Landscape features

Impact: Soil erosion

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 sediment 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 sediment was 86%. Sediment removal efficacy has a standard deviation = 14.4 with a range of 45 to 100%.
- Buffer width alone explains 37% of the total variance in removal efficacy for sediment.

- Buffer slope was linearly associated with sediment removal efficacy either positively (when slope ≤ 10%) or negatively (when slope > 10%).
- 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 slope : The break point where the relationship between buffer slope and sediment removal efficacy changes from positive to negative is estimated to be 10% with a 95% of confidence interval of 8.14 to 11.72%.
- Buffer vegetation type : Buffers composed of only grasses or trees remove more sediment than that with mixed grasses and trees.

Conclusion

Vegetated buffers are generally effective in removing sediment from runoff. Buffer width, slope, and vegetation type are important factors for designing an effective buffer.