WORLD
RESOURCES
INSTITUTE

THE RESTORATION DIAGNOSTIC

Case Example: Maradi and Zinder Regions, Niger

KATHLEEN BUCKINGHAM AND CRAIG HANSON

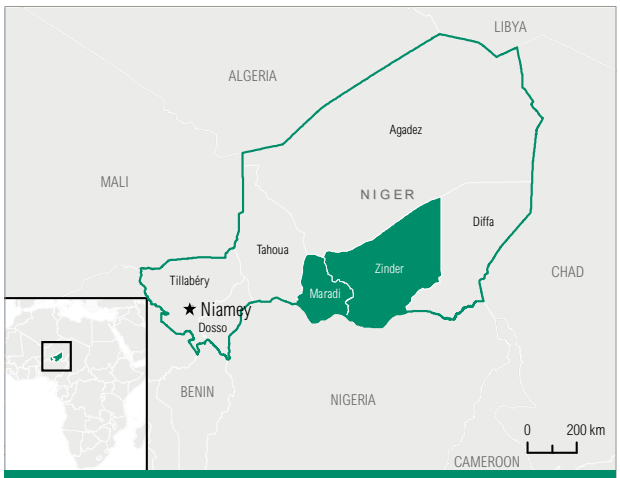
WRI.ORG

CASE EXAMPLE: MARADI AND ZINDER REGIONS, NIGER

SUMMARY

The Maradi and Zinder regions lie in southern Niger. From the late 1960s through the 1980s, these regions—along with the wider Sahel—suffered periodic droughts and crop failures that led to widespread famine and exacerbated rural poverty. The landscape was threatened by severe desertification.

By the mid-1980s, however, the outlook started to change. Many areas in Maradi and Zinder started to undergo restoration into productive agroforestry landscapes. Driving this restoration was a locally driven practice called "farmer-managed natural regeneration" (FMNR), where farmers allow native trees and shrubs to regrow from remnant underground root systems and/or plant new ones amid crop fields. Farmers selectively prune branches to maintain desired densities. The woody perennial plants interact with soils and crops to create an agro-ecological system that improves conditions for crop growth. One particularly popular tree in the region is the native tree *Faidherbia albida*. Its roots fertilize the surrounding soil by fixing nitrogen, which boosts the yields of crops grown near the tree. Its leaves drop during the crop growing season, adding soil organic matter, retaining soil moisture, and preventing competition for sunlight (Winterbottom et al. 2013).



TIME PERIOD: mid-1980s to present

AREA RESTORED: 5 million hectares

TYPE OF RESTORATION: Farmer-managed natural regeneration (FMNR) (Active restoration)


NIGER BEFORE


NIGER AFTER

Since 1985, more than a million rural households in Niger have protected and managed trees in agroforestry landscapes across approximately 5 million hectares in Maradi and Zinder (Winterbottom et al. 2013). These practices have generated a number of benefits in the region, including:

- **Increased food security.** The on-farm natural regeneration of trees has a positive impact on annual cereal production, which is estimated to be in the order of 500,000 tons (Reij et al. 2009).[1] This is enough to feed an additional 2.5 million people (Reij et al. 2009). Many farmers now get more than 500 kg of grain per hectare without using inorganic fertilizers. Some have begun combining agroforestry with micro-dosing, the targeted use of small doses of fertilizer, and they get yields of up to 1,000 kg per hectare (Pye-Smith 2013). Furthermore, microclimate improvement through agroforestry positively impacts crop performance, as trees can buffer weather extremes that affect crop growth (Mbow et al. 2014).

- **Increased household income and diversity of income.** The restored landscapes generate grain, edible leaves, fodder for livestock, and honey. Likewise, farmers can use tree cuttings for construction poles and fuelwood. As a result, many farmers have doubled or tripled their incomes through the sale of these products (WRI 2008). Based on a conservative estimate, gross income in the region has grown by $17–$21 million per year (Haglund et al. 2011). Pye-Smith (2013) found that gross income per capita was $167 for FMNR adopters compared to $122 for non-adopters.

- **Increased resilience.** Farmers with more trees on their farms were better able to cope with the impacts of the 2004–05 (and subsequent) droughts because they were able to sell tree products such as firewood and fodder, which provided them with income to buy grain (Yamba 2005). Furthermore, crops and livestock in an "FMNR landscape" were more likely to fare better in drought than those in a treeless landscape (Rinaudo, T. 2014. pers. comm., 8 July).

- **Improved benefits for women.** The restored landscape reduced the burden on women for fuelwood gathering. In the early 1980s, it took women in the Zinder region about 2.5 hours/day to collect firewood; now, it takes them only about 0.5 hour/day (Larwanou et al. 2006).

- **Improved natural environment.** The landscape now has 200 million more on-farm trees than it did a few decades ago (Reij et al. 2009). In some areas, *Faidherbida albida* is the dominant species, but elsewhere native tree diversity has rebounded (WRI 2008). In addition, restoration contributed to climate change mitigation with the sequestration of an estimated 25 million tons of carbon over the 5 million hectares during the past two decades. This is based on an average of 5 tons of carbon sequestered per hectare. The quantity of carbon sequestered is likely to increase over the years as farmers continue to protect on-farm trees, which are growing in size (Reij, C. 2014. pers. comm., 16 December).

WHICH FEATURES AND KEY SUCCESS FACTORS WERE EXHIBITED?

The Maradi and Zinder experience exhibited a number of the features and key success factors of forest landscape restoration.

Motivate

Farmers became motivated to engage in farmer-managed natural regeneration due to several factors:

- **CRISIS EVENTS.** Maradi and Zinder experienced periods of food insecurity during the 1970s and 1980s, with acute famine occurring in 1984 and 1988 due to crop failures (WRI 2008). Several factors contributed to these crisis events. One factor was rapid population growth. Another was poor soil quality. Contributing to the latter was the fact that much of the region's natural vegetation had been cleared, thereby removing sources of organic matter and nutrients, reducing the soil's moisture retention capacity, and exposing the land to erosion from wind and rain. The French colonial government had encouraged Nigerien farmers to clear their land of trees—mimicking the dominant farm field model in Europe—in order to grow crops for export (WRI 2008). By 1975, most of the natural woodlands of Maradi and Zinder had been converted to farm fields. A third factor was drought. A major drought event from 1969 to 1973 affected 50 million people across the Sahel, including the Maradi and Zinder regions. The decline in tree cover led to an increased susceptibility to droughts (Sendzimir et al. 2011).

- **BENEFITS.** Restoration into agroforestry systems was expected to provide a number of economic, social, and environmental benefits—and it did. Economically and socially, it improved food security, household income diversity, land values, and the well-being of women. Furthermore, farmer-managed natural regeneration made economic sense and was a cost-effective approach to restoring degraded land. Input costs are negligible and the labor is freely provided by land managers. In contrast, intensive tree planting programs sponsored by international development programs over a dozen years in the 1970s and early 1980s cost $1,000 per hectare to plant and maintain. Yet less than half of the 60 million trees planted survived (WRI 2008). Environmentally, restoration has improved soil health, available water, carbon sequestration, and biodiversity (WRI 2008).

- **AWARENESS.** The benefits of restoration were publicly communicated to farmers in the region by fellow farmers and by nongovernmental development organizations (WRI 2008). In particular, nongovernmental organizations pursued a proactive, concerted promotion campaign using volunteers, extension agents, field visits, training sessions, competitions, and later on radio, from 1984 until 1999 (Rinaudo, T. 2014. pers. comm., 8 July). Special mention should be made of the key role played by a project funded since 2002 by the International Fund for Agricultural Development (IFAD) in the Aguié district of the Maradi Region, which expanded in 2010 to cover most of the region. This project promoted FMNR practices and was a leader in developing village and inter-village institutions for the protection and management of on-farm trees. The village of Dan Saga evolved into a model site and has widely shared its experience, which has inspired others to replicate the model (Reij, C. 2014. pers. comm., 16 December).

Enable

Many enabling conditions were in place that facilitated restoration in Maradi and Zinder, namely:

- **ECOLOGICAL CONDITIONS.** Source populations of native trees and shrubs were present in the form of underground root systems, and soil seed banks that had survived over the years. Once pressures such as trimming the vegetation at their base or grazing disappeared, sprouts emerged from the roots (WRI 2008). Likewise, dedicated corridors prevented livestock from eating or trampling the young trees and crops, enabling restoration to occur unimpeded (Gray et al. 2014). The greatest gain for restoration was protection from free range animals for at least half the year, particularly during the vulnerable first year of growth (Rinaudo, T. 2014. pers. comm., 8 July).

- **POLICY CONDITIONS.** One of the most important success factors in Maradi and Zinder was the emergence of more clear and secure rights to land and trees for farmers. Prior to the 1980s, trees and any products from trees—such as wood and seed pods—belonged to the state. But in 1982, the government of Niger started a process of exploring reforms to rural land and natural resource tenure. This process led to the creation of a Rural Code in 1989 that was adopted as a framework ordinance in 1993 (Stickler 2012). The reformed code clarified and strengthened local rights to protect, manage, harvest, and benefit from on-farm trees (Winterbottom 2011). In 2004, the Forest Code formally recognized customary rights within forest reserves and customary rights to use forest resources located in areas held by local communities. Interestingly, by the mid-1980s, the expectation of tenure reforms, a weakened national government, and pilot project experience (Mamalo and Pennec 2010) triggered the start of on-farm tree regeneration even before the tenure reforms became official (Larwanou et al. 2006). What happened was that people acted on the perception that the trees belonged (or would belong) to them (Rinaudo, T. 2014. pers. comm., 8 July).

- **SOCIAL CONDITIONS.** The changes to the Rural Code further empowered farmers to make their own decisions about how trees on their land were managed. Furthermore, it ensured that the variety of food and livelihood benefits from the restored agroforestry landscape accrued to local farmers and villages. In addition, benefits accrued not only to male farmers, but also to women and nomadic herders through reducing time needed for collecting firewood and providing alternative incomes through non-timber forest products (WRI 2008).

- **INSTITUTIONAL CONDITIONS.** Village community groups provided a means of effective institutional coordination, creating and enforcing rules governing tree pruning, livestock management, and other practices. These groups provided an institutional structure for peer-to-peer learning of farmer-managed natural regeneration techniques (WRI 2008). They also created demarcated livestock corridors, which have protected farmers' crops and trees, safeguarded grazing and water access areas for herders, and resolved conflicts through agreed-upon dispute resolution mechanisms (Gray et al. 2014). Another move that clarified institutional roles was that the reformed Rural Code redefined forestry officers as extension agents (WRI 2008) instead of forest police.

Implement

Capacity and resources were in place to facilitate restoration in Maradi and Zinder, including:

- **LEADERSHIP.** Since the early 1980s, a number of champions of restoration in the region emerged. National champions included Mr. Guero Chaïbou, director of the earlier-mentioned IFAD-funded project; Dr. Mahamane Larwanou, a Nigerien agroforester now working for the African Forest Forum; and Dr. Abasse Tougiani, an agroforestry specialist from the National Agricultural Research Institute (INRAN) (Reij, C. 2014. pers. comm., 16 December). An important international champion was Australian agronomist Tony Rinaudo who pioneered farmer-managed natural regeneration. His leadership and passion were adopted and sustained by nongovernmental organizations such as Serving in Mission, World Vision, and others (WRI 2008).

- **KNOWLEDGE.** Restoration "know-how," particularly farmer-managed natural regeneration, existed in the region and was spread primarily via farmer-to-farmer engagement (WRI 2008).

- **TECHNICAL DESIGN.** Restoration into agroforestry landscapes leveraged traditional, proven techniques such as farmer-managed natural regeneration, water harvesting, and planting windbreaks for soil and water conservation (Larwanou and Saadou 2011).

- **FINANCE AND INCENTIVES.** Funding emerged to support restoration. For instance, in the 1990s, the U.S. Agency for International Development (USAID) provided to the government of Niger $20 million in transfer payments tied to satisfaction of policy conditionalities, including Forest Code reforms, land tenure policy reforms, and decentralization of natural resource management. USAID granted another $8 million to finance external assistance that provided technical advice, training, and research to the government of Niger to help it meet the conditionalities (WRI 2008). Between 2005 and 2013, IFAD and its cofunders invested about $31 million in the Aguié district, but only part of this was for restoration (IFAD 2011). External donor funds also helped support nongovernmental organizations in providing communication and outreach about the tenure reforms, as well as in providing visits and peer-to-peer training on farmer-managed natural regeneration techniques.

LOOKING FORWARD

The experience of the Maradi and Zinder regions is often hailed as a very successful example of forest landscape restoration, particularly of agroforestry landscapes (WRI 2008, Searchinger et al. 2013). But aspects of two features are worthy to note:

- **FEEDBACK.** The discovery of the scale of farmer-managed natural regeneration in southern Niger started in 2004. This led to a study that involved the U.S. Geological Survey using aerial photos and high resolution satellite images to identify long-term trends in agriculture and the environment across Niger, which also looked at the scale of FMNR (CRESA 2006). In 2006 the scale was estimated to be 3 million hectares (Tappan 2007). More detailed studies in 2009 showed a scale of 5 million hectares (Reij et al. 2009). The scale of FMNR was discovered gradually and late because of a lack of project monitoring. Although using remote sensing to monitor forest landscape restoration can be difficult where tree densities are low and a dense canopy does not form, other forms of monitoring are possible. Ground-based monitoring by nongovernmental organizations and farmers is used in Tanzania, for instance. Putting in place some form of monitoring system could play an important role in the long-term sustainability of restoration in these two regions, and inspire others across the Sahel. Monitoring provides a baseline, can attract greater donor support through providing greater evidence of impact, as well as encourage others to adopt approaches that are clearly gaining support.
- **MARKET CONDITIONS.** Restoration in Maradi and Zinder yielded much-needed food, but pressure to use these landscapes for food production will continue to grow. In 2008, the population of Maradi was around 2.8 million; it is projected to double in about 20 years (Pye-Smith 2013). Niger maintains one of the highest birthrates in the world at seven children per woman (World Bank 2013). To ensure the local people can sustain existing levels of food self-sufficiency, yields from these restored areas will need to increase commensurately or additional degraded areas will need to be restored into agroforestry systems (Pye-Smith 2013).

REFERENCES

Abdou, I. 2013. "Desertification control in Niger: The Medium Term Action Plan 2006-2011." In G. Ali Heshmati and V.R. Squires, eds. *Combating Desertification in Asia, Africa and the Middle East: Proven Practices*. Dordrecht: Springer Science and Business.

Abdoulaye, T., and G. Ibro. 2006. Analyse des impacts socio-économiques des investissements dans la gestion des ressources naturelles: Étude de cas dans les régions de maradi, tahoua et tillabéry au niger. Etude Sahélienne. Niamey, Niger: CRESA.

Centre Regional D'enseignement Specialise En Agriculture (CRESA). 2006. Impacts des investissements dans la gestion des ressources naturelles (GRN) au Niger: Rapport de synthese; Niamey, Niger: CRESA. Accessible at: <http://www.cilss.bf/IMG/pdf/etudesahelrapportNE.pdf>.

Gray, E., N. Henninger, C. Reij, and R. Winterbottom. 2014. "Integrated Landscape Management for Enhancing Resilience in African Drylands: Review and Assessment." Background Paper for the Economics of Dryland Resilience in Sub-Saharan Africa. Draft March 2, 2014. Washington, DC: World Resources Institute.

Haglund, E., J. Ndjeunga, L. Snook, and D. Pasternak. 2011. "Dry land tree management for improved household livelihoods: Farmer managed natural regeneration in Niger." *Journal of Environmental Management* 92: 1696–1705.

IFAD (International Fund for Agricultural Development). 2011. "Proposed loan to the Republic of Niger for the Food Security and Development Support Project in the Maradi Region (PASADEM)." Accessible at: <http://operations.ifad.org/web/ifad/operations/country/project/tags/niger/1625/project_overview>.

Larwanou, M., and M. Saadou. 2011. "The role of human interventions in tree dynamics and environmental rehabilitation in the Sahel zone of Niger." *Journal of Arid Environments* 75: 194–200.

Larwanou,M., M. Abdoulaye, and C. Reij. 2006. "Etude de la Régénération Naturelle Assistée dans la Région de Zinger (Niger): Une Première Exploration d'un Phénomène Spectaculaire." Comite Permanent Inter-Etats de Lutte Contre La Sécheresse dans le Sahel. Accessible at: <http://www.frameweb.org/ev_en.php?ID=17529_201&ID2=DO_TOPIC>.

Mamalo, A.K., and J. Pennec. 2010. "Rural Code of Niger: a decentralized and coordinated land management program." Accessible at: <http://www.inter-reseaux.org/mot/niger?lang=fr> (accessed 04/01/2014).

Mbow, C., P. Smith, D. Skole, L. Duguma, and M. Bustamante. 2014. "Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa." *Current Opinion in Environmental Sustainability* (6): 8–14.

Place, F., and D. Garrity. 2014. "Tree-based systems to increase resilience in drylands." Background paper to the Economics of Drylands. Washington, DC: World Resources Institute.

Pye-Smith, C. 2013. "The Quiet Revolution: How Niger's farmers are re-greening the parklands of the Sahel." ICRAF Trees for Change no.12. Nairobi: World Agroforestry Centre.

Reij, C., G. Tappan, and M. Smale. 2009. "Agro-environmental transformation in the Sahel: another kind of 'Green Revolution'." IFPRI Discussion Paper 00914. Washington, DC: International Food Policy Research Institute.

Searchinger, T., C. Hanson, J. Ranganathan, B. Lipinski,R. Waite, R. Winterbottom, A.Dinshaw, and R. Heimlich. 2013. *Creating a Sustainable Food Future: Interim Findings*. Washington, DC: World Resources Institute.

Sendzimir, J., C.P. Reij, and P. Magnuszewski. 2011. "Rebuilding Resilience in the Sahel: Regreening in the Maradi and Zinder Regions of Niger." *Ecology and Society* 16 (3): 1. Accessible at: <http://www.ecologyandsociety.org/vol16/iss3/art1/>.

Stickler, M. 2012. "Rights to Trees and Livelihoods in Niger." *Focus on Land in Africa*. Accessible at: <http://www.focusonland.com/countries/rights-to-trees-and-livelihoods-in-niger/>

Tappan, G. 2007. "RE: Extent of Natural Regeneration in Niger." FRAME web site post, July 12. Washington, DC: FRAME Community, United States Agency for International Development. Accessible at: <http://www.frameweb.org/ev_en.php?ID=52653_201&ID2=DO_DISCUSSIONPOST_LIST>.

Winterbottom, R. 2011. "USAID's legacy in agriculture: integrating natural resources management into agricultural practices and livelihoods." Final draft May 31. Washington, DC: World Resources Institute

Winterbottom R., C. Reij, D. Garrity, J. Glover, D. Hellums, M. McGahuey, and S. Scherr. 2013. "Improving Land and Water Management." World Resources Institute Working Paper. Washington, DC: WRI.

World Bank. 2013. "The World Bank Databank; Fertility rate, total (births per woman)". Accessible at: <http://data.worldbank.org/indicator/SP.DYN.TFRT.IN >

WRI (World Resources Institute). 2008. *World Resources 2008: Roots of Resilience—Growing the Wealth of the Poor*. Washington, DC: World Resources Institute.

Yamba, B., M. Larwanou, A. Hassane, and C. Reij. 2005. "Niger study: Sahel pilot study report." Washington DC: *U.S. Agency for International Development and International Resources Group*

ENDNOTES

1 Based on an average yield of 100kg/ha/year on 5 million hectares of land.

ACKNOWLEDGMENTS

WRI thanks the following for reviewing and giving helpful suggestions for improving this case study:

Rasmus Klocker Larsen (SEI), Cheikh Mbow (CGIAR), Tony Rinaudo (World Vision), Chris Reij (WRI), and Juan-Carlos Altamirano (WRI)

ABOUT THE AUTHORS

Kathleen Buckingham is a Research Associate for the Global Restoration Initiative in the Forests Program at WRI.

Contact: kbuckingham@wri.org

Craig Hanson is the Global Director of the Food, Forests & Water Programs at WRI.

Contact: chanson@wri.org

ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

PHOTO CREDITS

pg. 2 left and right, Chris Reij

Each World Resources Institute report represents a timely, scholarly treatment of a subject of public concern. WRI takes responsibility for choosing the study topics and guaranteeing its authors and researchers freedom of inquiry. It also solicits and responds to the guidance of advisory panels and expert reviewers. Unless otherwise stated, however, all the interpretation and findings set forth in WRI publications are those of the authors.

creative commons

Copyright 2015 World Resources Institute. This work is licensed under the Creative Commons Attribution 4.0 International License.
To view a copy of the license, visit http://creativecommons.org/licenses/by/4.0/

WORLD
RESOURCES
INSTITUTE

10 G STREET NE
SUITE 800
WASHINGTON, DC 20002, USA
+1 (202) 729-7600
WWW.WRI.ORG