Do Soils Gain Carbon Following Conversion of Ryegrass/Clover to a Moderately Diverse Pasture?

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One approach to offset or reduce the increases in atmospheric CO_2 is to sequester carbon in soil. To identify a farm management practise that sequesters carbon, we tested the hypothesis that following pasture renewal (PR) a moderately diverse pasture sward would store more carbon (C) relative to a ryegrass/clover sward. Diverse swards can have greater root biomass with potential to contribute more C into soil.
CO_2 exchange was measured using eddy covariance at three sites on a Waikato dairy farm. The CO_2 exchange was coupled with measurements of imports and exports of carbon to calculate a net ecosystem carbon balance (NECB) for each site over 4 years. All sites had ryegrass/clover swards on similar soils, site histories and management. One ryegrass/clover site (Control) was undisturbed, while in year 2 two sites underwent PR: to a ryegrass/clover sward (NewRye) and to a moderately diverse sward with deeper rooting species (NewMix) including chicory, plantain, lucerne, ryegrass and clover.
Prior to PR (year 1), two sites lost C, while the third site (NewRye) was a slight C sink. In the 3 years following PR (years 2-4), all sites lost C, with the NewRye site losing about half as much C as the other two sites. However, between years 2-4 the NewRye lost substantially more C than the NewMix and Control sites after accounting for site differences observed in year 1. Pasture production was similar between the NewRye and NewMix sites and lower in the Control site.
When initial differences in NECB prior to PR are accounted for, the moderately diverse pasture sward lost relatively less C than a ryegrass/clover sward implying that diverse swards may be a farm management practise able to sequester more (or lose less) C, while maintaining pasture production.