AN EMPIRICAL APPROACH TO DIFFUSE POLLUTION – CAN WE DERIVE LAND-USE INSTENSITY THRESHOLDS?

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ABSTRACT

This paper analyses water quality and land-use patterns for some 3000 individual catchments on Irish rivers and streams. An attempt is made to derive land-use intensity "thresholds" as guidelines for planners and catchment managers tasked with controlling water pollution and preventing further degradation of ecological status. The Irish National Rivers Monitoring Programme incorporates ecological surveys at 3200 sites on some 13,200 km of river channel and some 2000 river sites also have physico-chemical monitoring. A 20-m resolution digital elevation map was used to delineate upstream catchments for over 3000 water quality monitoring sites on Irish rivers using custom-written software. GIS software was then used to clip the corresponding land-use characteristics for these 3000 catchments. Statistical analysis of land-use types versus water quality was carried out in an attempt to identify links between water quality and land-use. A Monte Carlo approach was used to select subsets of hydrologically independent catchments in order to produce confidence limits for the relationships. The direct link between water quality at the monitoring sites and the immediate upstream catchments provided a robust comparison between land-use patterns and water quality. Clear relationships between water quality and land-use were observed, with water quality improving as upstream land-use became less intensive. Land-use categories of varying levels of intensity were defined - intensive, less intensive and non-intensive. Urban areas were treated separately in order avoid confusion between diffuse and point source pollution in rural catchments. The results enabled probabilities to be assigned to the likelihood of achieving satisfactory water quality in rivers and streams flowing through land-use categories of different levels of intensification. A number of possible "cut-off" thresholds for land-use intensification are examined with a view to assisting catchment managers. Ongoing intensification of land-use will lead to degradation of water quality assuming no change in current practices. If such intensification thresholds are exceeded, then special additional measures will be required in order to maintain or restore good ecological status and satisfactory water quality. It is important to have such assessment tools for identifying the areas that are at risk from water quality degradation particularly as catchment management moves away from simply monitoring water quality to the implementation of highly targeted measures aimed at controlling pollution. The causes of serious pollution are usually very obvious but the causes of slight and moderate pollution may not always be so apparent. In this context it is hoped that the results will be of benefit to planners and river basin managers who have the target of achieving good water status within their River Basin Districts as required by the EU Water Framework Directive.

Keywords: Thresholds for land-use intensity, water quality, GIS, diffuse sources of pollution.