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Evaluating the placement and performance of nature based measures for managing flood runoff in intensively farmed landscapes

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Over the past decade economic losses from fluvial floods have greatly increased and it is becoming less viable to use traditional measures for managing flooding solely. This has given rise to increasing interest in alternative, nature based solutions (NBS) for reducing flood risk that aim to manage runoff at the catchment source and deliver multiple benefits. In many cases these measures need to work with current agricultural practices. Intensive agriculture often results in increases in local runoff rates, water quality issues, soil erosion/loss and local flooding problems. However, there is potential for agriculture to play a part in reducing flood risk. This requires knowledge on the effectiveness of NBS at varying scales and tools to communicate the risk of runoff associated with farming.

This paper assesses the placement, management and effectiveness of a selection of nature-based measures in the rural landscape. Measures which disconnect overland flow pathways and improve soil infiltration are discussed. Case study examples are presented from the UK where a large number of nature-based measures have been constructed as part of flood protection schemes in catchment scales varying from 50 ha to 25 km2.

Practical tools to help locate measures in agricultural landscapes are highlighted including the Floods and Agriculture Risk Matrix (FARM), an interactive communication/visualization tool and FARMPLOT, a GIS mapping tool. These have been used to promote such measures, by showing how and where temporary ponded areas can be located to reduce flood and erosion risk whilst minimising disruption to farming practices. In most cases land managers prefer small (∼100-1000m3) temporary ponding areas which fill during moderate to large storm events since they incur minimal loss of land. They also provide greater resillience to multi-day storm events, as they are designed to drain over 1-2 days and therefore allow for storage capacity for proceeding events. However, the performance of isolated temporary storage areas can be limited during extreme events. At larger scales taking a treatment train approach using a network of measures has been shown to achieve greater benefits, e.g. by reducing local flood peaks and capturing sediments.

Current local scale evidence presented here has been used to inform environmental policy on the correct placement and design of flood reduction measures. Further long term data collection is required to assess the larger scale impact of these measures. These data can be used to inform scenario-based modelling approaches. By holding and attenuating runoff in rural landscapes, benefits for local flood peak reduction, water quality improvement and sediment management can be achieved. However, there is still a need to examine the sustainability of such measures through long term environmental payment schemes, considering how they could be funded across generational timescales rather than political cycles, and to monitor these measures over longer timescales and in multiple settings.