Land Use Change and Climate-Smart Agriculture in the Sahel since 1975

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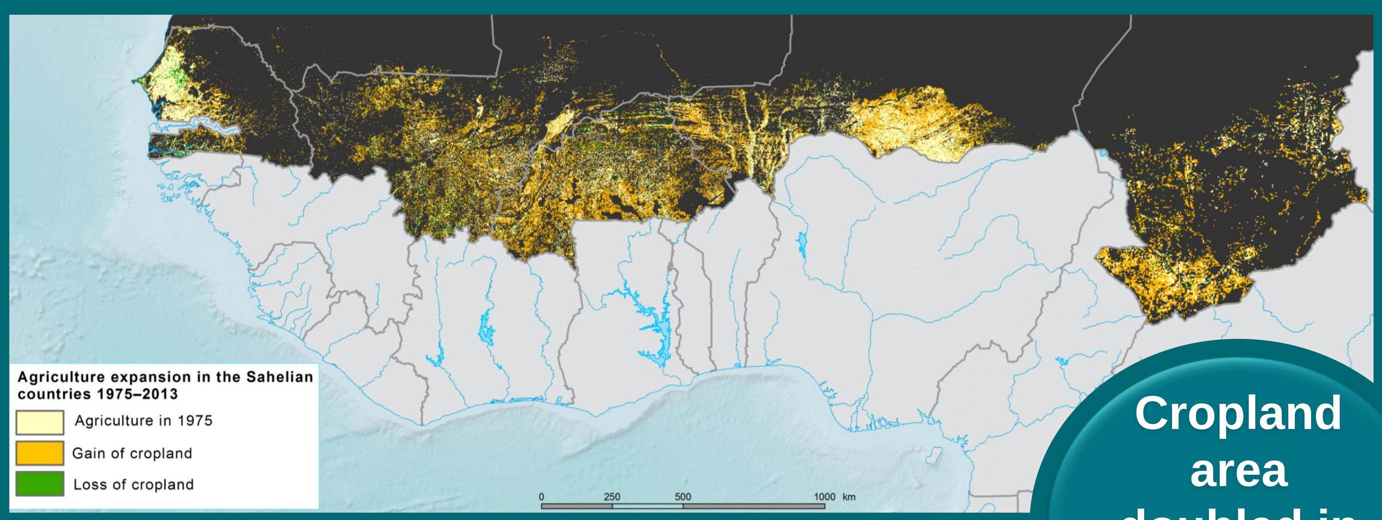
The transformation of the Sahelian agriculture

For the past 40 years, major shifts in land use have occurred in the Sahel. Fueled by high population growth and a growing demand for food, agricultural expansion accounts for most land cover change across the subregion. In many areas, the land under cultivation has expanded substantially mainly by destroying or depleting the natural vegetation. Agriculture expanded into most of the suitable soils that were occupied by the natural Sahelian savanna and cut into the traditional pastoral areas of northern Senegal, Mali, Niger, and Chad. Niger's vast south-central agricultural zone, already heavily cultivated in 1975, became fully saturated with cropland and expanded eastward into the pastoral zone.

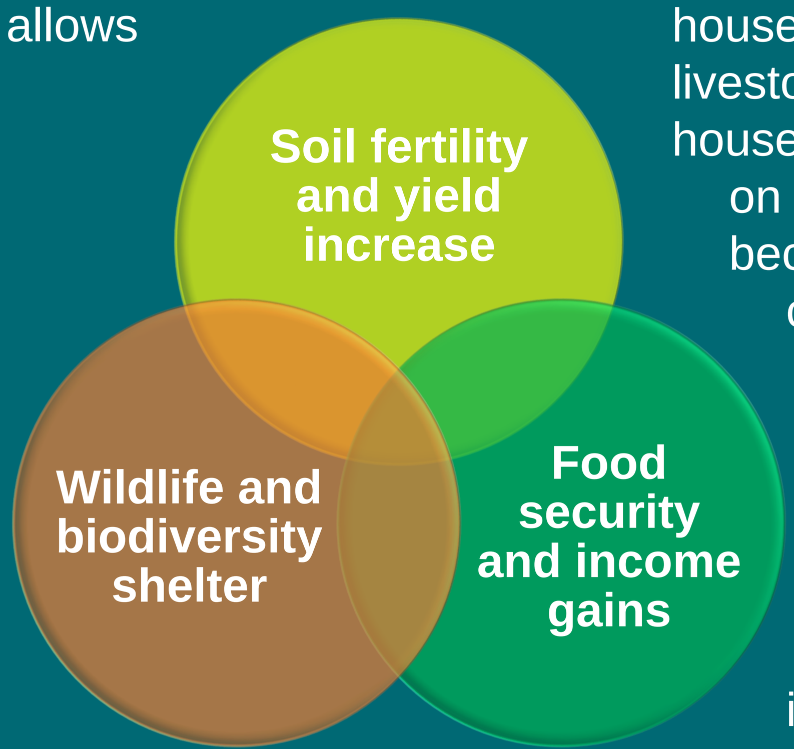


The expansion of cropland between 1975 and 2013. By 2013, cropland had expanded rapidly across the whole region, reaching a total of 43.5 million hectares (CILSS, 2016).

Cropland area doubled in the past 40 years

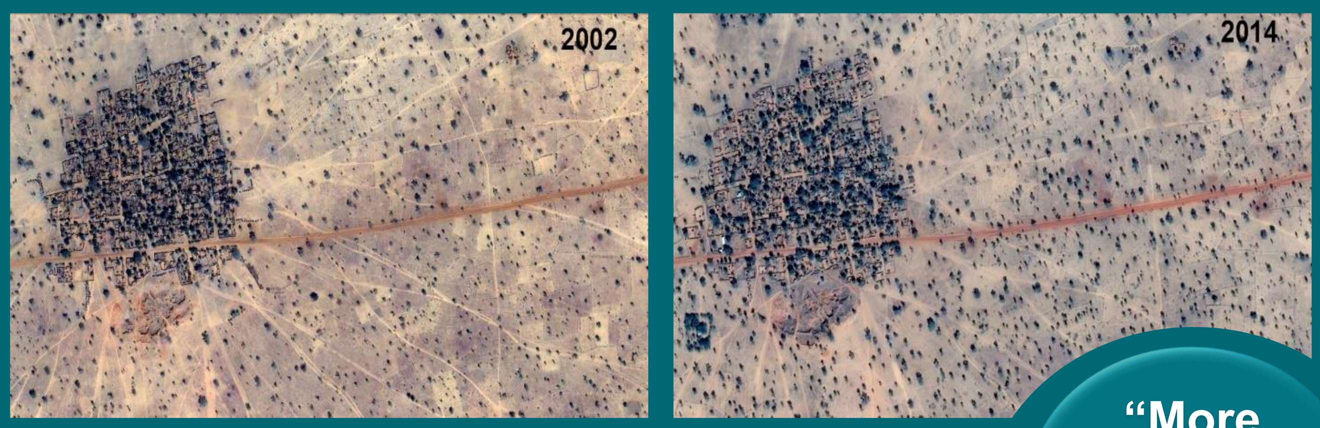
Impacts of FMNR on crop yield, food productivity and economics

As a foundational practice, FMNR is a starting point from which to add other climate-smart practices on agricultural land. The multiple benefits of FMNR represent a real win-win strategy, including improvement of soil fertility, increase in tree-based fodder, more firewood, reduced wind speeds, and local moderation of high temperatures. In southern Niger, FMNR has increased cereal production by an average 100 kg/ha, and as a result, the region produces an additional 500,000 tons of cereals in an average year. On-farm trees also produce fodder, which allows households to keep more livestock. In drought years, farm households can literally survive on their on-farm trees, because they can prune or cut some trees and sell firewood, which generates cash and allows them to buy cereals in the market. FMNR products are then a significant source of income for households.



The emergence of Farmer-Managed Natural Regeneration (FMNR)

In the late 1970s, Sahelian agriculture experienced recurrent drought, famine and reduced soil fertility, which led smallholder farmers to rethink their practices and develop innovative climate-smart agriculture. These practices included Farmer-Managed Natural Regeneration (FMNR), which allowed farmers to build more complex, more productive and more drought-resilient new agroforestry systems. In the early 2000s, field visits and aerial surveys revealed that farmers had indeed not planted the trees on their farmland, but rather had protected and managed woody species as they emerged spontaneously from underground root systems, which were still alive, or from the "seed memory" of the soil (seeds that remain dormant until the rainfall). It can be argued that FMNR, which leads to the creation of new agroforestry parklands, is the gold standard of climate-smart agriculture.



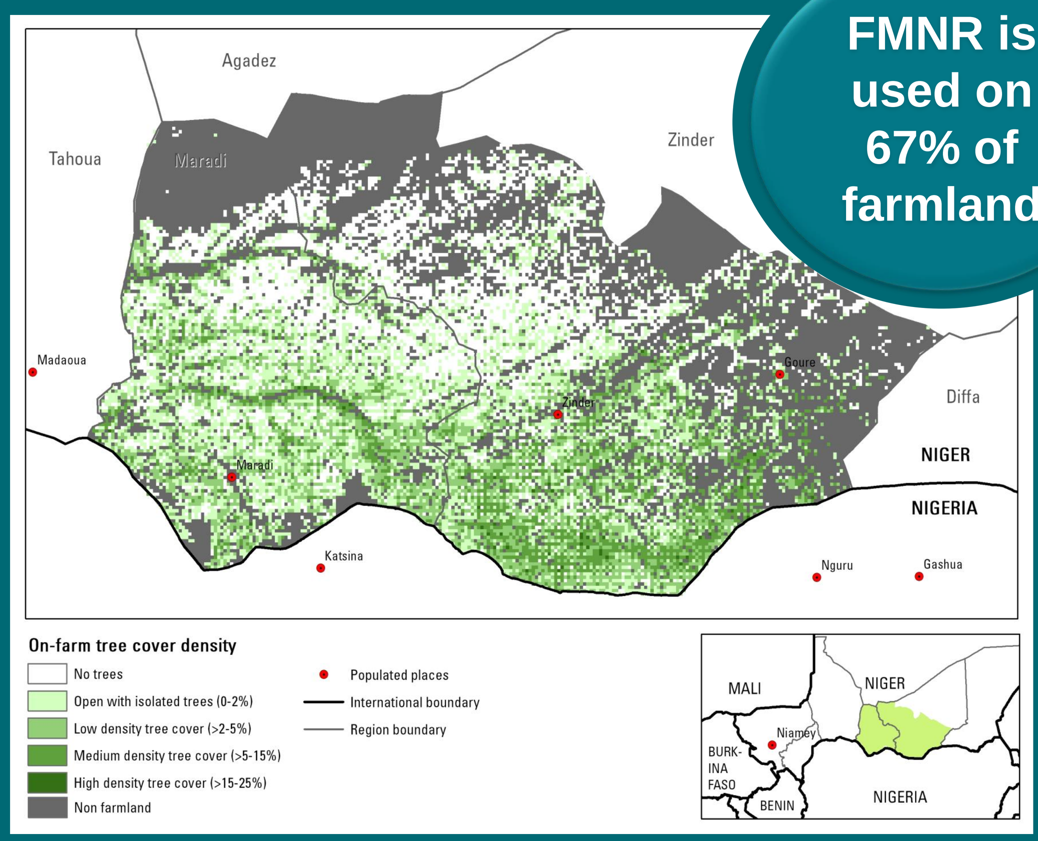
An example of the increasing tree density in the Zinder Region. The images show relatively high on-farm tree density, both in proximity to a village. Although the village has grown, tree density has also increased in the last decade ©Google Earth.

"More people, more trees"

Scale and dynamics of FMNR in southern Niger

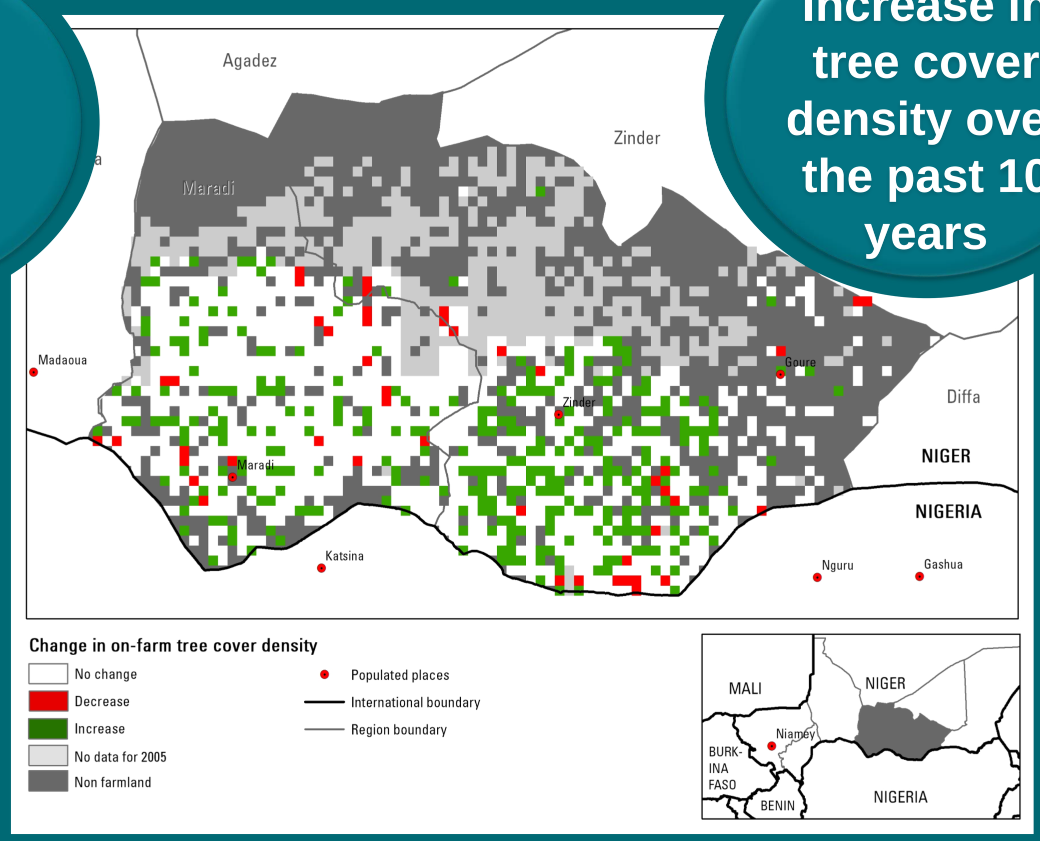
FMNR has already been scaled up in parts of the Sahel and is practiced widely in the densely populated parts of Niger, on the Seno Plains in Mali, and to some extent in parts of Burkina Faso and Senegal. The large-scale re-greening by farmers in Niger's Maradi and Zinder Regions is literally a story of "more people, more trees".

FMNR is used on 67% of farmland



In the Maradi-Zinder Regions, FMNR is used on 67% of the farmland (4.2 million ha), of which 32% is open with isolated trees, 23% is covered by a low tree cover, 11% by a medium tree cover, and 0.3% by a high level of tree cover. On average, the communes of south Zinder have the highest tree cover on farmland.

Increase in tree cover density over the past 10 years



In Although, most of the sample plots (75%) showed no change in on-farm tree cover density between 2005 and 2014, approximately 23% of the plots showed substantial increases in tree density across southern Maradi and Zinder Regions. Less than 2 percent of the data indicate a decrease in on-farm tree cover density.

The success in these regions implies that the greatest potential for FMNR – where it is minimally or not currently practiced – is in areas with high population densities. Even though the trend of agricultural expansion is likely to continue across the Sahel, further degrading the vegetation on the remaining natural landscapes, it is hopeful to say that the number of on-farm trees is also likely to increase. The challenge is then to not only increase the number of trees, but also their diversity.

***Faidherbia albida* improves soil fertility and produces fodder for livestock. Farmers use high on-farm densities of this species because they increase crop yields.**

Open with isolated trees (0-2%)

Low density tree cover (2-5%)

Medium density tree cover (5-15%)

High density tree cover (15-25%)

Mapping FMNR

Several years ago, a team from the USGS Earth Resources Observation and Science (EROS) Center developed a practical technique using high resolution satellite imagery to map on-farm tree cover density in the Sahel, where most tree cover is scattered and diffuse (Cotillon and Mathis, 2016). Their method allows one to accurately estimate the tree density (in percent) within a user-defined sample plot, as shown on the left. Throughout their analysis, tree cover density has been used as a proxy for the extent of adoption of FMNR across the Maradi-Zinder landscape, both in 2005 and 2014.

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CILSS. (2016). Landscapes of West Africa—A Window on a Changing World: Ouagadougou, Burkina Faso, CILSS, 219 p. at http://eros.usgs.gov/westafrica/
Cotillon, S., and Mathis, M. (2016). Tree cover mapping tool—documentation and user manual (ver. 1.0, March 2016): U.S. Geological Survey Open-File Report 2016–1067, 11 p., http://dx.doi.org/10.3133/ofr20161067.