Finding optimal size and location for wetland restoration sites for best nutrient removal performance using spatial analysis and modelling

Results in Brief

Identification of sites for wetland aids water quality

Wetlands play a vital role in removing excess nutrients from agricultural catchments, which can have a negative impact on water quality. An EU-funded project identified the optimal size for wetlands and mapped their location within agricultural areas to reduce nutrient levels.

The EU-funded Horizon 2020 OPTWET project developed a fast method of identifying suitable locations for wetland construction. This technique also determined the effectiveness of wetlands in removing nutrients and the best use of land in agricultural catchments for reducing nitrogen and phosphorus levels.
The suitability of a site for restoring or creating a wetland depends on many factors, like the underlying geology, soils, topography, hydrology, drainage, and land ownership. “Recording and characterising a site’s soils and hydrology often requires extensive, expensive, and time-consuming ground surveys and is therefore limited to small areas,” says researcher Dr Evelyn Uuemaa. “One solution is to use topography, the study of the shape and features of a landscape, which strongly determines water movement patterns,” she adds.

Researchers therefore used open source orthophotos and light detecting and ranging (LiDAR) data, which are freely available in New Zealand, to develop a fast and efficient method for identifying suitable locations for wetlands. Orthophotos are aerial photographs geometrically corrected so that the scale is uniform to accurately measure distances. LiDAR, acquired by remote sensing, provides detailed topographic information by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor.

Use of models

A simple suitability modelling approach that weights locations relative to each other based on given criteria helped identify the spatial distribution of the sites most suited to wetland creation or restoration. “For suitability modelling, we calculated several derivatives from the digital elevation model - slope, topographic wetness index, flow accumulation and stream size, and used them to determine suitability for wetland,” Dr Uuemaa explains.

As flooding of infrastructure like roads and farms must be avoided within the suitable area, researchers required infrastructure data for the study area. “We used orthophotos with a 30 cm pixel size for more detailed analysis of the infrastructure information and to identify the spatial distribution of the sites most suited to wetland creation or restoration,” comments Dr Uuemaa.

Another key result was a simple dynamic model for estimating the efficiency of nutrient removal of wetland and applying it to natural wetland. “The model demonstrated that small seepage wetlands in the headwaters of streams can be very effective at removing nitrogen loads,” claims Dr Uuemaa. “It is also easily applicable to other wetlands and is currently being implemented in France,” she adds.

Results mapped

The study helps raise awareness of the functions and value of small pastoral seepage wetlands located in the headwater areas of the catchments, which are not only important in terms of nutrient removal but also for biodiversity. As their nutrient removal efficiency per unit of land area is high, farmers may be more willing to leave these natural wetlands undrained and fence them to prevent the access of livestock,
which might damage the ecosystem.

OPTWET showed that analysis of the terrain using high-resolution topographical data can produce suitability maps for wetlands. These can be easily used by decision makers and planners for watershed management. “This rapid technique reveals potential wetland creation or restoration sites at a reasonable cost. With the help of the resulting map managers can plan for wetland creation or restoration without having to wait for field-data collection,” Dr Uuemaa concludes.

Keywords

OPTWET, wetlands, nutrient, water quality, catchment, orthophotos, LiDAR

Project Information

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