Briefing for designers of net zero land use systems about soils and flooding

Expert Panel

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1. **There are many different soil types,** critically influencing key hydrological properties in multiple ways. Understanding where different dominant soil types lie across the landscape is vital if flood risk is to be factored into land use planning.
2. **Soil structure (both inherent and management-related) governs runoff and flooding.** Soil function and structure determine whether rainfall is absorbed or becomes surface runoff; freely draining, well-structured soils with good vegetation cover can absorb intense rainfall (over 50 mm per hour), while compaction turns soils into sources of runoff and erosion. Slowly draining soils have more opportunities to store water above the soil and to slow the flow.
3. **Flood resilience can be guided by spatial mapping of soil hydrology**. Identifying the distribution of dominant soil types across the landscape is a critical prerequisite for assessing natural drainage capacity and mitigating site-specific flood risks. Existing tools and maps are available for this in many geographical areas and could be built upon and scaled geographically. Other important data layers include terrain, slope and runoff pathways.
4. **Soil erosion and waterlogging can lead to losses of soil organic carbon and increases in nitrous oxide emissions on mineral soils**. Net Zero land use planning should integrate state-of-the-art knowledge and methods to minimise greenhouse gas emissions from soil.
5. **Effective nutrient management planning** is critical to avoid leaching of phosphorous and nitrates into waterways causing pollution build up, algal blooms and aquatic dead zones.
6. **Land use must match land capability.** In high-rainfall and steeply sloping areas, inappropriate land use and management increase runoff and flooding, highlighting the need to align cropping and farming systems with soil and landscape capacity. Inherently wet also soils have limited capability for cropping unless drained, and drainage maintained. There are opportunities to slow the flow in these landscapes.
7. **Risk is predictable and manageable.** Runoff and erosion risks arise from predictable interactions between inherent soil type, crop choice, slope, and management, and should be anticipated in land use and system design.
8. **Connectivity determines downstream impacts.** Landscape connectivity controls whether runoff and sediment reach watercourses. Slope-oriented cropping and tracks, and poorly designed drainage and boundary features can unintentionally amplify erosion and flooding if they inadvertently create effective pathways.
9. **No single solution fits all contexts.** Land use systems and remediation must be soil-type specific, accounting for inherent soil behaviour, management practices, and susceptibility to runoff, rather than applying uniform approaches.
10. **Well-designed systems deliver multiple benefits.** Landscape heterogeneity and natural flood management measures can slow flows while also supporting soil health and wider ecosystem services, including productivity, biodiversity, carbon benefits, water quality and reduced soil loss.

11. **Long-term, well-maintained mitigation is essential.** Effective systems depend on adequate funding and technical support, correct placement and ongoing maintenance of measures supported by monitoring, adaptive management, and awareness of trade-offs such as potential yield reductions.
12. **System-level change is needed for persistent problems.** Ongoing erosion in certain areas highlights the need for land use systems that actively discourage high-risk cropping on vulnerable land, rather than relying solely on voluntary compliance. Clear, well-signposted flooding-related soil management guidance is needed. Historical guidance on soil erosion needs to be update and open access.

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