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# Positive impact of moderate stubble grazing on soil quality and functioning in dryland wheat agro-pastoral systems

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Livestock stubble grazing in post-harvest wheat fields is common in drylands. Previous studies have shown that this practice causes land degradation. Therefore, the objective of this study was to examine the effect of long-term stubble grazing by comparing soil quality indicators in continuous wheat croplands of two rain-fed farming systems: with moderate stubble grazing (GR) vs. entire stubble retention (NO). Multi-annual averaged dry organic matter residue retained on the ground surface was ∼0.8 Mg ha-1 in NO, as opposed to ∼0.3 Mg ha-1 in GR. The same soil characteristics were also studied in 'natural' lands (NAT) to assess land-use change impact. The study was implemented in the semi-arid, northern Negev of Israel. Sampling of soil was implemented during the summer, at depths of 0-5 and 5-10 cm. Some of the results suggest the degradation of soil quality following land-use change from NAT to croplands, as well as in GR, compared to NO. This includes the coarse root biomass, which was 67% to ∼ two times greater under NAT than that under NO and GR. This impact was also revealed by the aggregate slaking index which was 18% to two times greater under the two cropland treatments than that under NO, as well as for the clay dispersion index which was ∼ two to three times greater under the two cropland treatments than that under NO. At the same time, unexpectedly, the majority of soil characteristics showed better soil quality under GR than that under NO. For example, hygroscopic moisture content under NAT was only 10% greater than that under GR, but 22% greater than that under NO. Overall, soil aggregation properties also suggested negative impact of land-use change, but, at the same time, showed a positive impact on soil quality by GR compared to that under NO. Also, the soil organic carbon pool was similar between NAT and GR, which had 16-22% greater value than that under NO. The soil organic carbon's stratification ratio was marginally affected by treatment ($P = 0.1015$), and was 4% and 17% greater under NAT than that under NO and GR, respectively, revealing the clearest layering of soil organic carbon under NAT and the least clear layering under GR. This suggests that mixing of organic residues in soil is smallest under NAT and greatest under GR. This study shows that, in the long term, together with the input of animal excretion, the mixing of stubble residue in soil imposed by the livestock hoof action compensates for the quantitative loss of stubble, increasing soil organic carbon pool, strengthening soil quality, and improving geo-ecosystem functioning.