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Collaborative Catchment-Scale Water Quality Management using Integrated Wireless Sensor Networks

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Summary
The challenge of improving water quality (WQ) is a growing global concern [1]. Poor WQ is mainly attributed to poor water management and outdated agricultural activities. We propose that collaborative sensor networks spread across an entire catchment can allow cooperation among individual activities for integrated WQ monitoring and management. We show that sharing information on critical parameters among networks of water bodies and farms can enable identification and quantification of the contaminant sources, enabling better decision making for agricultural practices and thereby reducing contaminants fluxes.

Motivation and results
Nutrient losses from land to water have accelerated due to agricultural and urban pursuits [2]. In many cases, the application of fertiliser can be reduced by 30-50% without any loss of yield [3]. Thus information about nutrient levels and trends around the farm can improve agricultural practices and thereby reduce water contamination. The use of sensor networks for monitoring WQ in a catchment is in its infancy, but more applications are being tested [4]. However, these are focussed on local requirements and are mostly limited to water bodies. They have yet to explore the use of this technology for catchment-scale monitoring and management decisions, in an autonomous and dynamic manner.
For effective and integrated WQ management, we propose a system that utilises local monitoring networks across a catchment, with provision for collaborative information sharing. This system of networks shares information about critical events, such as rain or flooding. Higher-level applications make use of this information to inform decisions about nutrient management, improving the quality of monitoring through the provision of richer datasets of catchment information to local networks.
In the full paper, we present example scenarios and analyse how the benefits of collaborative information sharing can have a direct influence on agricultural practice. We apply a nutrient management scheme to a model of an example catchment with several individual networks. The networks are able to correlate catchment events to events within their zone of influence, allowing them to adapt their monitoring and control strategy in light of wider changes across the catchment. Results indicate that this can lead to significant reductions in nutrient losses (up to 50%) and better reutilization of nutrients amongst farms, having a positive impact on catchment scale water quality and fertilizer costs.

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