Restoration of agricultural landscapes and dry forests in Senegal

Gray Tappan, Mike McGahuey & Robert Winterbottom

This article was submitted for inclusion in the forthcoming edition of ETFRN News 60 - Restoring African drylands, due for release in December 2020

"Decentralized, community-led initiatives lead to positive and sustainable outcomes — massive investments are not needed."

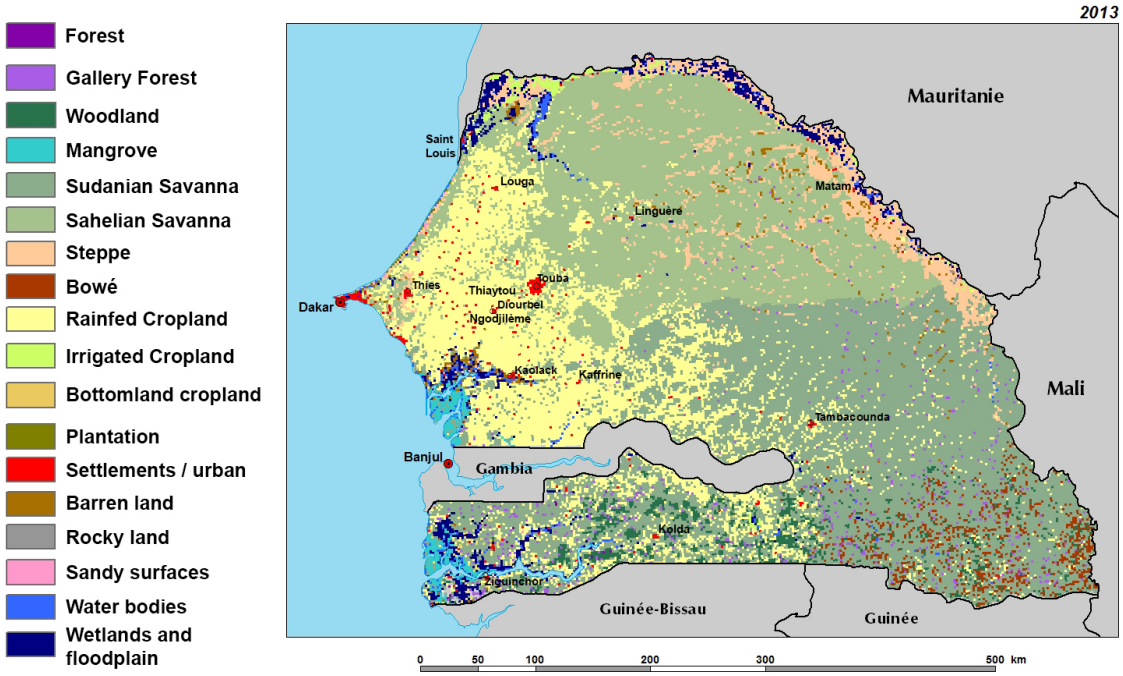
Introduction

Senegal — like all the countries of the Sahel — presents a vivid picture of changing landscapes that reveal the interdependence and interactions between the country's people and the land that sustains them. A five-fold growth in the population since 1960 has driven a dramatic loss of savanna, woodlands and forests. This can be seen in the extent and complexity of changes in land use and land cover (LULC) through aerial and satellite photography from the 1950s and 1960s, and studies integrating time-series imagery with ground-based monitoring (Tappan et al. 2004; CILSS 2016).

Senegal is known for its landscape diversity, from the semi-arid open savannas and steppes in the north, typical of the Sahel, to wooded savannas, woodlands, forests and wetlands in the southern Sudanian and Sudano-Guinean zones. Superimposed on this are agricultural regions, including the large "Peanut Basin," where high population density and farming activities have completely replaced the original wooded savannas.

The most striking change over the past decades has been the expansion of cropland into central and southern Senegal (Tappan et al. 2004). In a recent mapping exercise (CILSS 2016), trends in LULC classes using 40 years of Landsat imagery showed that cropland expanded by 26% between 1975 and 2013, including into protected areas and on plateaus and terraces with soils once considered too marginal for growing crops (Figure 1). The expansion has also resulted in the fragmentation of savannas and woodlands, replacing contiguous expanses of natural habitat with a mosaic of crop fields and woodlands. During the

Figure 1. Land use and land cover in Senegal, 2013. *Based on visual analysis of Landsat images and extensive field observations. Source: Tappan et al. (2016).*



Aerial view of *Faidherbia albida* among rainfed cropland at the end of the rainy season, with their white, leafless canopies. Photo: Gray Tappan

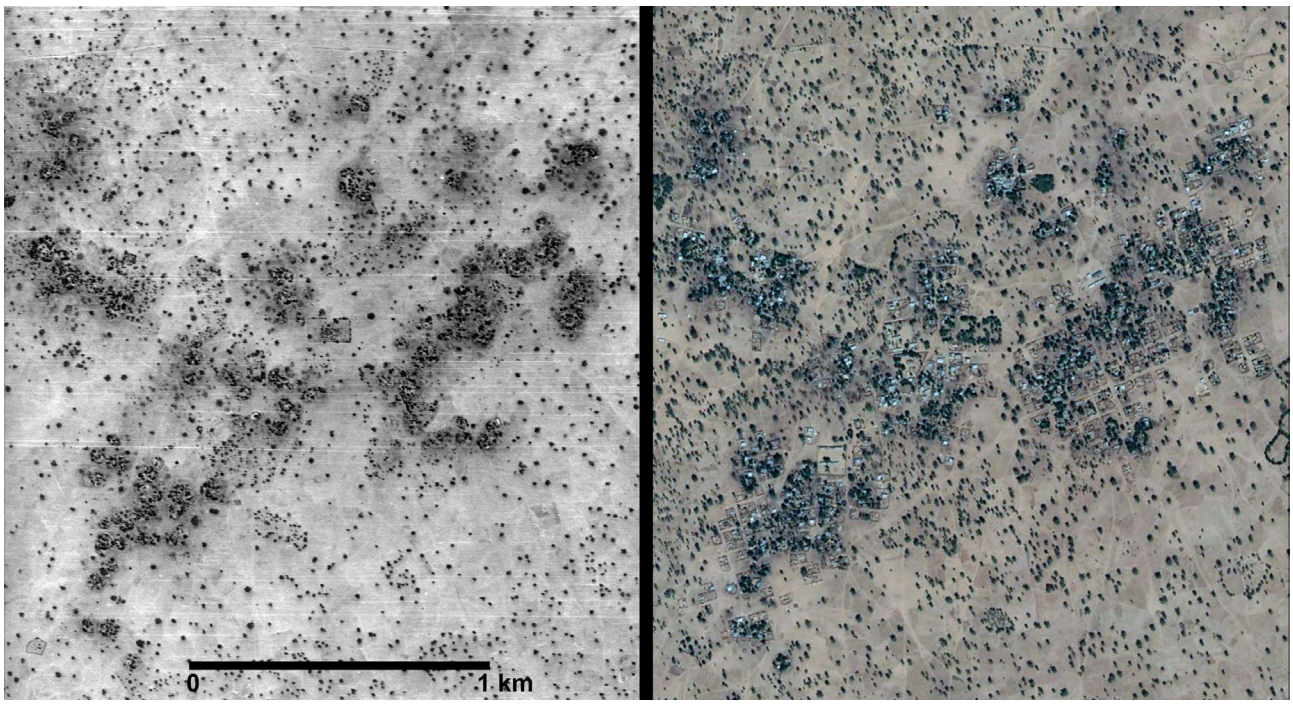
same 38-year period, woodlands decreased by 42%, due to cropland expansion and to uncontrolled timber and charcoal extraction, livestock grazing and frequent bush fires. The decrease was also influenced by misguided agricultural development policies, weaknesses in implementing decentralisation policies, and outdated forestry practices (Faye and Ribot 2017).

But despite these changes in land cover, important and sustained local initiatives have protected the remaining forests, assisted natural regeneration on agricultural fields, controlled bush fires, and promoted the sustainable harvesting of natural products. These efforts have helped to restore landscapes while improving farmers' livelihoods and strengthening their resiliency. Scaling up of such practices requires an understanding of the key enabling factors and critical interventions.

Regeneration of agroforestry parklands

The Peanut Basin of west-central Senegal is centred on former Wolof kingdoms, with enclaves of Serer communities. It was named after the introduction of peanut crops by the French in the early 1900s and is the most fundamentally altered region in the country (Tappan et al. 2004). By the 1980s, the pressure on land led to a major decline in the use of fallows, grazing land decreased to a minimum, and continuous cultivation replaced nearly all natural vegetation, which once comprised parklands dominated by *Acacia raddiana* in the north and *Faidherbia albida* elsewhere.

Despite the high rural population density and resource degradation, local farming systems have protected natural resources and generated substantial improvements to the land. These include increases in tree cover in cropland and grazing areas that resemble the integrated agro-silvopastoral systems that were found in the region 50 years ago. A participatory study of two farming communities near Bambey used remote sensing to provide high-resolution time-series images to map land use and land cover (Tschakert and Tappan 2004). Ngodjilème a Serer village, and Thiaytou a Wolof village, were selected for more detailed assessments. In both communities, rainfed agriculture is an important source of income, primarily from the cultivation of millet, peanut, sorghum and cowpea (Tschakert and Tappan 2004).

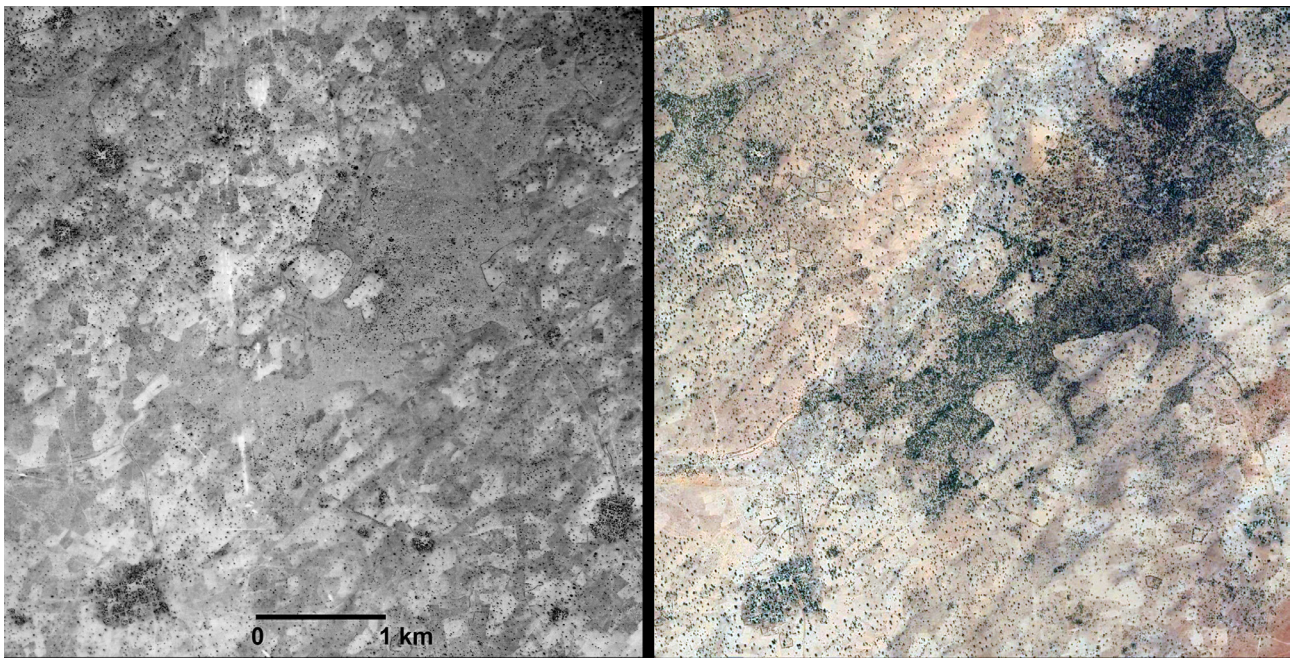


Comparison of the Serer village of Ngodjilème and surrounding cropland based on the same field of view in March 1989 (left) and February 2019 (right). Sources: JICA, and Maxar Technologies with Google Earth.

In both villages, farmers engage in the protection of mature trees in the fields; these were dominated by *Faidherbia albida* in association with several other species (Stancioff et al. 1986). This species has many ecological and economic advantages: trees lose their leaves in the rainy season and fix nitrogen, providing Sahelian farming systems with a major source of nutrients (Charreau 1974); and they act as windbreaks in the dry season. Economically, this land-use system can increase millet yields by 30 to 50% or more, while providing an important source of fuelwood, poles and fodder (Felker 1976).

Time-series remote-sensing imagery assessed changes in land resources and farming systems. The study used aerial photography from March 1989 and satellite imagery from February 2019 for Ngodjilème and from March 2020 for Thiaytou. Although the 1989 photograph was film-based, the image resolution from both sources is similar, at approximately 2 metres, facilitating direct comparison.

Ngodjilème is a typical Serer village, with dispersed groups of homesteads separated by fields of farmed parklands. Driven by rapid population growth, it has expanded 240% in 30 years. In the images below, trees are seen as dark spots. Overall field tree density was at a low point in 1989, having decreased slightly relative to a 1968 satellite photograph which showed an average cover of 4.3% (Tschakert and Tappan 2004), following severe droughts in the 1970s and 1980s (Lericollais 1987). After 1989 tree cover and density almost doubled — from 4.1% in 1989 to 7.7% in 2019 — and this increase was not limited to fields immediately around the village. To document changes in land resources, Tappan et al. (2000) took time-series landscape photographs at dozens of ground sites in the Peanut Basin. The photographs showed that while some mortality occurred following the 1982-84 drought, tree cover among mature trees remained relatively stable into the late 1990s. They also observed that natural regeneration of field trees was very low during the drought years but increased in the wetter years that followed. While better rainfall contributed to the regeneration of trees, the ultimate fate of small regenerating trees and the increase in tree cover had more to do with active protection by farmers. This is consistent with the indigenous and adaptive intensification that Serer farmers adopted decades ago to fight the degradation of land and resources. The practice includes the



Comparison of cropland and communal grazing land around Thiaytou village (bottom left of photo) in March 1989 (left) and March 2020 (right); vegetation in the commons improving from degraded open shrub savanna to dense wooded savanna. Sources: JICA, and Maxar Technologies with Google Earth.

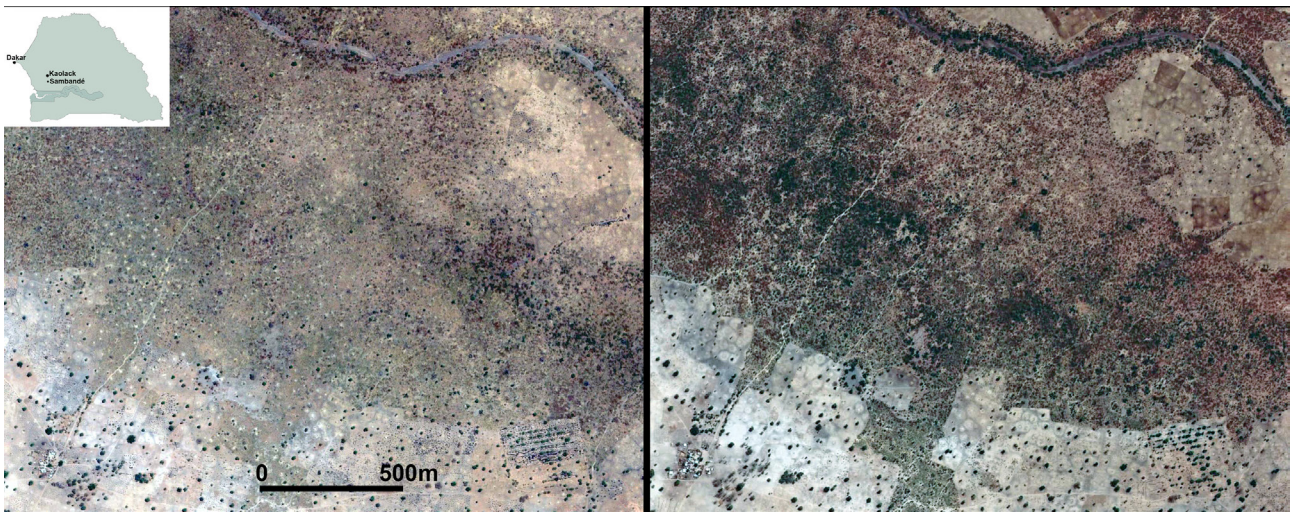
integration of agriculture, tree protection and regeneration, and animal husbandry (Garin et al. 1990; Lericollais and Faye 1994; Tschakert and Tappan 2004).

A similar increase was observed around the Wolof village of Thiaytou over approximately the same period. The photograph from March 2020 (right) shows the integration of livestock, with a well-maintained livestock corridor providing access from the village to grazing land in the northeast. It is clear that the village has not grown much in size over 31 years; this is due to substantial rural-to-urban youth migration. Important differences shown in the two images include the almost total loss of short-term fallow and the doubling in tree cover from 1.9% in 1989 to 4.0% in 2020, indicating that farmers have given considerable importance to the protection and management of field trees, particularly *Faidherbia albida*. But the most striking change is local protection and tree regeneration in community grazing lands (centre and upper right of the 2020 photo). This area has been transformed from degraded open shrub savanna to a dense wooded savanna with 61% woody cover, equivalent to the woodlands of Senegal's southern regions.

Managing agroforest parklands and the results from protecting trees on cropland can be seen in hundreds of other villages throughout the Peanut Basin and beyond. The historical record of high-resolution satellite photography from 1968, aerial photography from the 1970s to the 1990s, and the excellent detailed satellite record in the last two decades clearly show the progress being made by local people in improving and diversifying the resource base. The villages of Ngodjilème and Thiaytou are just two examples of successes in managing agroforestry parklands and the results from protecting trees on cropland.

Successful community-based forest restoration in Sambandé

Around 2000, the 1,050-hectare Sambandé forest in Kaolack Region was being degraded by recurring brush fires, illegal fuelwood cutting, agricultural encroachment, and excessive pruning by migrating herders. The 1996 Decentralization Law gave authority to manage the forest to the local Keur Baka commune, but the commune members lacked the financial resources and institutions to develop and implement an effective management plan (M.L. Bodian, pers. comm., 2020). But since then and as a result of two GTZ



Time-series images of Sambandé forest (2003 left; 2020 right), revealing the impacts of the sustained-yield management plan developed and implemented by local community-based organisations. Sources: Maxar Technologies with Google Earth.

(German Agency for Technical Cooperation)-led projects, the development and implementation of sustained-yield management plans have restored much of the forest. By 2020, the forest had become well-wooded and productive. New revenue streams from the sale of charcoal, firewood and tree fruits improved the well-being and resilience of surrounding populations and paid for Sambandé's management.

What made the difference? Most importantly, the people in the surrounding area treated the Sambandé forest as their property, managed it responsibly and considered it their savings bank. For risk-averse farmers, this change in attitude required evidence that community-based forest management was viable for both the community and the forest. The process was initiated in 1999 when one of the GTZ projects helped the surrounding villages to develop and negotiate a local convention that provided a framework of regulations and allowed management rights to be transferred from communes to villages (M.L. Bodian, pers. comm., 2020).

Within this framework, projects helped communities establish a simple, protected area management plan aimed at restoring the degraded forest and supported by an inter-village platform called the *cadre d'animation et de concertation* (Robinson 2011). The initial plan limited forest use to residents of the nine surrounding villages, prohibiting the cutting of green wood but allowing the gathering of deadfall (for domestic use only), and allowing tree fruit to be sold. Residents who violated the rules or outsiders who gathered any forest products would be fined, and the village group organized guards to patrol the forest and escort violators to village authorities.

Within a couple of years, villagers saw that the forest protection plan they themselves had adopted and enforced produced evidence that the approach was working; areas once bare were now covered with trees, some several metres tall. The Decentralization Law was beginning to work for the community. As stated by Robinson (2011 p. 39) about the implementation of protected area plans in the Kaolack region, "For the first time, villagers asserted that they 'owned' uncultivated land and prosecuted residents of other villages who used the trees occurring there."

Through a further (GTZ) project, in partnership with a national programme and the Sambandé community, a forest management plan was prepared, technically validated by the Senegal Forest Service and approved by local government. The plan, which is still operational today, was oriented to revenue generation and sustainable yield and included the commercialisation of charcoal and firewood as well as tree fruit. In addition to providing technical assistance, the project strengthened local institutions to manage the forest, and

helped transform the original platform into an Inter-Village Committee.

The relationship between the Sambandé community and Forest Service staff changed, from one of suspicion and adversity to a true partnership. Over time, both the Forest Service and local communities found that collaboration was more effective in achieving their respective objectives. Some foresters deviated from procedures in positive ways that provided support and legitimacy to local regulatory authorities, and Forest Service administrators admitted candidly that while community regulators rarely followed procedures, they were more effective than Forest Service agents alone (Robinson 2011). Sambandé provided proof of how communities and the State can collaborate to restore natural forests and improve rural livelihoods.

The Sambandé outcomes strongly affirm a foundational premise of the Decentralized Law of 1996 and the Forest Code Reforms of 1998: when people feel secure about their ownership of something of value, they will care for it and invest in it. The evidence also affirms that when rural populations invest in the care of a forest, Forest Service agents can spend less time policing and more time using their forest management skills to assist rural populations in managing their forests, thereby ensuring forest sustainability.

By paying their taxes, investing local resources in managing the forest and improving the livelihoods and general welfare of local people, villagers around Sambandé proved their autonomy, particularly in the past 5 years when they operated without project support. Sambandé's experiences point the way to supporting sustainable, community-managed forests.

Conclusions

In the above initiatives, self-motivated populations increased food security and reduced vulnerabilities to climatic shocks by restoring and sustainably managing local forest resources. To regenerate agroforestry parklands, farmers built on traditional systems to increase on-farm tree density and convert degraded lands to densely wooded savannas. These actions increased crop yields and produced new sources of livestock browse. The population of Sambandé restored the local forest and managed it to sustainably produce fuel and fruit. The agroforestry parklands were restored without a project. Modest project support helped the Sambandé community to establish local institutions that set and enforced rules that applied sound forest management practices and strengthened targeted value chains. Project assistance was phased out when the community's capacity was sufficiently strong to manage the forest sustainably.

The sustained achievements from the locally managed initiatives described above lie in stark contrast to the poor track record of longer-term impacts from many large, centrally controlled projects that focus more on infrastructure than on capacity building. While the Sambandé projects built the community's capacity to exercise choices when managing forest resources and enterprises, centrally controlled projects often make critical decisions in the place of the ultimate beneficiaries, weakening the sense of local ownership and increasing the chance that forest management will not continue after the end of project.

The time and effort needed to scale up these successes have been much reduced by taking stock of what has worked. This includes identifying the changes that led to success, such as the transfer of rights and responsibilities, use of appropriate technologies, greater roles for local populations in developing forest value chains, and identifying the steps that established those changes, e.g., training, peer-to-peer visits, and policy modifications.

References

Charreau, C. 1974. S*oils and tropical dry and dry–wet climate areas of West Africa and their use and management*. Department of Agronomy, Cornell University.

CILSS (Comité Inter-états de Lutte contre la Sécheresse dans le Sahel). 2016. *Landscapes of West Africa: A window on a changing world*. U.S. Geological Survey EROS Center, Garretson, South Dakota, U.S.

Faye, P. and J. Ribot. 2017. "Causes for adaptation: access to forests, markets, and representation in eastern Senegal." *Sustainability* 9(311).

Felker, P. 1976. *State of the art: Acacia albida as a complementary permanent intercrop with annual crops*. University of California Riverside, U.S. 133 pp.

Garin, P., A. Faye, A. Lericollais and M. Sissokho. 1990. "Evolution du rôle du bétail dans la gestion de la fertilité des terroirs sereer au Sénégal." *Les Cahiers de la Recherche Développement* 26:65–84.

Lericollais, A. 1987. *La mort des arbres a Sob, en pays sereer (Sénégal)*. ORSTOM, Dakar, Senegal.

Lericollais, A. and A. Faye. 1994. Les troupeaux sans pâturages en pays sereer au Sénégal. In: Blanc-Pamard, C. and J. Boutrais (eds.), *Dynamique des Systèmes Agraires: A la croisée des parcours*. ORSTOM, Paris, pp. 165–196.

Robinson, E.S. 2011. *Trading solidarity for environmentality: subject formation and intimate government of forests in Kaolack Region, Senegal*. MA thesis, University of Illinois, Urbana-Champaign, U.S.

Stancioff, A., M. Staljanssens and G. Tappan. 1986. *Mapping and remote sensing of the resources of the Republic of Senegal: A study of the geology, hydrology, soils, vegetation and land-use potential*. Remote Sensing Institute, South Dakota State University. 653 pp.

Tappan, G., M. Cushing, S. Cotillon, M. Mathis, J. Hutchinson, S. Herrmann and K. Dalsted. 2016. *West Africa land use land cover time series*. U.S. Geological Survey data release.

Tappan, G., M. Sall, E. Wood and M. Cushing. 2004. "Ecoregions and land cover trends in Senegal." *Journal of Arid Environments* 59:427–462.

Tappan, G., E. Wood, A. Hadj, R. Lietzow, M. Sall. 2000. "*Monitoring climate and human impacts on the vegetation resources of Senegal: drought, agricultural expansion, and natural resource management*." U.S. Geological Survey EROS Data Center, Sioux Falls, SD., Unpublished Report.

Tschakert, P. and G. Tappan. 2004. "The social context of carbon sequestration: considerations from a multi-scale environmental history of the old peanut basin of Senegal." *Journal of Arid Environments* 59:535–564.

This article was submitted for inclusion in the forthcoming edition of ETFRN News 60 - Restoring African drylands, due for release in December 2020, containing 25 articles plus interviews and boxes describing farmer-led, NGO, private sector, government and international initiatives. These highlight the roles of varied policies and stakeholder interests, and identify opportunities to encourage smallholder and community participation in scaling out successes and meeting national, regional and global commitments.

This article may undergo further editing prior to publication of the complete edition, and as such, could differ from the version presented here.

Published by: Tropenbos International, Wageningen, the Netherlands

Issue date: October, 2020

Authors: **Gray Tappan,** *Geographer, US Geological Survey, EROS Center, Sioux Falls, USA*
Mike McGahuey, *Fellow, Global Evergreening Alliance, Arlington, Virginia, USA*
Robert Winterbottom, *Fellow, Global Evergreening Alliance; Stoddard, New Hampshire, USA*

Editors: Nick Pasiecznik and Chris Reij
Copy-editing: Patricia Halladay

Cover photo: A Senegalese farmer explaining the benefits from protecting and managing *Faidherbia albida* trees in his field. Photo: R. Winterbottom

ETFRN
c/o Tropenbos International
P .O. Box 232,
6700 AE Wageningen,
the Netherlands
etfrn@etfrn.org
www.etfrn.org