



Contour bench terrace afforestation systems in the semi-arid Israeli Negev: Effects on soil quality and geodiversity

Ilan Stavi (1) and Eli Argaman (2)

(1) Dead Sea & Arava Science Center, Ketura 88840, Israel (istavi@adssc.org), (2) Soil Erosion Research Station, Rishon Lezion, Israel (eliar@moag.gov.il)

Afforestation activities are a widely accepted means of restoring degraded lands. In the semi-arid Negev of southern Israel, extensive lands have been modified for runoff-harvesting-based afforestation projects comprised of contour bench terrace systems (also called shichs/shychs/shikim). However, some alarming evidence in recent years calls for assessing the environmental impact of these afforestation lands. We assessed the effects of contour bench terrace afforestation systems on the soil quality of the uppermost layer (0–5 cm depth) and the 0–80 cm profile, as well as on herbaceous vegetation productivity in 2-year-old and 9-year-old afforestation systems, and natural, undisturbed hillslopes. Results showed considerable differences between the sink (contour bench terraces) and source (inter-terrace spaces) areas of the afforested lands. Normalizing data to the relative cover of these areas revealed similar herbaceous vegetation biomass and soil wetting front values for the natural hillslopes (1.47 Mg ha⁻¹ and 59.8 cm, respectively) and 9-year-old afforestation systems (1.64 Mg ha⁻¹ and 59.3 cm, respectively), and significantly lower values for the 2-year-old systems (0.07 Mg ha⁻¹ and 49.4 cm, respectively). Unexpectedly, the opposite trend was recorded for soil hygroscopic moisture content, which was significantly smaller for the natural hillslopes (1.7%) and 9-year-old systems (1.9%) than the 2-year-old systems (3.2%). Soil bulk density was also significantly affected by afforestation treatment, following the trend 2-year-old systems > 9-year-old systems > natural hillslopes (1.57, 1.55, and 1.53 Mg m⁻³, respectively). Soil penetration resistance varied greatly throughout the 80-cm soil profile. There was no significant effect of afforestation treatment on soil gravimetric moisture content (in the spring). Overall, soil quality and herbaceous vegetation cover were only slightly greater on the north-facing hillsides than those on the south-facing hillsides. We concluded that the establishment of contour bench terraces increases geodiversity on a hillslope scale, but removes the surface soil (A horizon) from extensive areas, increases soil compaction, and decreases herbaceous vegetation production, adversely affecting soil quality, pastoral productivity, and ecosystem functioning and health in the short term. However, over the long term, self-restoration of small-scale geodiversity and functioning of the geo-ecosystem is suggested to improve soil quality and increase herbaceous vegetation productivity in these dryland forestry systems.