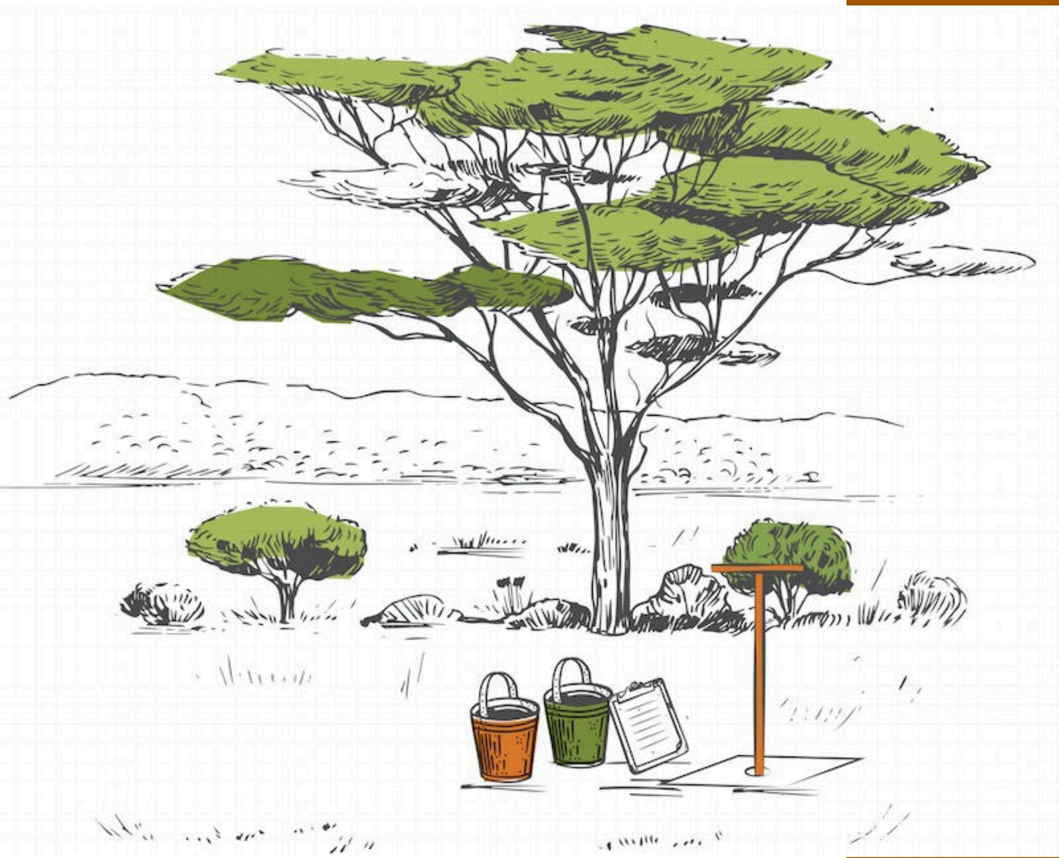
THE LAND DEGRADATION SURVEILLANCE FRAMEWORK

Chawia LDSF Report
October, 2024



LDSF

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This LDSF report

Summarises findings from the survey of the Chawia LDSF site conducted in 2024. More details on the LDSF methodology can be found on the LDSF website.

About the LDSF

The LDSF was developed in response to the need for a simple, low-cost and flexible framework for monitoring and assessing land health. It is designed to be used by a wide range of stakeholders, including government agencies, non-governmental organizations, research institutions, and local communities. The LDSF is based on a set of simple, standardized protocols for collecting data on land cover, land use, soil health, and land degradation. These protocols can be adapted to local conditions and are designed to be used by people with limited technical expertise. The LDSF is designed to be used in a wide range of ecosystems, including forests, grasslands, croplands, and rangelands. It is currently being used in more than 20 countries around the world.

About the Chawia LDSF site

The Chawia LDSF site is located in Taita Taveta County, in the Taita Hills. The site is characterized by a mosaic of land uses, including agriculture, agroforestry, and natural vegetation, including important biodiversity hotspots such as the Chawia and Iyale forests. The Chawia forest itself is a small remnant of the once extensive Taita Hills forests, which have been largely cleared for agriculture. Given the relatively small size of remaining forest fragments in the Taita Hills, they are of high conservation value for biodiversity, carbon storage, and as water towers.

The majority of the landscape in the Chawia LDSF site is under agriculture. Hence, enhanced agricultural management through Nature-based Solutions (NbS) is a key strategy to improve soil and land health in the area, also reducing pressure on remaining forest fragments. In this report we summarise findings from the 2024 survey of the Chawia LDSF site, focusing on land cover, land use, soil health, land degradation, and hydrologic function.

Photographs from the Chawia LDSF site. Photo credit: Anthony Ochieng

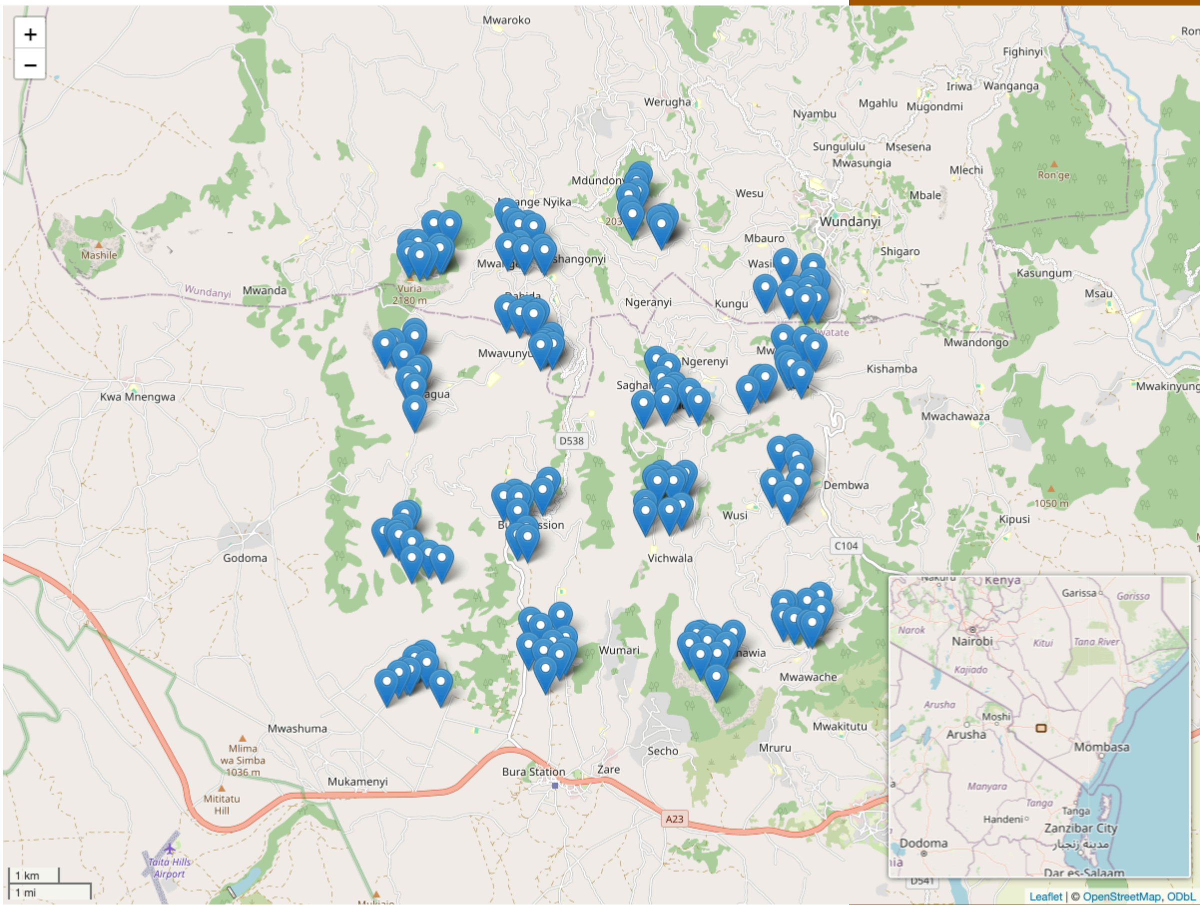

Figure 1: The Chawia LDSF site. The markers show sampling plot locations. Cluster 1 is in the lower-left of the site and cluster 16 in the upper-right.

Background

The Land Degradation Surveillance Framework (LDSF) has been applied across the global tropics to assess processes of land degradation, soil health, and for monitoring of land restoration at scale (Vågen, T.-G., Winowiecki, L. A., Tamene Desta, L. & Tondoh, J. E. [1]; Vågen, T.-G. & Winowiecki, L. A. [2]; Vågen, T.-G. & Winowiecki, L. A. [3]; Winowiecki, L. *et al.* [4], Winowiecki, L., Vågen, T.-G. & Huising, J. [5]). This LDSF survey was conducted in the Taita Hills (Figure 1) as part of the project "Delivering nature-based solution outcomes by addressing policy, institutional and monitoring gaps in forest and landscape restoration". The project is funded by UKPACT and implemented by World Agroforestry (ICRAF) in collaboration with the African Wildlife Foundation (AWF) and the Food and Agriculture Organization of the United Nations (FAO).

The focus of the project is on Nature-based Solutions (NbS), including forest and landscape restoration (FLR), interventions to increase biodiversity, enhance ecosystem services, secure jobs and improve livelihoods, while accelerating action on climate change at local, national and international levels.

Land use

Land use shows how people use a given area or landscape – whether for development, conservation, tree planting, cropping, or mixed uses. Agroforestry, for example, is a mixed land use system that combines trees and/or shrubs with crops and/or livestock.

Overall, the most common land use type within the Chawia site is annual agroforestry, followed by protected area, and fallow. Annual agroforestry refers to annual cropland with trees. As shown in Figure 2, there are significant variations between clusters in terms of dominant land use. For example, cluster 4 is predominantly a protected area and some woodlots. This cluster is in Vuria forest. Cluster 6 is mostly annual agroforestry and annual crops.

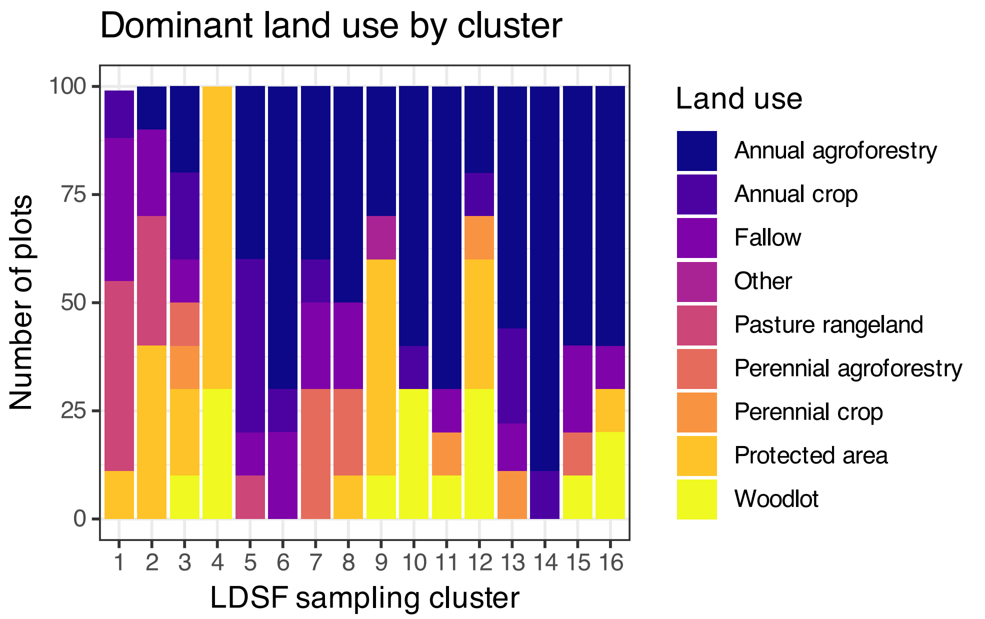

Figure 2: Dominant land use types in the Chawia LDSF site.

Land cover

Land cover data reflect how much of an area or region is covered by agriculture (croplands), forests, wetlands, impervious surfaces, and other land and water types. Water types include wetlands or open water. The different types of land cover can be managed or used quite differently.

In terms of vegetation structure classification, the most common type within the Chawia site is cropland, followed by bushland, and forest.

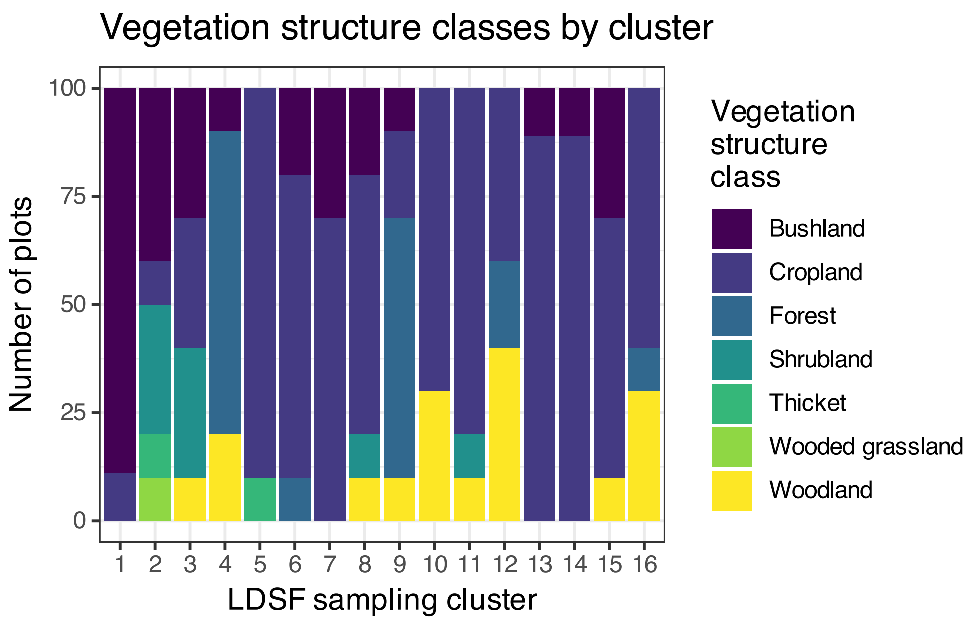

Figure 3: Vegetation structure classes in the Chawia LDSF site.

Tree and shrub densities

Tree and shrub densities vary strongly between clusters, as shown in Figure 4 and Figure 5. Cluster 9 (Chawia forest) has the highest median tree density, followed by clusters 12 and 4. Cluster 9 also has the highest median shrub density, but with a lot of variability within the cluster, followed by clusters 1, 2, and 7.

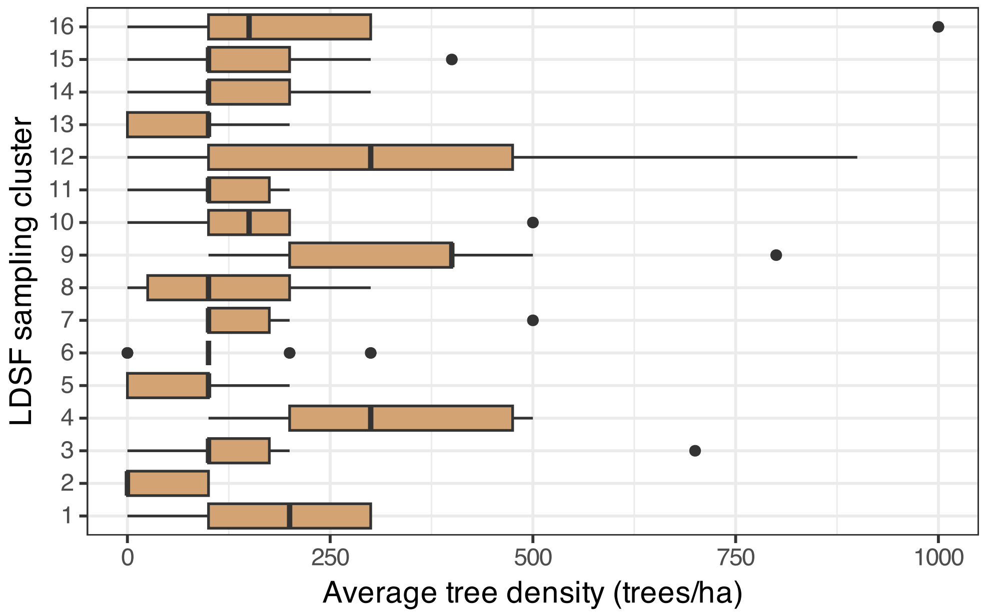

Figure 4: Tree density by cluster.

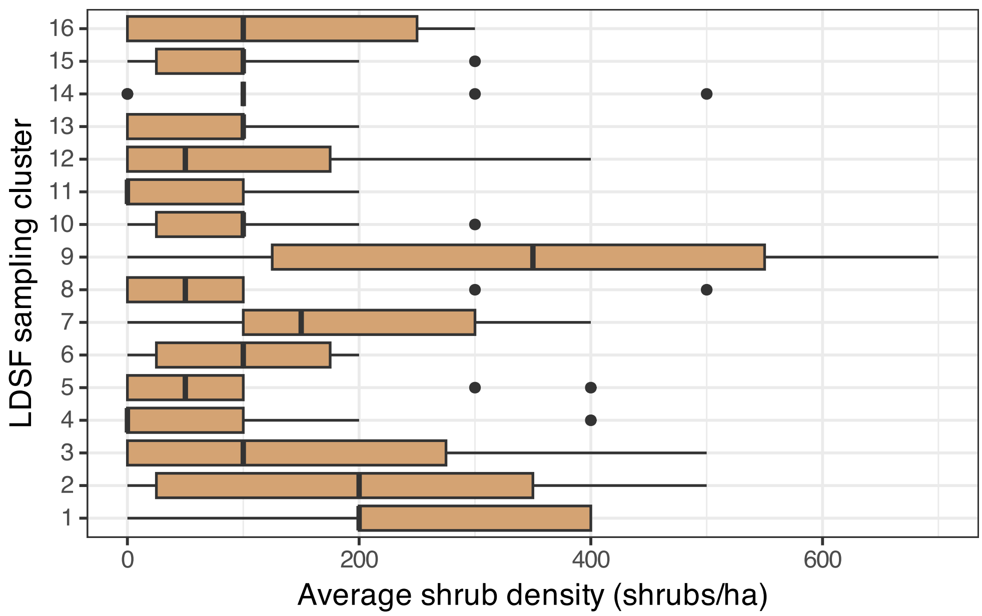

Figure 5: Shrub density by cluster.

Tree species composition

The most common tree species in the Chawia LDSF site are *Eucalyptus saligna*, *Grevillea robusta*, *Acacia mearnsii*, and *Tabanaemontana stapfiana*. However, we see a big difference between cropland, woodlands, and forest, for example.

In cropland, the most common species are *Grevillea robusta*, *Catha edulis*, and *Persea americanum* (Figure 6). In forest, the most common species are *Tabanaemontana stapfiana*, *Psychotria pseudoplatyphylla*, and *Macaranga conglomerata* (Figure 7). In woodlands, *Eucalyptus saligna* is by far the most common species, followed by *Acacia mearnsii*, and *Calliandra calothyrsus* are the most common species.

In other words, we see more exotic species, including fruit trees in croplands. As mentioned, woodlands are dominated by *Eucalyptus saligna*, which is fast growing and sought after for construction material, among other things. In forested areas, we find more indigenous species, and also a higher diversity of species per plot overall (Figure 8). The median number of unique species found in woodland and cropland are very similar (Figure 8), although the absolute number of unique tree species is higher in cropland (N=45) relative to woodland (N=19). As mentioned earlier (Figure 3), the site is predominantly cropland (53% of the plots), which may explain the higher number of unique species in cropland, 17% of the site is woodland and 17% is forest.

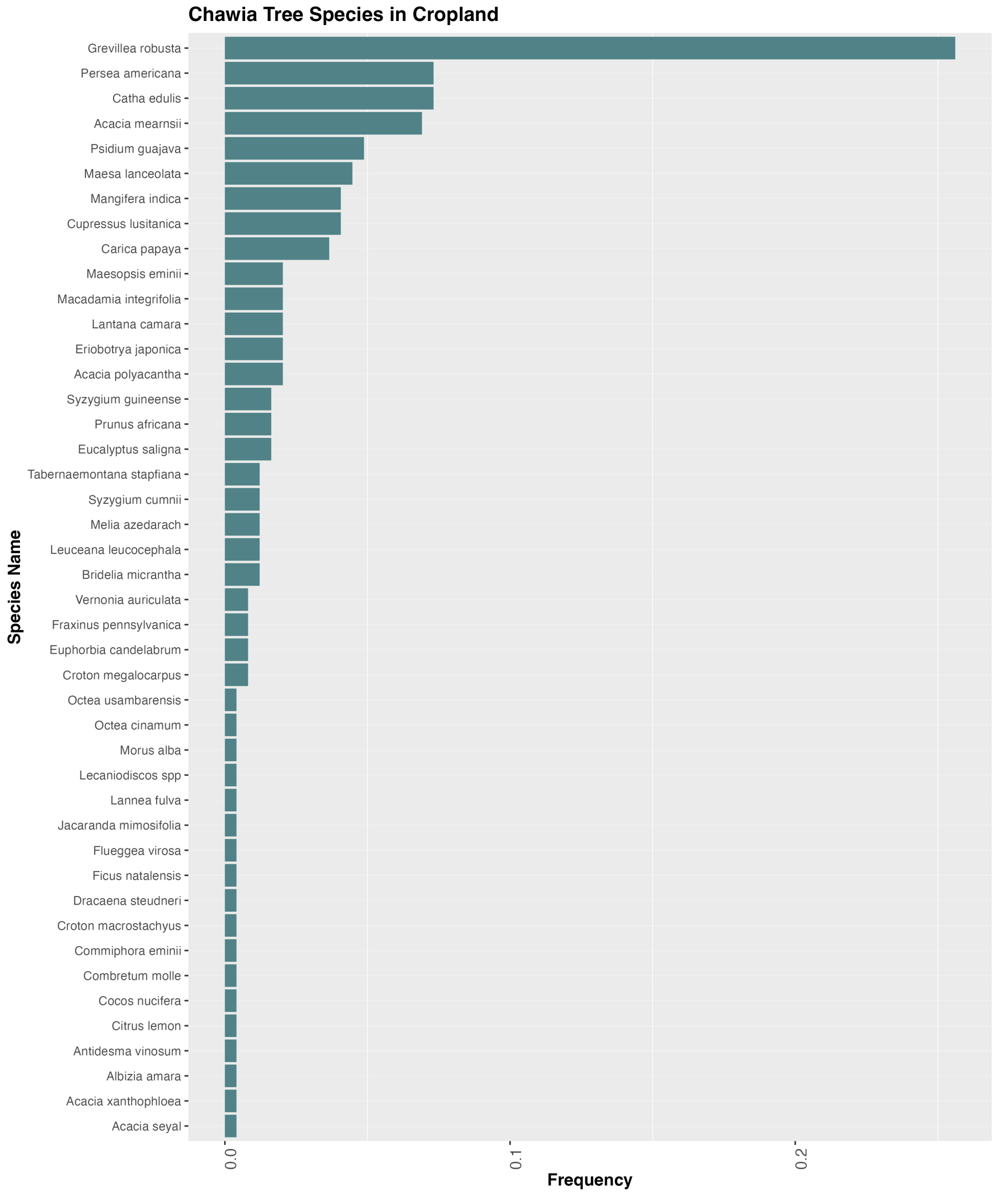

Figure 6: Tree species found in cropland areas within the Chawia LDSF site, ranked according to frequency of occurrence.

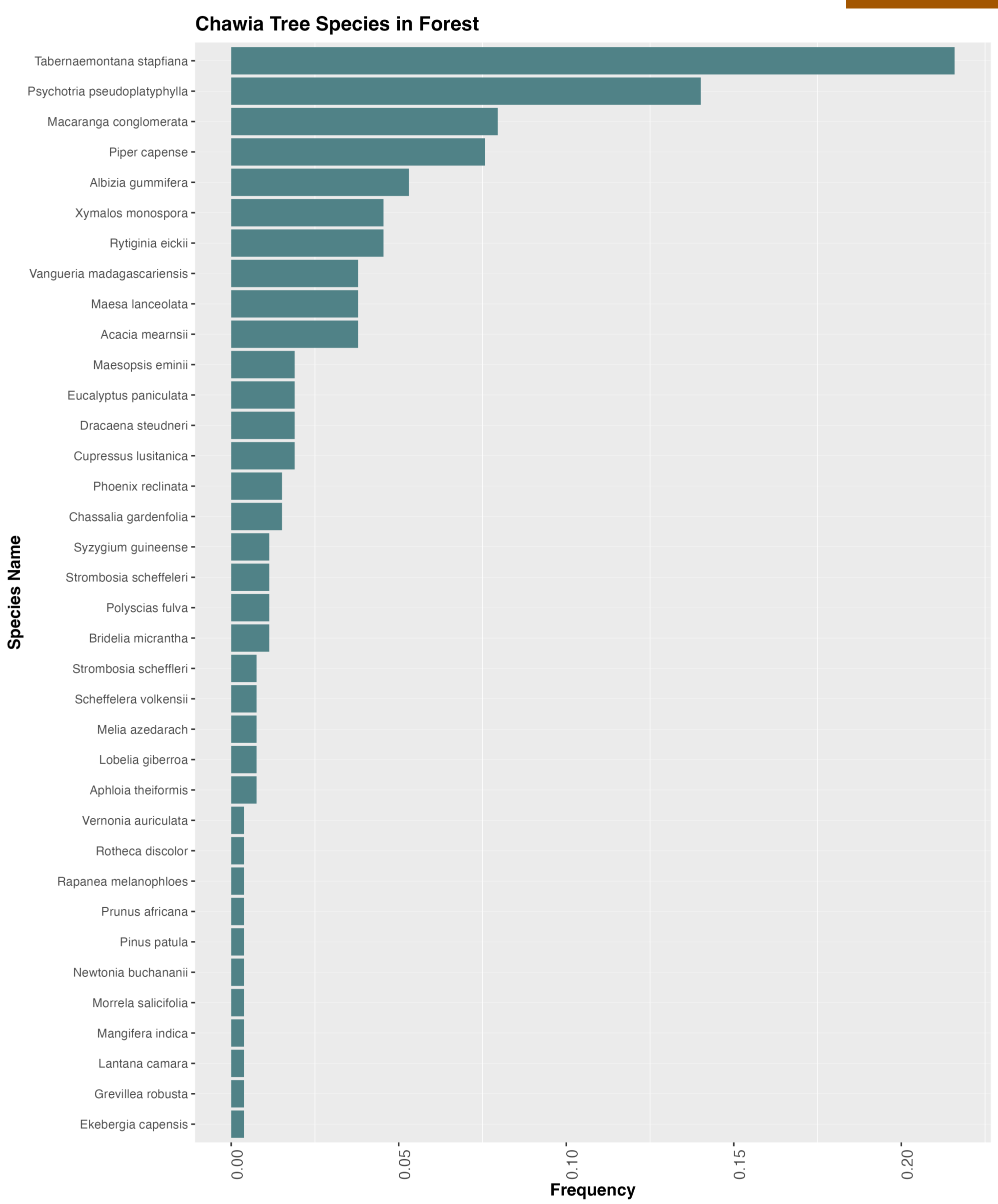

Figure 7: Tree species found in forest areas within the Chawia LDSF site, ranked according to frequency of occurrence.

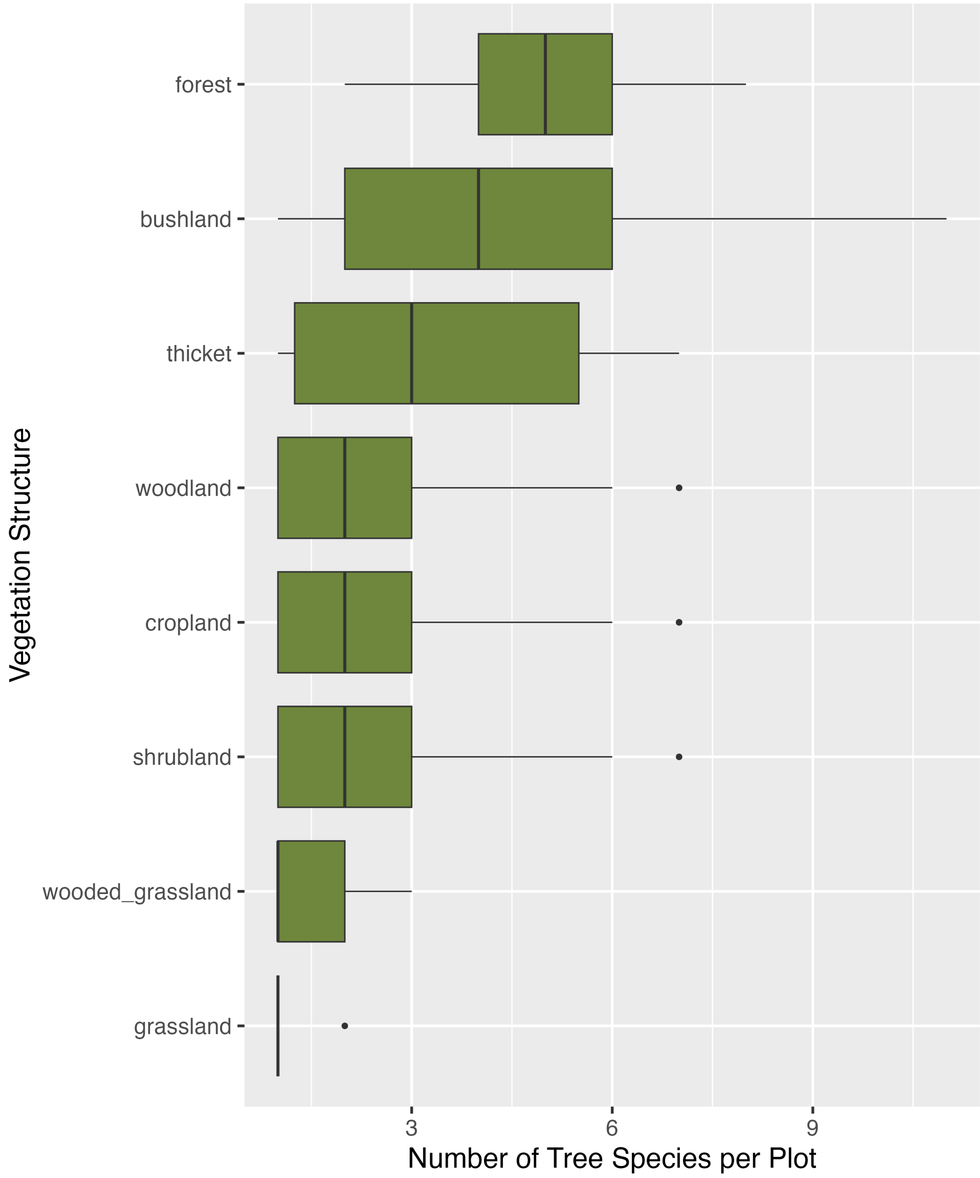

Figure 8: Tree species diversity in different vegetation structure classes within the Chawia LDSF site.

Soil erosion

Erosion is arguably the most widespread form of land degradation in the tropics. There are many forms of soil erosion as illustrated in Figure 9. In the LDSF, each sub-plot (n=4) is classified according erosion status as None/Sheet/Rill/Gully. Based on this, a visible erosion score is calculated by aggregating the erosion observations (0 - no erosion, 4 - all subplots have erosion). We model the prevalence of soil erosion for each plot by considering plots with three or more subplots with erosion as eroded and then predicting the probability of erosion in each plot. As shown in Figure 10, erosion prevalence is low to moderate in the sampling clusters, with the exception of cluster 1 where there is severe soil erosion.

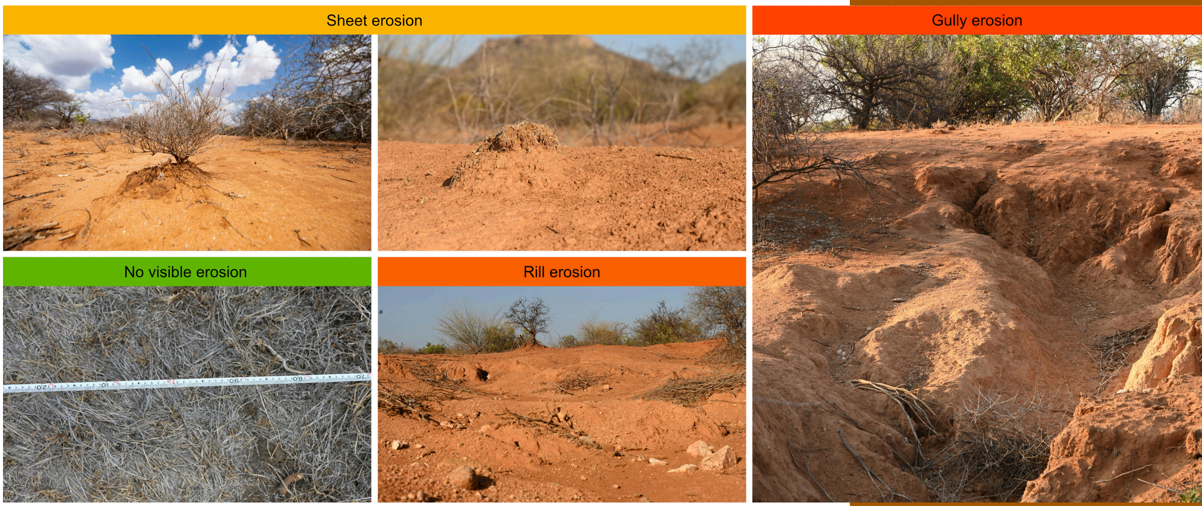

Figure 9: Illustration of different types of soil erosion recorded in the LDSF.

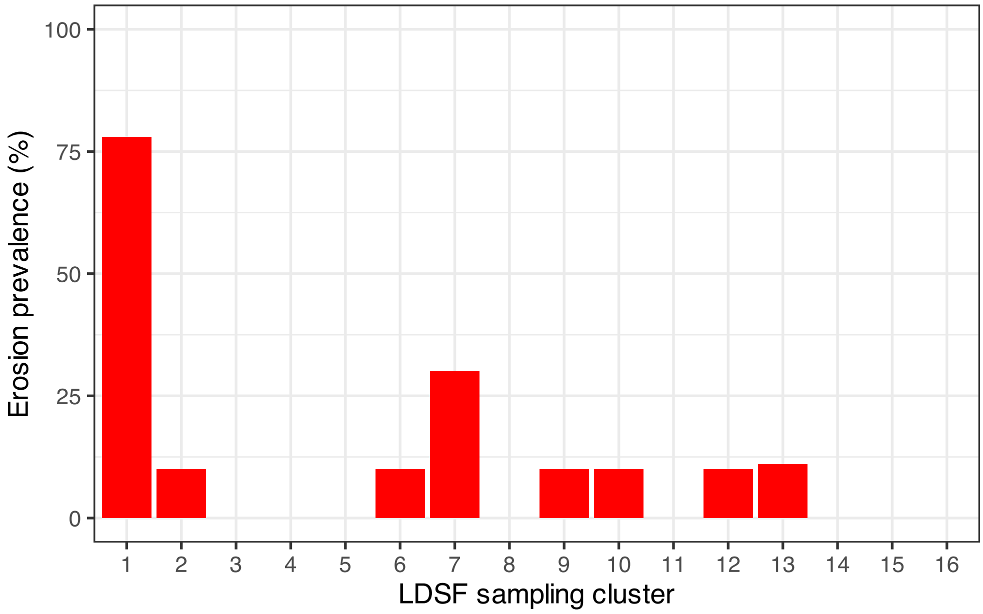

Figure 10: Erosion prevalence by cluster.

Soil health

We define soil health as an "integrative property that reflects the capacity of soil to continue to support both agricultural production and the provision of other ecosystem services". We use a number of indicators to assess soil health (Figure 11), including soil organic carbon (SOC), soil pH, and soil texture. We summarise some of the key soil health characteristics here.

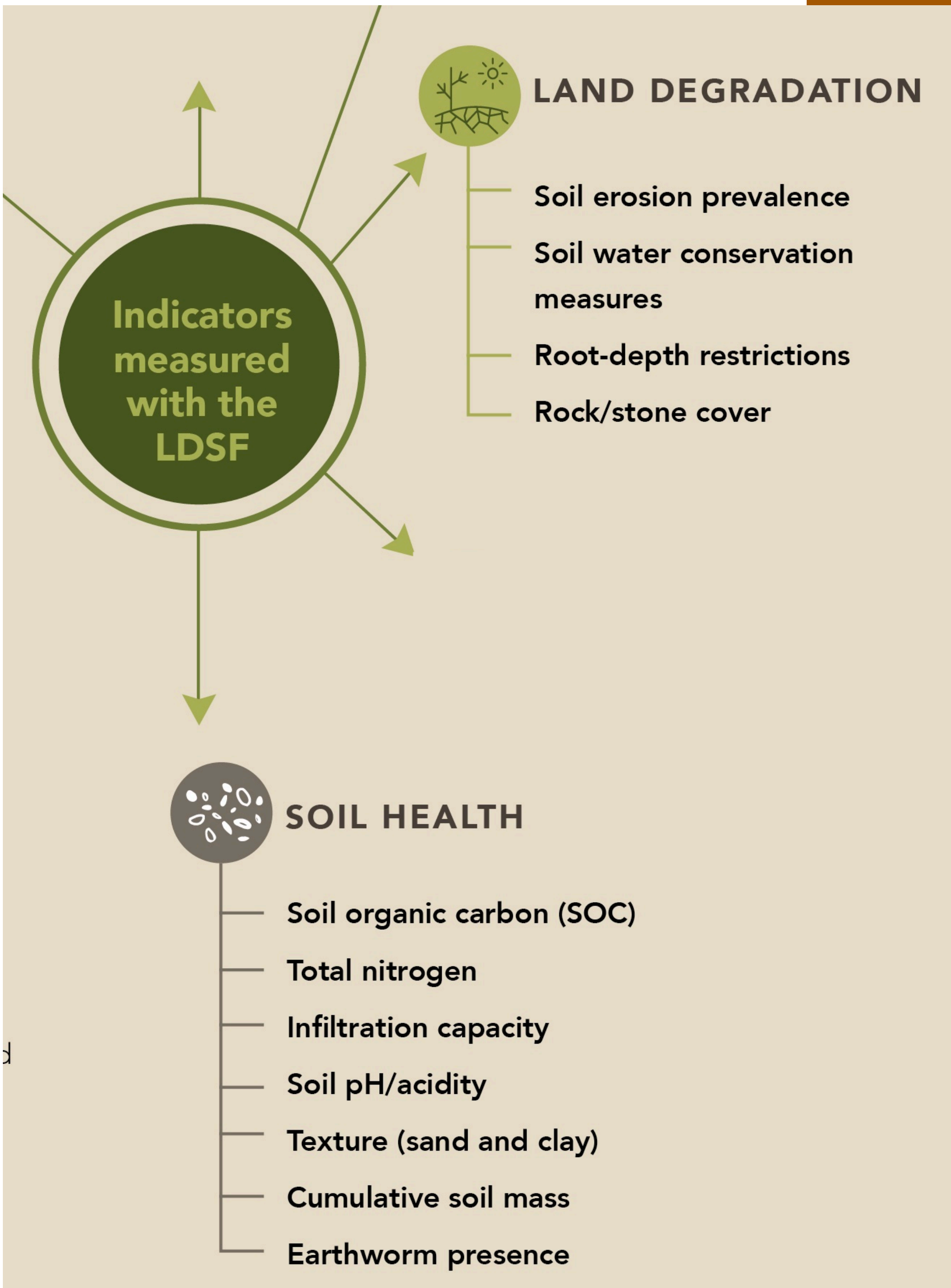

Figure 11: Soil health indicators assessed in the LDSF.

Soil organic carbon

Soil organic carbon (SOC) is a key indicator of soil health. It is a measure of the amount of carbon, which provides the energy that drives the soil system (Kibblewhite, M. G., Ritz, K. & Swift, M. J. [6]), stored in the soil in the form of organic matter. SOC is important for soil fertility, water retention, and climate change mitigation. As shown in Figure 12, SOC levels are particularly low in clusters 1, 2, and 3, which are predominantly cropland. Concentrations of SOC are orders of magnitude higher in Vuria forest (cluster 4). Topsoil SOC is highest in forested areas (Figure 13), followed by woodland. This highlights the importance of forest remnants for carbon storage in the landscape, in addition to their role as biodiversity hotspots.

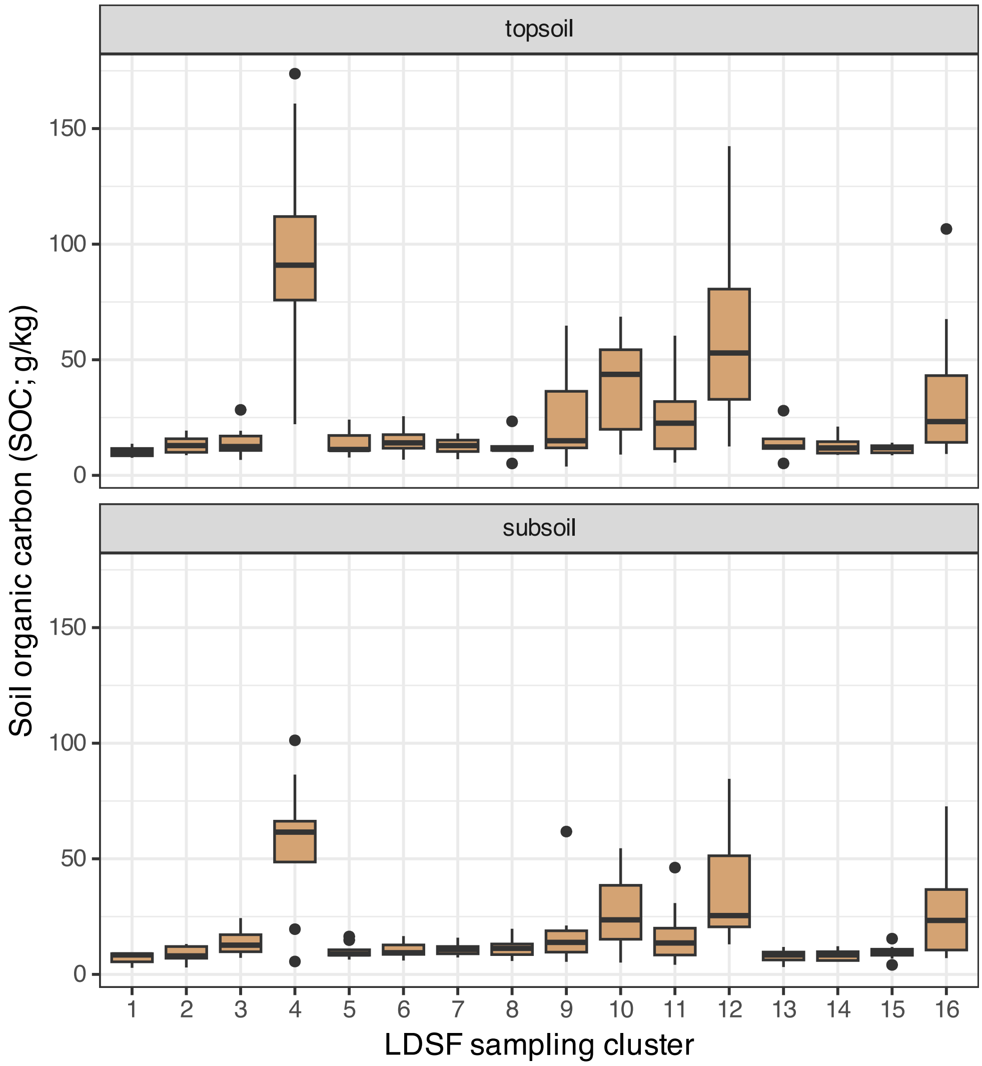

Figure 12: Soil organic carbon levels by cluster.

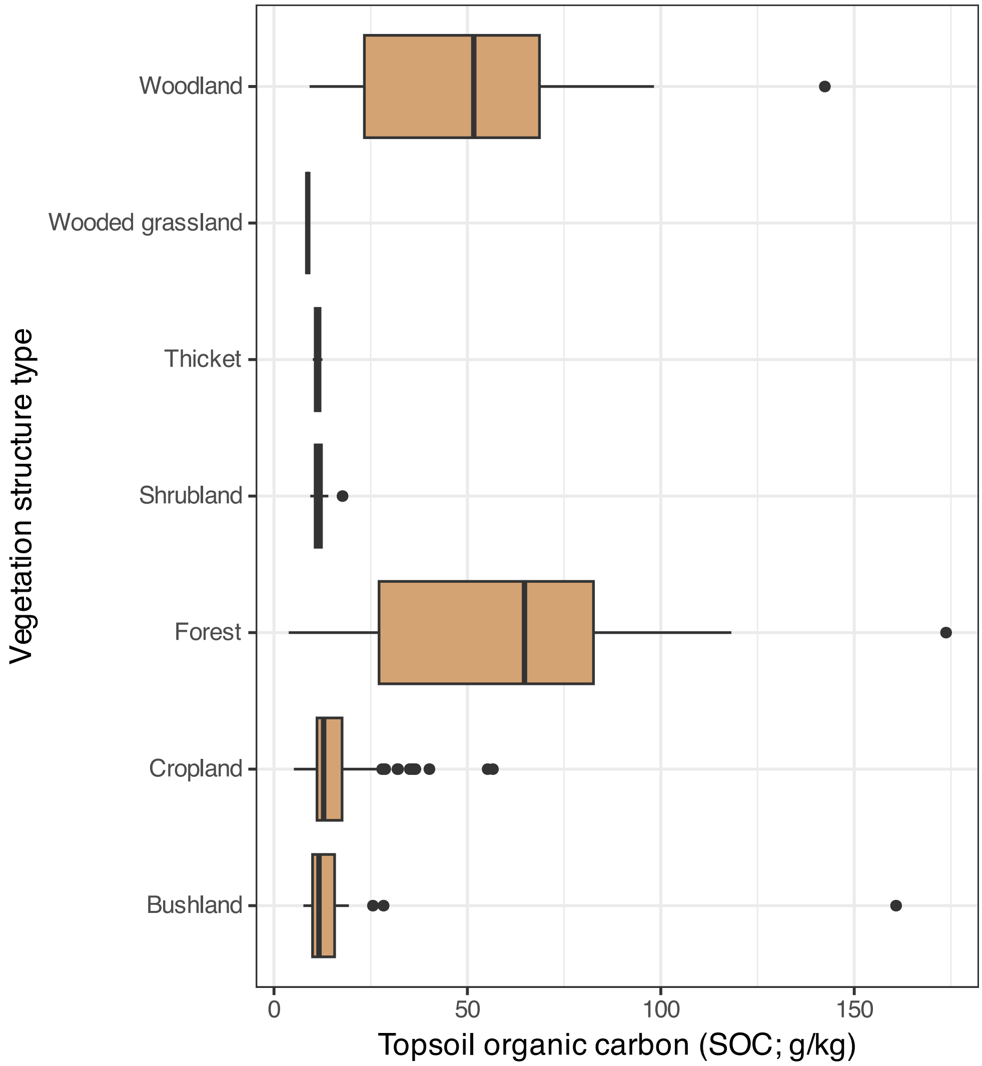

Figure 13: Soil organic carbon levels in topsoil (0-20cm) by vegetation structure type/class.

Soil pH

Soil pH is lower in clusters with forest, as expected (Figure 14). Clusters 5 and 6, which are located in a valley have median pH values above 8, meaning that they are alkaline. Most of the clusters have pH values between 5 and 7.5, which is considered slightly acidic to neutral (Figure 14).

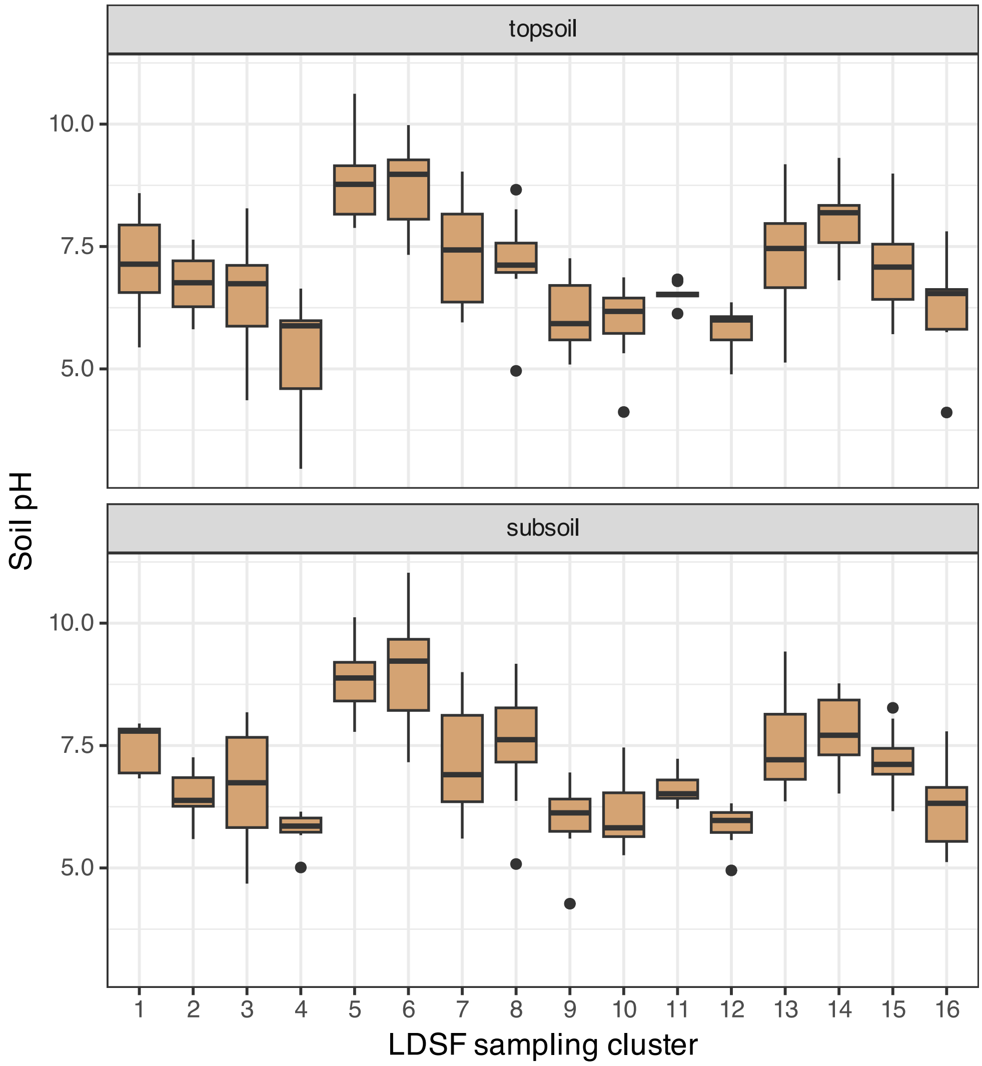

Figure 14: Soil pH levels by cluster.

Soil texture

Soils in the Chawia site have relatively high sand content in general, as shown in Figure 15.

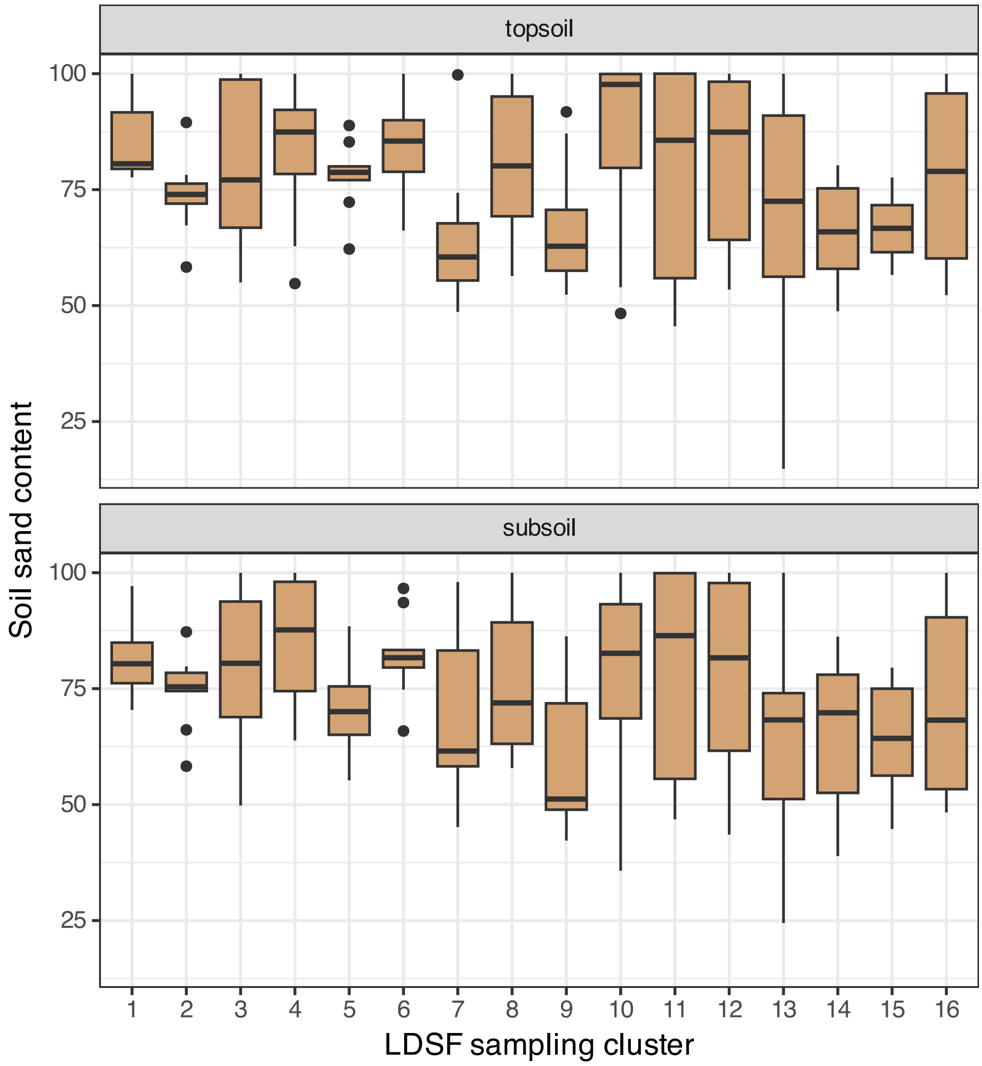

Figure 15: Soil sand content by cluster.

Infiltration capacity

Infiltration capacity is a key indicator of soil health. It is a measure of how quickly water can move into the soil. Infiltration capacity is particularly low in cropland areas, as shown in Figure 16. This is likely due to soil compaction and reduced soil organic carbon levels in cropland areas. In contrast, infiltration capacity is highest in woodland, although with a lot of variability, followed by shrubland and forest. Croplands generally show low infiltration capacity, which can lead to increased runoff and soil erosion.

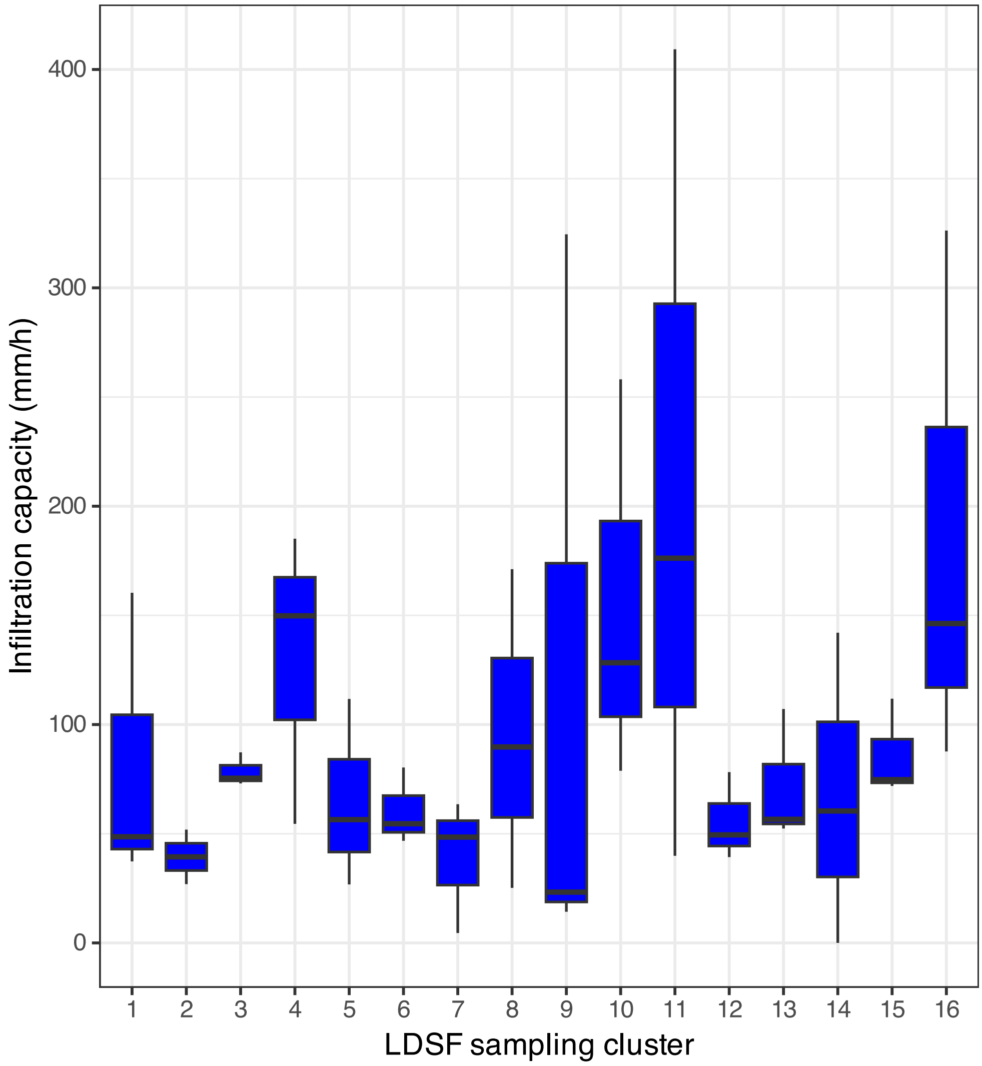

Figure 16: Infiltration capacity by cluster.

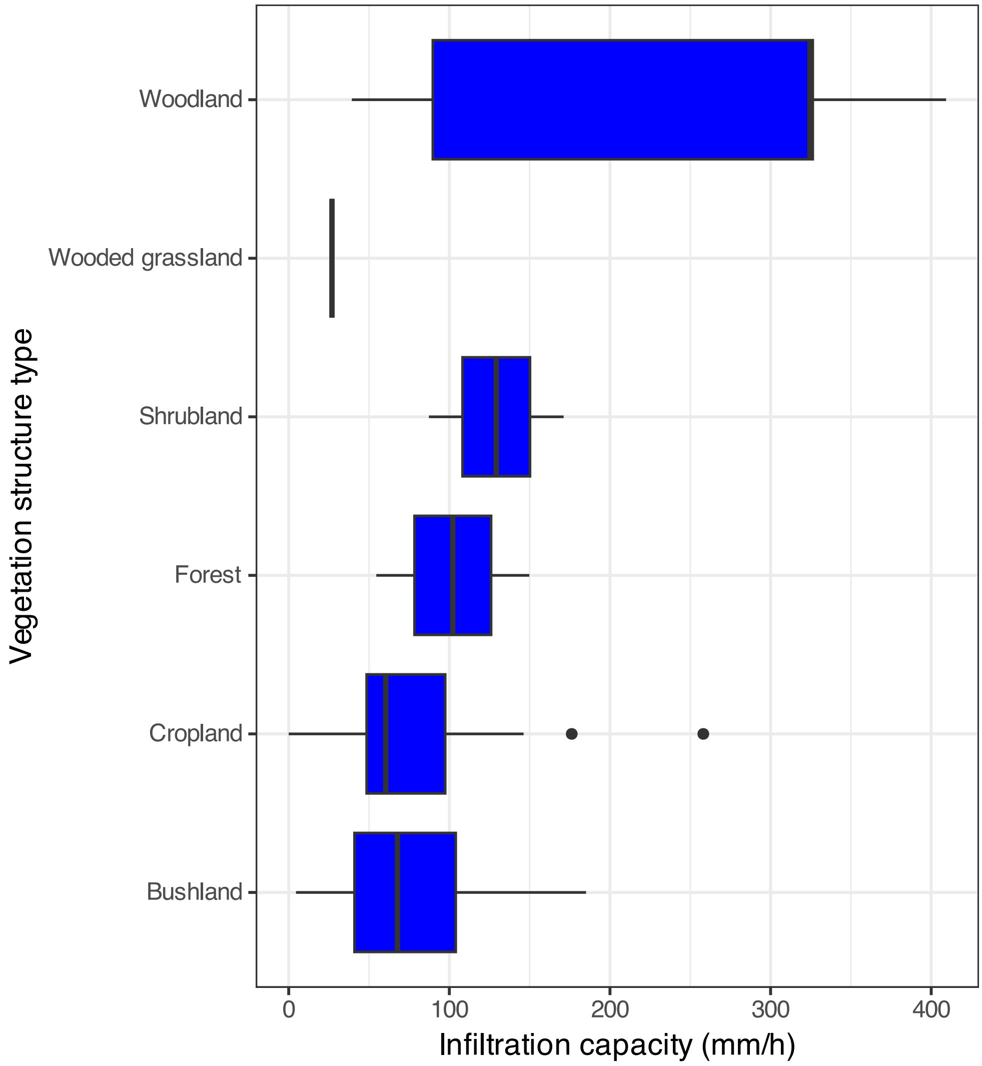

Figure 17: Infiltration capacity by vegetation structure type/class.

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