Natural flood risk management in flashy headwater catchments: managing runoff peaks, timing, water quality and sediment regimes

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Over the past decade many European catchments have experienced an unusually high number of flood events. A large number of these events are the result of intense rainfall in small headwater catchments which are dominated by surface runoff generation, resulting in flash flooding of local communities. Soil erosion and related water quality issues, among others, are typically associated with such rapid runoff generation. The hazard of flooding is increasing owing to impacts of changing climatic patterns (including more intense summer storms), intensification of agriculture within rural catchments and continued pressure to build on floodplains. Concurrently, the cost of constructing and maintaining traditional flood defences in small communities outweigh the potential benefits. Hence, there is a growing interest in more cost effective natural approaches that also have multipurpose benefits in terms of sediment, water quality, and habitat creation. Many catchments in Europe are intensively farmed and there is great potential for agriculture to be part of the solution to flood risk management. Natural flood management (NFM) is the alteration, restoration or use of landscape features with the aim of reducing flood risk by slowing down, storing (and filtering) rapid surface runoff. NFM includes measures such as temporarily storing water in ponds/wetlands, increasing soil infiltration, planting trees on floodplains and within catchments, re-meandering and wood placements in streams/ditches.

In this presentation we highlight case studies from densely instrumented research sites across the UK (which could be typical of many European catchments) where NFM measures have been installed in small scale flashy catchments. The presentation will give an overview of the function of these measures in these catchments and how other multiple benefits are being accrued. Study catchments include the headwater catchments of the Bowmont (3 to 8 km2) and Belford Burn (6 km2) catchments. These catchments are known for their rapid runoff generation and have downstream local communities at risk of flash flooding. In Bowmont, NFM measures are currently being put in place to restore river bars and to store water more effectively on the flood plains during these flashy events. For example, Apex engineered wood structure in the river channel and riparian zones are designed to trap sediment and log bank protection structures are being installed to stop bank erosion. Tree planting in the catchment is also taking place. In the Belford catchment storage ponds and woody debris have been installed over the past five years to help to reduce the flood risk to the village of Belford. A dense instrumentation network has provided data for analysis and modelling which shows evidence of local scale flood peak reductions along with the collection of large amounts of sediment. A modelling study carried out (using a pond network model) during an intense summer storm showed that 30 small scale pond features used in sequence could reduce the flood peak by $\sim$35% at the local scale. Findings show that managing surface runoff and local ditch flow at local scale headwater catchments is a cost effective way of managing flashy catchment for flood risk and sediment control. Working with catchment stakeholders is vital. Information given by the local community post flooding has been useful in placing NFM measures throughout the catchments. Involving the local communities in these projects and giving them access to the data and model outputs has helped to develop these projects further.