Landscape features

Impact: Nutrient leaching_run-off

Reference 31

Zhang, XY; Liu, XM; Zhang, MH; Dahlgren, RA; Eitzel, M 2010 Review of vegetated buffers and a meta-analysis of their mitigation efficacy in reducing nonpoint source pollution JOURNAL OF ENVIRONMENTAL QUALITY, 39, 76-84. 10.2134/jeq2008.0496

Background and objective

Agricultural nonpoint-source pollution has been listed as one of the leading sources of pollution in rivers and water bodies throughout the world. Vegetated buffers are a well-studied and widely used agricultural management practice for reducing nonpoint- source pollution. To quantify the relationships between pollutant removal efficacy and buffer width, buffer slope, soil type, and vegetation type.

Search strategy and selection criteria

Studies published in peer reviewed journals. 1) Studies provided quantitative results on pollutant removal by vegetated buffers.

Data and analysis

The aggregated efficacy data extracted from the reviewed studies were analyzed using a set of statistical procedures. Boxplots were created to examine the distribution of efficacy values. The relationship between pollutant removal efficacy and buffer width was fitted to the theoretical model using nonlinear regression analysis. The relationship between buffer slope and sediment removal efficacy was fitted to a segmented linear regression model. A preliminary statistical model with all the variables including buffer width, slope, vegetation type, soil drainage type, and site was built and tested for the significance of each independent variable. As none of the interaction terms among these variables were significant, the models were built without them. To examine the differences between and within study sites, a mixed effect model was first built with a random error associated with site. However, the parameter of site and its associated random error were found to be not significant with P values > 0.8 for all pollutant models. Therefore, site was removed from the models. Models were selected based on their goodness-of-fit measures such as the R2 value and adjusted R2 value. All the statistical analyses were performed using SAS 9.1 and SigmaPlot 10.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
73	Agricultural fields	Outflow from vegetated buffers	Inflow into vegetated buffers	Metric: Efficacy N mass retention; efficacy P mass retention; Effect size: Percentage of the considered metrics in the intervention that represents the difference of the considered metrics between intervention and control	56%

Results

- The median removal efficacy for N was 68.3%. Nitrogen removal efficacy has a range of 2.2–99.9% and standard deviation = 21.1. The median removal efficacy for P was 71.9%. Phosphorus removal efficacy has a range of 22– 96.3% and standard deviation = 21.1.

- Buffer width alone explains 44% of the total variance in removal efficacy for N and 35% of the total variance in removal efficacy for P.
- Buffers composed of trees have higher N and P removal efficacies than buffers composed of grasses or mixtures of grasses and trees.
- NA
- NA

Factors influencing effect sizes

- Buffer width : The removal efficacy increases quickly with increase in buffer width and the rate of increase becomes smaller as the buffer gets wider until the efficacy approaches a maximum value (the removal capacity).
- Buffer vegetation type : Buffers composed of trees had a higher removal efficacy than buffers composed of grasses or mixed grasses and trees.
- NA : NA

Conclusion

Vegetated buffers are effective for removing N and P.