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New process and management insights from pesticide data captured at high resolution in river catchments

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Upland surface water catchments are important drinking water source areas in both Northern Ireland and the Republic of Ireland, representing areas with lower potential for contamination and, therefore, treatment costs. In recent years, however, issues with pesticides and exceedances of the EU Drinking Water limit (0.1 μg L-1) in the raw water supply have become a concern.

This is the case with the selective herbicide 2-methyl-4-chlorophenoxyacetic acid (MCPA) which is widely used to control broadleaf weeds and, in particular, soft rush (Juncus effusus) cover. MCPA usage is prevalent in areas of marginal and upland agricultural land where it is applied by broadcast spraying in areas of rough grazing and pasture, usually in late spring and summer when drier ground allows access. However, as MCPA is highly susceptible to leaching and soils supporting rush growth are prone to waterlogging, applications in these areas are very vulnerable to loss to water bodies during runoff events. Despite being in widespread use for decades, there have been limited studies on the dynamics and environmental fate of MCPA or its impact on aquatic ecosystems.

A major initiative in Irish cross-border catchments (www.sourcetotap.eu) is investigating whether financial incentives to alter agricultural management practices in source water catchments could offset the costs of water treatment. High resolution monitoring is used to characterise MCPA fluxes at catchment scale and provide a baseline from which to gauge the effectiveness of the management measures implemented. For this, a programme of monitoring has been established across two major river catchments (c.350km2), using a paired catchment approach with one control and one treatment catchment. In both, pesticide transfers are captured in detail every 7 hours during the main risk period from April to November and at other times on a daily basis.

Initial analyses demonstrate that exceedances of the Drinking Water limit are more frequent ($\sim$37% of 7 hr samples) than indicated by weekly raw water samples at local water treatment works. The findings highlight that the extent of the MCPA issue is far greater than initially thought and that MCPA transfers are strongly driven by short duration storm events occurring over several hours to a day. Estimates of pesticide loads from the high resolution data are assessed and compared to regulatory monitoring, with implications for the water treatment process examined.

The suite of pesticides analysed alongside MCPA includes Trichlorpyr, Mecoprop and Fluroxypyr. These pesticides have a variety of agricultural applications, meaning they are used in different localities and at different times of year based on land use and crop type. They can therefore contribute to the understanding of the differences in sources, pathways and timings associated with MCPA transfers in the catchments. The analysis presented relates catchment physical characteristics and land management to temporal and spatial patterns in pesticide occurrence during low and high flow periods. Concentration-discharge responses during select storm events were analysed for all pesticides and the patterns in the hysteresis magnitude and direction are examined. Implications for agricultural management practices will be discussed.