Phosphorus is a major pollutant of surface waters, contributing to poor water quality. A recent study investigated best management practices to reduce the over-application of phosphorus and minimise phosphorus losses from agriculture in four regions across Europe and North America.

**In Europe**, the Water Framework Directive\(^1\) and the Nitrates Directive\(^2\) include direct and indirect measures to control the use of phosphorus in agriculture and to reduce phosphorus pollution from agricultural land to surface and ground waters. Although phosphorus is essential for the healthy development of people, animals and plants, it can accumulate in soils if more is applied to land in chemical fertilisers and manure than is removed through harvesting of crops.

Phosphorus remains for a long time in soils and river and lake sediments and it takes many years of mitigation before improvements in water quality to be seen. In order to meet goals of sustainable agriculture and good water quality, the researchers identified common approaches to good practice in Denmark and Northern Ireland, as well as two regions in the United States; the Chesapeake Bay watershed and the state of Arkansas.

Although a wide variety of methods are used, the researchers detected some common trends based on a ‘mass balance’ approach. This tries to achieve a balance between the amount of phosphorus inputs (from fertilisers, feeds and animals) and phosphorus removal (for example, in crops, animals, manure, animal products).

In Denmark, loss of phosphorus from agriculture continues to be significant in lake and estuary eutrophication. This is in spite of progress in achieving a mass balance of phosphorus in over 25 years of environmental regulations. These have reduced the annual surplus of phosphorus in Denmark from 29 kg per hectare in 1980 to 11 kg per hectare in 2006.

In Northern Ireland, the use of inorganic phosphorous fertilisers has fallen, but imported feed concentrates have risen. Therefore, overall inputs of phosphorus to the agricultural system are still higher than the amount removed. This has led to research into low-phosphorus diets, regulations controlling manure application which are part of the action programmes under the Nitrates Directive and programmes to develop alternative uses of manure, such as energy sources, in order to restore rivers and lakes.

Nutrient management to control phosphorus was implemented as a result of declining water quality in the Chesapeake Bay watershed. These included regulating fertiliser and manure application through nutrient management plans, changes to the diets and feeds of animals to reduce phosphorus in manure, sharing the cost of installing buffer strips at the edges of fields along river courses, and reducing soil erosion through conservation tillage methods.

In Arkansas, the deteriorating quality of drinking water for the City of Tulsa, Oklahoma, led to a lawsuit against several poultry companies in the area. The settlement led to development of poultry litter management regulations lasting from 2003 to 2008. The length of time these regulations were in force has been too short to detect what impact they had on water quality.

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