

# Agroforestry and water retention

## Reference 6

Sinare, H; Gordon, L.J. 2015 Ecosystem services from woody vegetation on agricultural lands in Sudano-Sahelian West Africa. *Agriculture, Ecosystems & Environment* 200, 186-199. doi: 10.1016/j.agee.2014.11.009

## Background and objective

The Sudano-Sahelian zone of West Africa has a strong north–south gradient in landcover. The scattered woody vegetation on cropland is a result of farmers’ selection of trees and shrubs to keep when preparing fields (Kessler, 1992, Lykke et al., 2002). Scattered trees and shrubs also characterize pastoral land especially in the northern part of the region. The literature on how woody vegetation contributes with multiple benefits useful for people is scattered across many different disciplines. There does not, to the best of our knowledge, exist any systematic synthesis of the role of woody vegetation for livelihoods in the Sudano-Sahelian zone of West Africa. To integrate knowledge about the role of woody vegetation for people in the region, both in terms of direct use and income generation (provisioning services), and the influence of woody vegetation on ecosystem processes in the landscape (regulating services). We focus on the Sudano-Sahelian zone of West Africa specifically, asking what the status of current scientific knowledge is regarding (i) ecosystem services that are generated from woody vegetation, from both the perspective of specific individual woody species and at landscape scale; (ii) beneficiaries of ecosystem services from woody vegetation, and (iii) seasonal and inter-annual variation in generation of ecosystem services from woody vegetation. Here, only results regarding soil water regulation are reported.

## Search strategy and selection criteria

The search string for the review was constructed in an iterative process to capture ecosystem services from woody vegetation in the region described in different bodies of literature and conceptualized in different ways. It consists of one part with search terms related to woody vegetation and species, one part with search terms related to ecosystem services and land use, and one part with search terms related to the geographic area. The final search was conducted in ISI Web of Science for the years 1960–2014 on March 13, 2014. (Search String not reported here for brevity). 1) Studies are from the defined geographic area (Sudano-Sahelian zone of West Africa). 2) Studies treat woody vegetation in general or species included in Table 1. 3) Studies explicitly treat woody vegetation on fields, fallow or pasture land. Studies under conditions representing farmers’ fields are included but not pure experimental plots on station. 4) Studies with field data and field data combined with modeling are included, not pure modeling studies. 5) Studies describe use of species/woody vegetation, or effects of species/woody vegetation on e.g. pollination, pest control, soil properties, water and yield, which can be interpreted as ecosystem services. 6) Studies on how management, e.g. pruning, affect the effects of woody vegetation on e.g. soil properties, water and yield are excluded. 7) Pure reviews are excluded.

## Data and analysis

Reported provisioning services from woody vegetation were analyzed in terms of the benefits (direct and income) these services contribute with to livelihoods. The benefits to livelihoods described in the studies were classified into six categories: (I) nutritional diversity (leaves, fruits and other parts of trees and shrubs used in meals or consumed between meals); (II) medicinal uses (leaves, fruits, bark, roots and other parts of trees and shrubs used for medicinal, hygienic or cosmetic purposes); (III) sustain livestock (branches and fruits from trees and shrubs used as fodder to livestock or browsed by free ranging livestock); (IV) material assets (material from trees and shrubs used for construction or handicraft); (V) energy (wood from trees and shrubs used as firewood); and (VI) income (products from the five previous categories reported to be sold to get cash income).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
138	Cropland and pastureland in Sudano-Sahelian zone of West Africa.	Presence of woody vegetation	Not specified	Counting of studies reporting on role of woody vegetation for soil water content. Results were coded as: 1) positive effect (all articles studying the species reports positive effect), 2) Contested positive (articles studying the species reports either positive or no effect), 3) No effect (articles studying the species reports no effect), 4) Trade-offs (articles studying the species reports negative or ambiguous effects).	50%

## Results

- The effect of woody vegetation on water flows has mainly been studied at the plot level, but one study addresses landscape effects of land clearance.
- On the plot level, most studies are focused on difference in soil water content under influence of woody vegetation as compared to outside influence of woody vegetation. The studies of soil water content are focused on changes in the topsoil. The majority of these studies of topsoil water content show positive effect of woody vegetation. The studied species are common parkland trees, and shrubs common on fields, fallow and pasture land.
- The contested positive effect reported for *A. digitata* and the potential trade-off reported for *B. aegyptiaca* and *A. tortilis* ssp. *raddiana* are primarily related to seasonal variations, where positive effects are found during the rainy season (*A. digitata*) or during the second half of the rainy season (*B. aegyptiaca*, *A. tortilis* ssp. *raddiana*), negative effects during the first half of the rainy season (*B. aegyptiaca*, *A. tortilis* ssp. *raddiana*), and no effect during the dry season (*A. digitata*, *B. aegyptiaca*, *A. tortilis* ssp. *raddiana*).
- Studies on the plot level also reports decreased steady-state infiltration rate and saturated hydraulic conductivity for *P. biglobosa* and *A. digitata*, especially close to trunks, increased infiltration under *G. senegalensis* and *P. reticulatum*, and increased relative air humidity under *F. albida*.
- Decreased evaporation but increased evapotranspiration is observed under *G. senegalensis* and *P. reticulatum*, as well as decreased deep drainage losses (under *G. senegalensis* and *P. reticulatum*) and run-off.

## Factors influencing effect sizes

Potential trade-off reported for *B. aegyptiaca* and *A. tortilis* ssp. *raddiana* (Fig. 4) are primarily related to seasonal variations.

## Conclusion

No clear conclusion available.