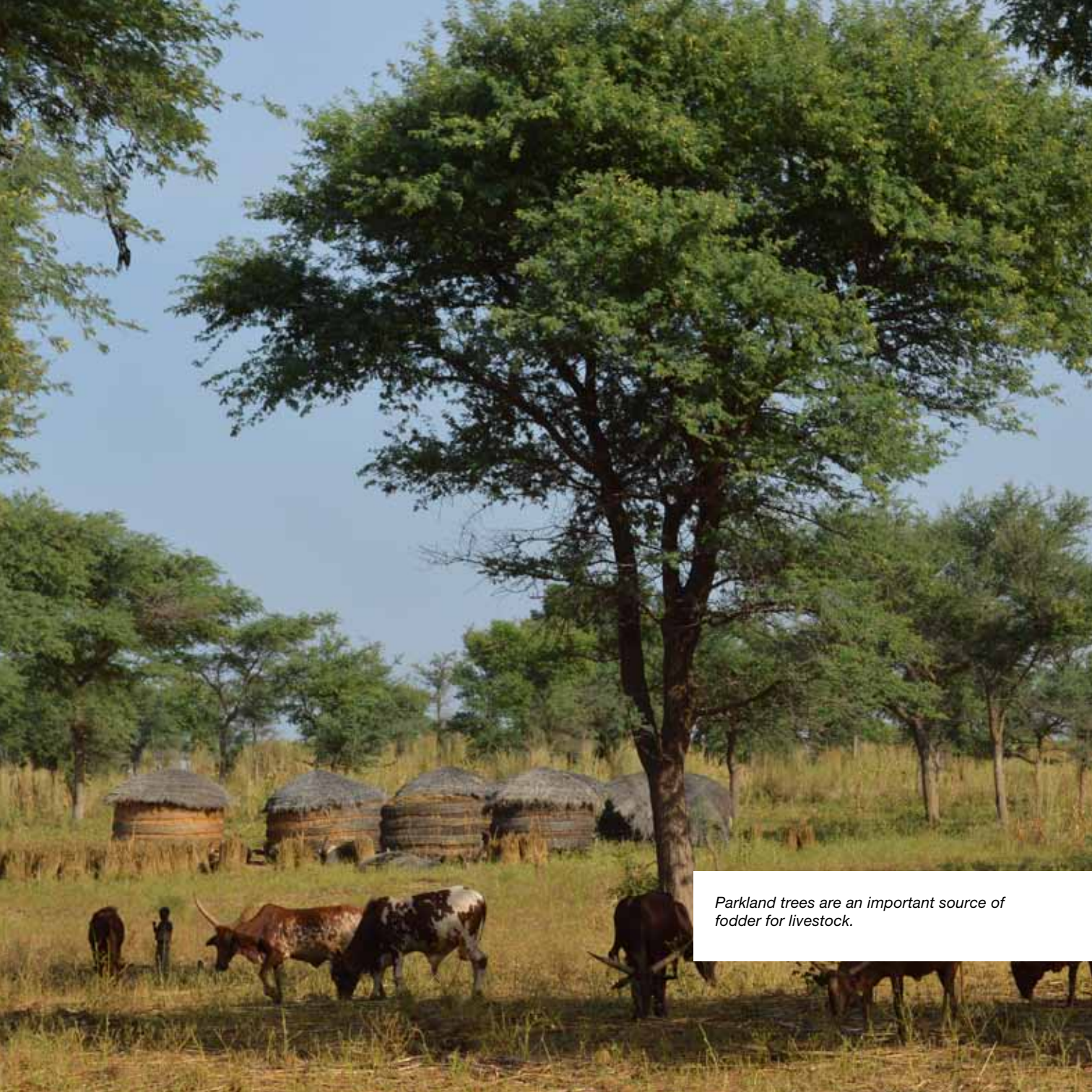
“There is absolutely no doubt that farmer-managed natural regeneration has huge potential in areas like the Sahel,” says Dennis Garrity, former Director General of the World Agroforestry Centre and the United Nations Drylands Ambassador. “However, there is an urgent need for further research, not just on the impact of these practices, but on the optimum tree densities, and the species which farmers could use to optimize their total benefits. We also need to gain a better understanding of how the practices have spread so rapidly from village to village, and from farmer to farmer.”

Box 1: What is farmer-managed natural regeneration?

Farmer-managed natural regeneration – *la régénération naturelle assistée* in French, *sassabin zamani* in Hausa – is a practice which involves identifying and protecting the wildlings of trees and shrubs on farmland. It depends on the existence of living root systems and seeds. Shoots from roots grow more rapidly than saplings from seed, and they make up the bulk of the protected woody matter on farms in southern Niger. Farmers will generally choose five or so of the strongest stems from stumps they wish to retain on their land, pruning away the remainder. These stems can periodically be harvested to provide firewood and timber. Farmers will often allow one stem to develop into a full-size tree. The species favoured vary from place to place; so does the density of trees. Some projects have advised farmers to keep 40 trees per hectare, but densities of over 150 are not unusual.



Farmers are now protecting shoots like these.



Parkland trees are an important source of fodder for livestock.

Chapter 1: DROUGHT, FAMINE AND REGENERATION

Niger is one of the poorest places in the world. In 2011, it was ranked 186 out of 187 countries in the Human Development Index devised by the United Nations Development Programme (UNDP). Life expectancy at birth is 53 years; infant mortality is the second highest in the world; 40% of children under the age of five are underweight; just 15% of women can read and write. In 1950, the country's population was around 2 million. It is now over 17 million and growing at a rate of 3.6% a year. The average woman in Niger has 7.16 children, and half the population is under the age of 15.

This sprawling, landlocked country, three-quarters of which is desert, seldom makes news for the right reasons. During the early 1970s, crop failures led to widespread malnutrition and the death of tens of thousands of people. There were further severe droughts in the mid-80s and in 2005 and 2010, when poor rains and plagues of locusts led to meagre harvests. Surviving in this environment has always been difficult, requiring ingenuity and considerable imagination.

The degradation of Niger's parklands, the areas where most of the settled agricultural activity takes place, is intricately linked to population growth. "When our parents



Abasse Tougiani, who has spent two decades researching farmer-managed natural regeneration, with farmer Naziru Amadu of Mirriah.

were young, there were relatively few people here and there were many trees," says Ali Neino of Dan Saga. In his grandparents' day, the forests were so rich in wildlife that women were reluctant to venture out of the villages on their own. As the population rose in the 1960s and 1970s, the demand for firewood and wood products increased. "It wasn't long before most of the trees had been cut down," says Ali. Droughts simply made matters worse, and the degraded farmland frequently failed to provide the growing population with enough food to last the year.

"During this period, there was a dramatic reduction in the number of some of the most important tree species, such as *Parkia biglobosa* and *Guiera senegalensis*," says Abasse Tougiani, a senior scientist with the Institut National de la Recherche Agronomique du Niger (INRAN) and the World Agroforestry Centre's focal point in the country. "The government reacted by establishing large tree-planting programmes, most funded by foreign donors, with the aim of re-foresting degraded areas."

It is estimated that some 60 million trees were planted over a 12-year period, but less than 20% survived. There are various reasons why these forestry schemes failed. For one thing, the rights to the trees were often ill-defined. For another, little effort was made to involve local communities in either the planting or the maintenance of the new forests. There was also a strong focus on planting exotic rather than native species.

As we drive from the regional capital of Maradi towards Dan Saga, Tougiani stops to illustrate his point.



Uncontrolled grazing and wood cutting in Dankada-Dodo Classified Forest have led to the proliferation of the weed Sida cordifolia.

“This is what happens when local people are excluded from managing natural resources,” he says, encompassing with a sweep of his arms a wide expanse of almost treeless grassland infested by the weed *Sida cordifolia*. Despite its lack of trees, this is still known as Dankada-Dodo Classified Forest. “In the 1950s, the land here was covered by dense forest, but just look at it now,” says Tougiani. “Everybody thinks that if the land belongs to the government they have the right to cut timber and graze their animals. Nobody respects it.”

In contrast...

In the early 1980s, Tony Rinaudo was managing a development project established by Serving in Mission (SIM) in Maradi region. He realized that underneath the degraded fields there was a dense network of living roots, an underground forest which had survived the depredations of the past decades. Every year, farmers would hack the shoots away before sowing their crops, convinced that their fields should be ‘clean’. This practice was encouraged by extension agencies. However, Rinaudo saw this as an opportunity wasted and the Maradi Integrated Development Programme, which he managed, encouraged 12 farmers to experiment with natural regeneration.

Such were the benefits, which are described in the next chapter, that Rinaudo continued to promote the practice during a series of drought-related famines in 1984 and 1985. In return for ‘food-for-work’, farmers in over 100 villages agreed to prune and conserve regenerating trees in their fields. In the area where SIM operated, 88% practised some form of natural regeneration, adding around 1.25 million trees to the landscape each year. Word began to spread from farmer to farmer, and towards the end of the decade farmer-managed natural



These women in Dan Saga have benefited from better crop yields, thanks to the regeneration of their parklands.

regeneration was being promoted by extension agencies, non-government organizations (NGOs) and the media. Soon, farmers in other parts of Maradi began to change the way they looked after their land.

In Dan Saga, for example, increasing numbers of villagers began to encourage natural regeneration in their fields. Before long, the benefits – especially the increase in wood products – were obvious; so obvious, in fact, that neighbouring villagers began to steal their firewood. This prompted the chief to set up a general assembly and the villagers agreed to establish surveillance committees with powers to arrest anybody who was found stealing firewood or timber. Over the years, the farmers here benefited from training provided by INRAN, the World Agroforestry Centre and a succession of projects funded by IFAD. There has been a strong emphasis on establishing institutions to promote natural regeneration and ensure that the trees and bushes are well protected.



During the dry season, fodder from trees helps to sustain livestock.

A tree with a difference

It takes several hours, much of it on rough roads, to travel from Aguié to the southern parts of Zinder region, just north of the border with Nigeria. Once you reach the small town of Matameye the landscape begins to change. Here and to the east the dominant tree is *Faidherbia albida*, locally known as *gao*.

On our first day, we make frequent stops to ask whoever we can find about their experience. “Our parents told us that 50 years ago the water table used to be much higher,”

says Laminou Ibrahim, a 27-year-old farmer in Zedrawa village. In those days, trees such as *Parkia biglobosa* and *Lannea microcarpa* were very common. “And then the climate got much drier, and the water table began to fall, and the only tree that could survive here was *gao*,” he says. He points to a large *gao* tree beneath whose majestic canopy three women are pounding millet. Under a tree like that, he says, you will harvest 60–70 kg of millet – compared to just 10–15 kg on a patch of land the same size in a field without any trees. “Even if you can’t afford to buy any fertilizer, if you have *gao* trees in your fields, you are saved,” says Laminou.

In the larger village of Droum we hear a similar story. “If you take this plot of land,” says Rabé Yahaya, the local *waziri*, or traditional authority, indicating the area between three large trees, “it would give you about 60 kg of millet for one harvest. A plot of land the same size in a field with no *gao* trees might yield 15 kg at most.”



Rabé Yahaya, the local *waziri* in Droum, says *Faidherbia* trees have helped to significantly improve crop yields.

Faidherbia albida is an unusual tree as it exhibits reverse phenology: it loses its leaves at the onset of the rainy season and grows them during the dry season. “That means we can grow our crops under the trees,” says an elderly man who has just returned from Friday prayers to rest under a *Faidherbia* tree in Kiran Haussa village. “They drop their leaves just before the rains, in April and May, and that’s what makes the soil so fertile.”

None of the people we interview in southern Zinder seem to realize that *Faidherbia* – like all leguminous species – ‘fixes’ atmospheric nitrogen in the soil through its roots. All, however, are convinced of its power to improve fertility through the shedding of leaves.

“There’s no point in using manure or artificial fertilizers when you have *gao* trees in your fields,” says Bashir Mohamed in Droum village. “And it’s not just the area under the trees that’s more fertile. The wind will blow the fallen leaves across the fields, so that increases fertility beyond the trees as well.”

A review of six different practices which come under the heading of conservation agriculture, led by World Agroforestry Centre scientist Jules Bayala, found that *Faidherbia* trees have a significant effect on crops, increasing grain yields in a sample of studies by 240 kg per ha.² Testimony from these villagers suggests that the boost to yields is even greater in some places.

In many *Faidherbia*-rich areas farmers are practising natural regeneration. They protect and prune the shoots which rise from underground roots and they place thorn fences around self-seeded saplings to protect them during the dry season, when pastoralists have the right to graze their livestock wherever they wish.



This is the traditional form of transport for many farmers.

And it's spreading

Analysis of satellite imagery suggests that farmers have encouraged natural regeneration on around 5 million ha of land in Maradi and Zinder regions. The degree to which the land has been re-greened varies. According to Chris Reij, a sustainable land management specialist at the World Resources Institute (WRI), the canopy is densest in southern Zinder. "Here, all the villagers are involved, and it's obvious why – they know that *Faidherbia albida* increases soil fertility and crop yields," he says. Reij, who first began working in the Nigerien Sahel in 1984, describes the experience in southern Zinder as the high point of farmer-managed natural regeneration.

Many millions of dollars were spent during the 1970s and '80s on large-scale projects in the Sahel which attempted to restore degraded land through tree planting. Many of these projects failed. In contrast, a vast area of once denuded land has now been partially re-vegetated at little cost – thanks to the labour and enthusiasm of tens of thousands of farming families. The practice has now spread far beyond Zinder and Maradi. You only have to look out of the window as you drive to Niamey, some 650 km to the east, to see that farmers along much of this stretch of southern Niger are also encouraging the natural regeneration of trees in their fields.



Millet yields have risen significantly in many areas where farmers practise natural regeneration.

Chapter 2: ASSESSING THE BENEFITS

As she strips the side shoots off the stems of *Combretum glutinosum*, a versatile species which provides wood, medicines, fodder and a yellow dye, Rabi Saadou explains why she is happy to spend time and energy encouraging new growth from the stumps in her field. “The trees protect the soil from the wind, which makes sowing much easier than it used to be,” she says. “They give me wood that I can use for cooking or to sell, and the leaves make the soil more fertile and increase my crop yields.” The larger trees also provide shade, much appreciated by livestock and passing humans during the dry season.

Most farmers will mention several reasons why they are pruning and conserving trees in their fields. These may vary from one village to another, but there are certain benefits which are common throughout Maradi and Zinder. Not surprisingly, in these regions with long and bitter experience of droughts and hunger, farmers are keen to highlight the impact which natural regeneration has on crop yields. The anecdotal evidence for this is strong, even if some of the research on the subject is inconclusive.

Food for thought

In a discussion paper published by the International Food Policy Research Institute (IFPRI),³ Chris Reij, Gray Tappan and Melinda Smale wrote: “It seems reasonable to assume that one hectare of FMNR [farmer-managed natural regeneration] increases cereal yields on average by 100 kg, but the increase would be much higher in the case of *Faidherbia albida*.” Assuming 5 million hectares of re-greening, this implies an



Rabi Saadou of Dan Saga values trees for many different reasons.

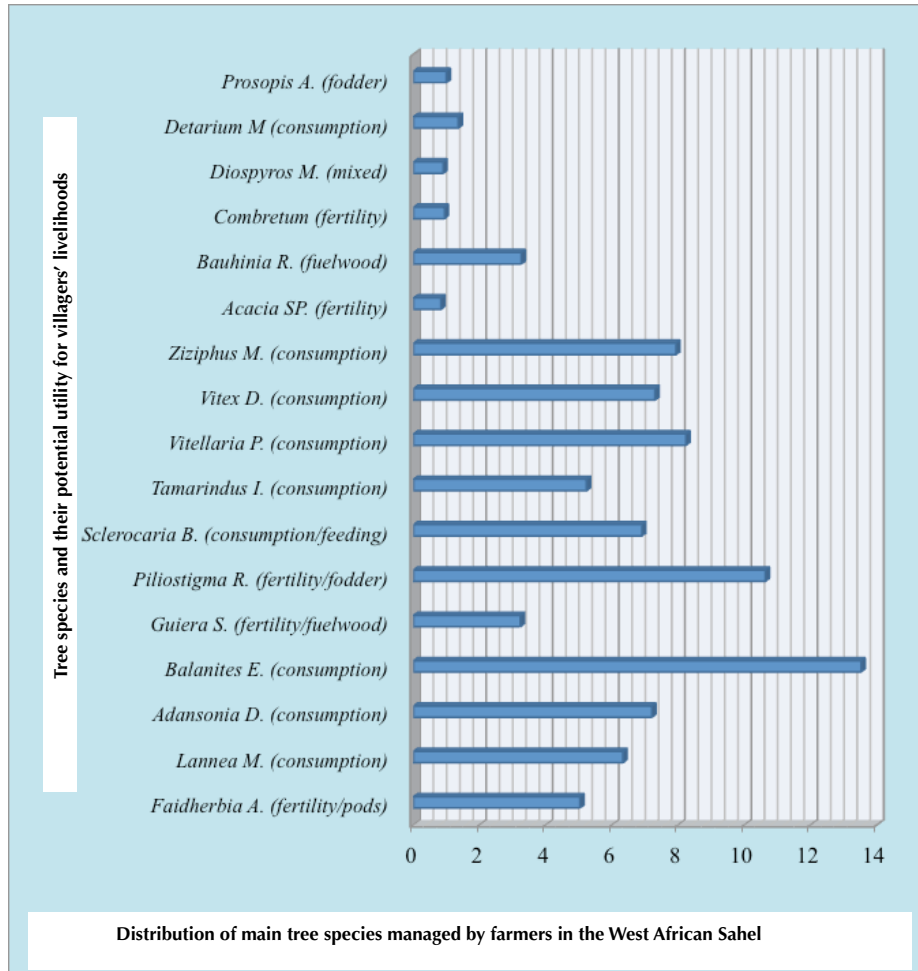
increase in production of 500,000 t of cereals a year. If the average person in Niger consumes 200 kg a year, this means that farmer-managed natural regeneration contributes enough extra food to satisfy the needs of 2.5 million people.

Reij says he and his colleagues were making a conservative estimate. “From our experience, the average yields in southern Niger in fields without any trees are 300–400 kg per hectare,” he says. “With trees, most farmers say they’re getting around 500 kg.” And indeed, many of the farmers interviewed for this booklet were emphatic about the fact that natural regeneration had increased their cereal yields.

The World Agroforestry Centre study mentioned in the introduction, conducted by Frank Place and his colleagues, provides an assessment of the economic impact of farmer-managed natural regeneration on over 1000 households in Niger, Mali, Burkina Faso and Senegal. They found that trees with beneficial soil effects, such as *Faidherbia*, helped to increase yields, with older and more mature trees having a greater effect than younger trees.

In contrast, research conducted by scientists from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Bioversity International concluded that farmer-managed natural regeneration did not significantly increase grain yields in their study area in Maradi region.⁴ The findings were based on an assessment of 410 randomly chosen households in 41 villages. The scientists attempted to distinguish between households which were practising natural regeneration – these comprised half of those surveyed – and those which weren’t. One could question this approach, according to Place, as nearly all households have some trees on their land – and are therefore practising natural regeneration to some degree.





The more favoured the species, the higher the score. For example, *Balanites* represents 13.25% of the trees managed by farmers in the West African Sahel. Source: 'Economic Impacts of Farmer Managed Natural Regeneration in the Sahel: End of Project Technical Report for Free University Amsterdam and IFAD' by Frank Place and Joachim Nyemeck Binam

Nevertheless, the ICRISAT and Bioversity team did find that farmer-managed natural regeneration led to an increase in the *value* of crop production, probably as a result of increased yields from other crops, such as cowpeas and groundnuts.

Their figures suggest that the gross value of crop production for farms practising natural regeneration was 71,333 CFA (US\$138), compared to 45,580 CFA (US\$88) for those who do not practise natural regeneration. Gross income per capita was 86,104 CFA (US\$167) for adopters and 62,996 CFA (US\$122) for non-adopters. The authors say that their findings “strongly support the continued promotion of FMNR [farmer-managed natural regeneration] as a low-cost means of enhancing rural livelihoods and improving local management of natural resources.”

Over the years, there has been sporadic research on the impact of *Faidherbia albida* on crop yields. The tree appears to be of particular importance in areas of low soil fertility. A study by Jean-Marc Boffa, a scientist who has devoted considerable time to investigating agroforestry practices in the Sahel, found that *Faidherbia* increased the nitrogen content of the soil by 15–156%.⁵ It also helped to increase levels of carbon, phosphorus, potassium, calcium and magnesium. Boffa found that the presence of *Faidherbia* increased millet yields by 49–153% and sorghum yields by up to 169%. In most cases, this meant an additional cereal yield of 400–500 kg per ha or more.

Some observers have suggested that the benefits of *Faidherbia* have been exaggerated, and that yields may be higher under and close to *Faidherbia* for reasons that have little to do with the intrinsic properties of the tree. Perhaps, they suggest, grazing livestock and roosting birds are partially responsible for increases in fertility; or the trees are taking advantage of the lenses of fertility which can be found in many fields.

“Well, it is true that birds roost in the *gao* branches and cattle are attracted to their shade in the dry season,” says Ali Amadou of Droum village. “Yes, that would help to increase soil fertility. But remember this. Cattle will also gather under other trees, such as the neem you

can see over there. But if you try growing crops under the neem you won't get much, because they cast so much shade during the growing season. The great thing about *gao* is that it casts no shade in the growing season, and we know that its leaves make the soil more fertile."

Much more besides

There is much less dispute – from a scientific point of view – about the tangible benefits of farmer-managed natural regeneration when it comes to providing fuelwood and material to make tool handles, roofing tiles, granary footings and the like. During

the first year of practising natural regeneration, farmers will gain fuelwood from pruned branches; from the second year onwards, the branches will be large enough to sell. One study found that over a 12-year period the wood sold as a result of farmer-managed natural regeneration in 100 villages in Maradi was worth US\$600,000. If a farmer prunes five stems on each of 40 stumps per hectare, harvesting only one a year, he or she could have an annual income by the sixth year of around 70,000 CFA (US\$135).

During recent years, many villages have established wood markets, and these are proving a considerable success. In Dan Saga, for example, a market was established in January 2008. Wood is collected at the roadside from farms and sold in the centre of the village. This is not a free for all, and community organizations have established rules about which species can



Natural regeneration has provided farmers with timber and fuelwood to use and sell.



Abdou Tchololo with a harvest of baobab leaves and grain.

be cut. Certain trees, such as *Faidherbia* and *Balanites*, can only be felled under exceptional circumstances.

The World Agroforestry Centre study led by Place concluded that trees added significantly to household incomes. In Niger and Mali, for example, the value of fruit, pods, leaves and other tree products amounted to around US\$1000 per household per year, with the total value being much higher in Niger. They estimated the value of fuelwood alone at between US\$224 and US\$256 per household in Niger.

Several species that farmers encourage in their fields – including *Strychnos spinosa*, *Balanites aegyptiaca*, *Ziziphus* and *Adansonia digitata*, the baobab tree – provide edible leaves and fruits for human consumption. These are particularly important during droughts, especially for poorer members of the community.

As we travel along the dirt road between Gouna and Mirriah, we stop to inspect four fat-trunked baobab trees in a field of sorghum and millet. The farmer, Naziru Amadu, comes to join us. He explains that he planted two of the baobabs; the others were self-seeded, and he has taken care to protect them from grazing livestock. From time to time, he collects the

leaves and takes them back to his house in Mirriah, where they are dried in the sun. "Then I grind the leaves into flour, and we add this to millet porridge," he says. "The rest I sell, and with the money I make I buy things I need for my family." He also harvests the baobab fruit, which he sells to juice traders.

You realize just how valuable baobab trees are when you reach Mirriah, where many thousands of trees, each of which belongs to an individual or family, stretch some 4 km along the riverbank. We meet an elderly man pushing a bicycle with three sacks, one full of harvested sorghum, another with millet, and the largest with baobab leaves. "If I sell these leaves fresh, like this, I'll get around 1000 CFA (US\$1.90), and they only took 30 minutes to collect," says Abdou Tchololo.

A recent study of the food supply in five villages in Kantché Department, in southern Zinder, found that the sale of leaves from a mature baobab tree can generate US\$27-US\$75, depending on when the leaves reach the market.⁶ Taking the upper limit, this would be enough to buy 175 kg of cereals. The research, led by Prof Yamba Boubacar, also investigated cereal production between 2007 and 2011, the latter being a year of severe shortages. The department had a surplus every year, ranging from 13,800 t in 2011 to 64,200 t in 2010. It may be no coincidence that this is an area dominated by *Faidherbia*.

Trees grown on farmland provide a range of other benefits too. They are a source of fodder for livestock, and for many farmers this is one of their main benefits. Working oxen are said to be in better condition and much stronger than they were in the past, when they didn't have access to a plentiful supply of tree fodder. Some trees provide nuts and fruit which can be processed into oils (See box: Oil for cash); others are an important source of traditional medicines.

Faidherbia is among the more versatile medicinal trees. "I see these trees as my pharmacy," says Laouali Dan Boula, a traditional healer in the village of Droum. "If a child has stomach problems, I can make a concoction out of the ground bark, and this will bring relief." He

also uses *Faidherbia* to tackle headaches and haemorrhoids. Many other tree species also have medicinal properties. A survey, led by Mbène Dièye Faye and John Weber of the World Agroforestry Centre, asked villagers in four Sahelian countries to list tree species in order of their importance and to specify their uses.⁷ Ninety-three per cent of the 116 species mentioned provided medicines and 90% provided food.

Wherever you travel in southern Niger, people will tell you that women have benefited as much as men from farmer-managed natural regeneration. "It has made a great difference to our lives," says Sakina Mati from Dan Saga. "Nearly all the women in my village now practise natural regeneration in their fields, and we do it just as well as the men." Now that they have trees growing in their fields, they no longer have to spend many hours each day searching for fuelwood, as they did in the past. The women are also benefiting from wood sales, as well as better crop yields, and many are making extra cash by collecting and selling other tree products, such as fruits and oils.



Laouali Dan Boula, a traditional healer in the village of Droum.

Box 2: Oil for cash

When researchers led by the World Agroforestry Centre conducted a survey of farmers' preferences of tree species and tree functions in four West African countries, the desert date – *Balanites aegyptiaca* – was identified as one of the most useful. “The villagers told us they could get many things from *Balanites*, including fruit, medicines and oil,” says Abasse Tougiani.

In Dan Saga, 10 members of a women's group – they have called themselves 'Benefit from Forest Products' in Hausa – are making oil from *Balanites* kernels which they collect in their fields. “It's a tradition we learnt from our parents,” explains Sakina Abu. “Besides getting oil, the process provides a nutritious cake which we can feed to our livestock.”

The women keep some of the oil they make for cooking, and sell the surplus for around 1500 CFA (US\$2.90) a litre. “This is now an important source of income for us,” says Sahia Kane, the group's president. “It means we can buy children's clothes, school books and medicines, which we often couldn't afford in the past.”

The women are helping Tougiani and his colleagues to collect different provenances of *Balanites*, which are now the subject of research in local nurseries. Eventually, it is hoped that this participatory domestication programme will provide villagers with vigorous saplings to plant in their fields.



Cracking Balanites seeds requires time and patience.



Harvesting baobab leaves near Mirriah.

Chapter 3: THE DRIVERS OF CHANGE

If the activities which have led to the re-greening of over 5 million ha of arid farmland are to be replicated elsewhere, it is important to understand – to use the jargon of development agencies – the drivers of change. At first sight, the story seems simple enough. Environmental degradation, drought and a severe shortage of wood meant that farmers had to change the way they managed their land to survive. Those who decided to protect and manage indigenous trees were quick to appreciate the benefits: natural regeneration in their fields helped to protect the soil, increase the supply of wood and fodder, enhance soil fertility and raise incomes.

However, this was not a linear progression, with a virtually barren landscape becoming incrementally greener and the number of trees increasing year by year. The process happened in fits and starts, with changes in government policy, advice from extension agencies, and the activities of NGOs and international donors all playing a role in this unusual story.

It has been suggested that increases in rainfall in the Sahel over the last two decades stimulated the process of re-greening. However, recent studies indicate that the relatively modest increase in rainfall has been insufficient to explain the scale of change in vegetation cover in southern Niger. The process, in short, has been largely driven by human intervention of one sort or another.



Seed pods from leguminous trees are often used as livestock fodder.

Chris Reij believes that this led to farmers and communities gradually taking ownership of their trees – even though this was not sanctioned under the Forestry Code. Farmers began to retain and encourage tree growth on their fields, without fear of persecution. At the same time, the government began to recognize that these activities posed no threat to the country's forest resources. Rather, they resulted in the regeneration of tree cover because farmers themselves stood to benefit. In 2004, a new Forestry Code became law. This recognized that trees on farmland belonged to the landowners, not to the state.

So was the decision to recognize the private ownership of trees on farmland a case of the government introducing policy retrospectively, having realized that many farmers had assumed ownership? Or was it a case of the government introducing enlightened reforms which subsequently stimulated the spread of farmer-managed natural regeneration? It is most likely to have been the former. But the important thing is that it was accomplished, and farmers now have a much greater say in what they do with trees in their fields.

"We now have a very good relationship with the forest agents, who are very supportive of the way we're managing our land," says Idi Daouda. However, the relationship between farmers and forest agents remains troubled in some areas. "I think you'll find that the forest agents are much more sympathetic in Maradi than they are here," says Mamane Bako, director of the Environment Department in Mirriah, in Zinder region. "The situation is a bit different in Zinder, largely because we haven't had the sort of projects that have benefited Maradi, and which brought the forest agents closer to the villagers."

It is now widely recognized that the new Forestry Code has greatly benefited farmers. "The private ownership of trees is very important, and this has led to a great change in farmers' attitude and behaviour," says Prof Adam Toudou. "*L'arbre est devenu un trésor à maintenir dans leurs champs.*" Trees have become a treasure to look after in their fields.

Projects that make a difference

Abasse Tougiani was based at INRAN's Maradi office from the early 1990s until 2006, and he has had first-hand experience of many of the projects which promoted farmer-managed natural regeneration. "Without these projects, it is very unlikely that the practice would have become so widespread," he says.

The first major project, the Maradi Integrated Development Project (MIDP), benefited from charismatic leadership – the Christian missionary Tony Rinaudo is a key player in this story – and its flexibility. Instead of dictating precisely what farmers should do, Rinaudo and his team encouraged them to decide how many trees they would manage and how to prune them. Indeed, the intrinsic flexibility of farmer-managed natural regeneration is one of its attractions. If a farmer is concerned about food security, he or she may maximize the number of trees on the land, knowing that they are drought-resistant and will provide firewood, fodder and other products which can be sold at any time of year. On the other hand, a farmer who wants to maximize crop production may choose to retain fewer trees and prune them heavily.

For Tougiani, the Valorisation des Initiatives Paysans en Agroforesterie (VIPAF) project, launched in 1998 by INRAN and the World Agroforestry Centre, represented an important milestone in Aguié Department. "This was the first project that treated the farmers as



Baobab fruits are highly valued for the juice they provide.



Villagers have played an important role in establishing and managing tree nurseries under various development projects.

partners, and put them on an equal footing with local government departments, researchers and everyone else involved in the project,” he says. This inclusive approach has been central to the success of the two most recent initiatives funded by IFAD in Aguié: le Projet de Développement Rural de l’Arrondissement d’Aguié (PDRAA) and le Projet de Promotion de l’Initiative Locale pour le Développement à Aguié (PPILDA).

“In the years before the IFAD projects began, the staff from the Ministry of Forestry had a very top-down approach,” recalls Ali Miko, a farmer in Dan Saga. “They saw their role as telling us what to do.” The VIPAF and IFAD-funded projects, in contrast, encouraged the farmers to set up their own committees and institutions, and these now play a key role in managing everything from the surveillance of farmers’ fields to community wood sales. Most villages where farmers are practising

natural regeneration now have their own committees, with 8–10 elected members. Farmers in Dan Saga are particularly proud of the fact that they have provided training to some 80 villages; in 2011 alone, the farmers they trained managed some 10,000 ha of land.

The survey conducted in Maradi by the ICRISAT/Bioversity team of scientists suggests that farmers benefit from having various sources of information about how to practise natural regeneration in their fields, including radio, contact with other farmers, government extension agencies, NGOs and projects such as those funded by IFAD. In recent years, school projects and competitions (see box: Inspiring success) have also helped to spread the word.

Box 3: Inspiring success

In June 2012, 400 farmers from eight communes in Mayahi Department attended a two-day training course organized by the local offices of the Department of Environment. Each commune identified 50 farmers, including 15 women, who would benefit from the training. On 3 August, Niger's Independence Day, prizes were given to the three individuals in each commune who were deemed to have performed best in their fields. "The training made a significant difference, and I fully expect it to increase crop yields and living standards over the coming years," says Sani Tari, deputy director of the Department of Environment in Mayahi.



Prize winner Soulay Ali.

The winner of the first prize of 20,000 CFA (US\$39) in the village of Maitsakoni was Soulay Ali. He admits that he had a head start on many other farmers as his father, who is now 90, began experimenting with natural regeneration long before there were any projects promoting the practice in this area. "I'd seen how it helped to protect his soil and increase fertility," he says, "so I'd always done it on my own plot of land. However, I thought this training would help me to improve my skills." As a result of natural regeneration, he says he has increased his millet yields from 25 to 45 'measures' on one particular field. Impressed by what they have seen, some of his neighbours are now coming to him for advice.



Farmer-managed natural regeneration is helping to keep granaries full in many villages – for now, at least.



Children in Droum village.

Chapter 4: LOOKING TO THE FUTURE

The re-greening of southern Niger is a good example of impoverished smallholders improving their food security by adopting practices which have cost them little other than their time and labour. Natural regeneration has helped to improve crop yields, the availability of wood and household incomes. However, many families still remain poor and at risk of hunger, especially when there are inadequate rains. Furthermore, the gains made over recent years are threatened by the rapid growth of the local population. In 2008, the population of Maradi was around 2.8 million. It is projected to double in less than 20 years.

This means two things. First, farmers need to further increase the productivity of their fields and make their farms more resilient to possible changes in the climate. Second, many people will have to find employment away from their family farms. "We will have serious problems unless the region establishes other activities which provide jobs for our children," says Ali Neino. These, he said, could include setting up small businesses, making patisserie and galettes, and working as drivers, carpenters and traders. Large numbers of people, says Ali, will continue to seek work as migrant labourers in neighbouring countries like Nigeria.

There is an urgent need to scale up the practice of natural regeneration across the Sahel, and to improve the way it is practised in areas such as Maradi and Zinder. Chris Reij and the authors of the IFPRI discussion paper suggest that there are important lessons to be learnt from the experience in southern Niger.



They believe that innovations adopted by local people – or ‘barefoot science’ – can be as important as cutting edge research. The most successful innovations are often simple, low-cost improvements of practices that are already known to farmers. Single techniques and practices are generally not enough to achieve real change, although they can act as a trigger for other innovations. Farmers should be encouraged to be flexible and decide what works best for them under their own social, economic and environmental conditions. Although individual farmers can achieve much on their own, more can be achieved when communities work together. This is precisely what has happened in villages like Dan Saga. Experience suggests that farmers are more likely to adopt practices which deliver significant benefits within the first year or two.

More research please

There is an urgent need for research which will provide a better understanding of how farmer-managed natural regeneration affects soils, environmental services such as water retention, and the micro-climate. We also need more research on the impact of natural regeneration on farmers’ incomes and behaviour. “It is flabbergasting that there is such a lack of empirical data on how trees such as *Faidherbia* influence crop yields,” says Dennis Garrity. “We know that farmers swear by what they are doing, but we have relatively little data about the impact of farmer-managed natural regeneration.”



To keep up with population growth, farmers will need to double their yields.

There are no specific guidelines for farmers about how to get the most out of natural regeneration. At present, they are 'learning by doing', with some help from development agencies. However, if the practice is to be scaled up across the Sahel, we need to have a better understanding of optimum tree densities and pruning regimes, how the age distribution of trees affects soil health and crop yields, and how to combine natural regeneration with the use of fertilizers to gain maximum yields. "We also need to start looking at how to improve farmer-managed natural regeneration by introducing new species, or by using different combinations of indigenous species," says Garrity.

"Farmer-managed natural regeneration is helping to buy time," says Chris Reij. "It is part of the solution – trees are the pillar for sustainable land use in these drylands – but it is not enough on its own. To keep up with population growth, farmers will need to double their yields in the next 5 to 10 years."

This is only likely to happen if a number of different practices are widely promoted, including farmer-managed natural regeneration, micro-dosing with mineral fertilizers – this alone could help to increase crop yields from 500 to 1000 kg per ha – better water harvesting and the use of improved seeds. The concept of a tree-based approach to Sahelian agricultural development is now gaining momentum. If it can be the basis of sustained support for Niger's rural communities, then the future may be a bit brighter for the next generation.



Plenty to smile about. Women have gained much from farmer-managed natural regeneration.

Endnotes

¹Frank Place and Joachim Nyemeck Binam. Economic impact of farmer-managed natural regeneration in the Sahel: end of project technical report for Free University Amsterdam and IFAD. World Agroforestry Centre, 2013.

²Bayala J et al. 2012. Cereal yield response to conservation agriculture practices in drylands of West Africa: a quantitative synthesis. *Journal of Arid Environments*, 2012.

³Reij C, Tappan G, Smale M. 2009. Agroenvironmental transformation in the Sahel – another kind of ‘Green Revolution’. International Food Policy Research Institute (IFPRI) Discussion Paper 00914.

⁴Haglund E et al. 2010. Assessing the impacts of farmer-managed natural regeneration in the Sahel: a case study of Maradi Region, Niger.

⁵Boffa J-M. 1999. *Agroforestry parklands in Sub-Saharan Africa*. FAO Conservation Guide. Rome: FAO.

⁶<http://africa-regreening.blogspot.co.uk/>

⁷Faye MB et al. 2011. Farmers' preferences for tree functions and species in the West African Sahel. *Forests, Trees and Livelihoods*, Vol 20.

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