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Impact of conservation practices on soil aggregation and the carbon management index after seven years of maize–wheat cropping system in the Indian Himalayas

B.N. Ghosh[a,*], V.S. Meena[b], N.M. Alam[a], Pradeep Dogra[a], Ranjan Bhattacharyya[c], N.K. Sharma[a], P.K. Mishra[a]

[a] ICAR-Central Soil and Water Conservation Research and Training Institute, 218 Kaulagarh Road, Dehradun 248 195, Uttarakhand, India
[b] Crop Production Division, ICAR-Vivekananda Institute of Hill Agriculture, Almora 263 601, India
[c] CESCRA, NRL Building, ICAR-Indian Agricultural Research Institute, New Delhi 110 012, India

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ABSTRACT

The carbon management index (CMI) and labile organic carbon (LOC) pools are postulated as very sensitive indicators of changes in soil organic carbon (SOC) due to land degradation within a short time in response to management practices. To test this hypothesis, we investigated LOC and CMI under a field experiment (2007–2013) in relation to runoff, soil loss, maize and wheat yields on a 2% (1.15°) land slope of the Indian Himalayas. In this study, the impacts of several resource conservation practices, including different combinations of vegetative barriers (VB), minimum tillage (MT), different organic amendments (OA) and weed mulch, were evaluated. Results revealed that the plots under MT + OA with three applications of weed mulch had more SOC, macroaggregate-associated C concentrations and macro-aggregates than conventional tillage (CT) + NPK with chemical weed control. Carbon management index varied from 47 to 59 and 42 to 55% with different conservation practices at depths of 0–5 and 5–15 cm depths, respectively. Incorporation of weed mulch along with application of OM, MT and VB (by *Palmarosa*) under MT improved CMI by 19.7 and 24.2% compared to CT plots with VB (by *Panicum*) and inorganic NPK at depths of 0–5 and 5–15 cm, respectively. Significant positive correlations were observed between CMI and maize yield ($r = 0.948$; $n = 24$; $P < 0.01$), CMI and wheat yield ($r = 0.872$; $n = 24$; $P < 0.01$) and CMI and wheat equivalent yield ($r = 0.906$; $n = 24$; $P < 0.01$). However, significant negative correlations were obtained for CMI and runoff ($r = -0.701$; $n = 20$; $P < 0.01$) and CMI and soil loss ($r = -0.768$; $n = 20$; $P < 0.01$). Results established that *Palmarosa* as VB along with OA plus weed-mulch under MT was the best management practice for decreasing runoff and soil loss and increasing system productivity on a 2% slope in the region. The single value CMI was strongly positively correlated with crop productivity and negatively correlated with soil loss. Hence, this single value CMI could potentially be used for assessment of soil degradation elsewhere.