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Assessing the severity and impacts of soil compaction from the plot to the catchment scale (and all scales in between).

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Agriculture is a dominant part of the UK landscape, composing 70% of the UK area and contributes £704 million to the UK economy every year. However, soil degradation has both direct and indirect impacts which cost between 0.9-1.4 billion. Of this, soil compaction has been attributed to £72 million worth of losses per year, of which £68 million is associated with flood damage and management costs. However, the locations and severity of agricultural soil compaction in both arable and pastoral fields is unknown, along with the impacts on soil hydrology, surface runoff and fluvial flooding at larger spatial scales. This study has combined soil sampling at a range of spatial scales with hydrological modelling to investigate how soil properties vary with scale and how the impacts upscale from field to catchment.

Different land management regimes which dominate agricultural landscapes in the UK have been assessed, including pastoral management (cattle, sheep and equine grazing land) and arable management tillage regimes (conventional tillage, minimal tillage and zero tillage). A comprehensive in-field testing and sampling programme was undertaken across sites in North Yorkshire (Skell catchment) and Leicestershire (Soar catchment), supported by further laboratory testing of samples for quantifying soil resistance and bulk density (proxies for soil compaction) and how water interacts with the soil structure (hydraulic conductivity, soil moisture). This exploration was repeated across the year to explore the seasonal nature of land trafficking and assess any soil health recovery with stock removal.

Soil characteristics were assessed at a range of spatial scales, from within the same field, to different fields of the same and different land management practices across the catchment. It was found that the range of physical soil properties varied significantly within the same field, particularly between in-field features such as feeding troughs and field gates, which were much more severely compacted. In fact, heterogeneity was just as evident within the same field as between different fields. Continuous spatial mapping allowed zones of compaction to be identified, and therefore target alleviation measures. We conclude by assessing the effect of different levels of soil compaction on catchment scale flood risk.