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Quantifying a sponge: The additional water in restored thicket

Restoration of degraded subtropical thicket in the Eastern Cape, South Africa, can result in the return of more than 30 tonnes of soil organic carbon per hectare.[1,2] Given that soil carbon is usually positively correlated with soil water-holding capacity[3-5], we hypothesised that restoration of thicket would greatly increase the sponge effect of its soils. As a first step towards examining this hypothesis, we used a model that predicts how changes in soil texture and soil carbon affect soil water-holding capacity.

In sandy and loamy soils, increases in soil water-holding capacity will tend to range from ~1% to ~8% for each per cent increase in soil organic carbon.[3,5-9] By contrast, within clayey soils, and within a particular range of soil carbon, an increase in soil organic matter can be expected to reduce, not increase, soil water-holding capacity. An increased sponge effect is consequently not a *fait accompli* in thicket restoration (see Figure 1).

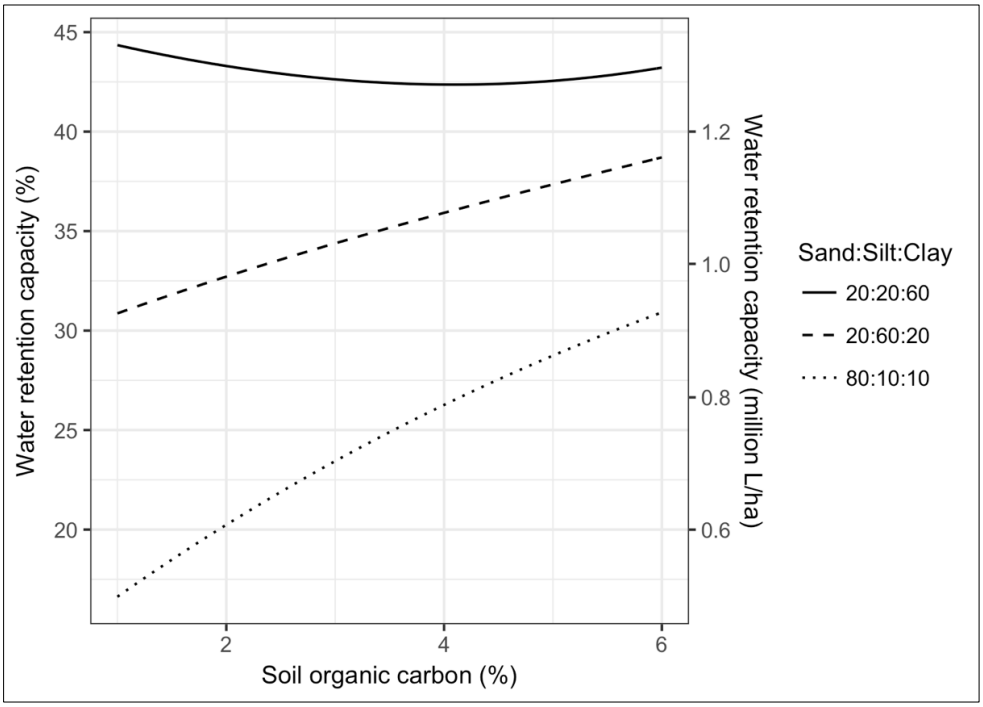

Figure 1: Modelled relationship between soil organic carbon (%) and water retention (%) using the equations of Rawls et al.[3]

The texture of soils across subtropical thicket varies greatly, but a large proportion are sandy (~80% sand content), with relatively small amounts of clay (~10%) and silt (~10%).[10] We consequently used a ratio of 80:10:10 sand:silt:clay to estimate how much water is likely to be stored when restoring thicket. Assuming that soil carbon increases from 2% to 5% in the top 30 cm of soil[11], the model predicts that an extra ~255 thousand litres of extra water would be stored per hectare. Across a farm of, for example, 5000 hectares, the amount of extra water stored would be 1.28 billion litres, and across the ~1 million hectares of the subtropical thicket biome that is degraded[12] the amount would be 255 billion litres. In conclusion, restoring degraded subtropical thicket at the biome-scale is likely to result in the additional storage of more than 200 billion litres of water. To put this amount in perspective, Theewaterskloof Dam, Cape Town's main storage dam, holds ~400 billion litres when full.

The additional water storage in subtropical thicket soils would result in myriad benefits for society, including greater productivity of the landscape for livestock and game (particularly during droughts), flood mitigation, and greater flow of water from groundwater into rivers.[13] It would be instructive for government and private landowners to have a hydrological model that shows how creating an underground dam of 200 billion litres would increase supply of water to farmers and towns across the Eastern Cape. Our hypothesis is that the economic returns from the additional water alone would be well worth the costs of restoring the 1 million hectares of degraded thicket.

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