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Delineating Effective Riparian Buffer Widths for Water Quality Protection

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Delineating Effective Riparian Buffer Widths for Water Quality Protection

Objective

Agricultural pollution added to streams has shown to be a major problem throughout the world. The use of vegetated strips between farm fields and adjacent streams is one technique to reduce loadings of sediment and chemical pollutants to streams draining agricultural lands. These runoff buffer zones are commonly referred to as riparian buffer strips.

A major problem associated with designing riparian buffers is in determining the appropriate width for buffers in a specific setting. This case study demonstrates a GIS-based method for determining the efficiency of riparian buffers in agricultural watersheds.

Method

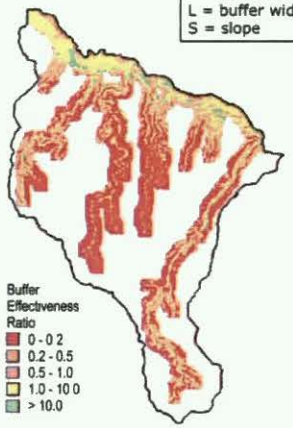
Phillips´ Riparian Buffer Delineation Equations (RBDE) are one way for selecting appropriate riparian buffer widths for water quality protection. The methodology includes separate formulae for predicting the effectiveness of buffers in attenuating (1) sediment (and adsorbed pollutants) delivered by overland flow (Bagnold´s law) and (2) dissolved pollutants transported primarily through subsurface routes (Darcy's law and Manning equation). The hydraulic version of the RBDE was calculated for the Tuis watershed in Costa Rica, in GRID ARC/INFO. The method requires the selection of a reference buffer which is used to compare buffer effectiveness for riparian areas. A land cover map was made from satellite imagery.

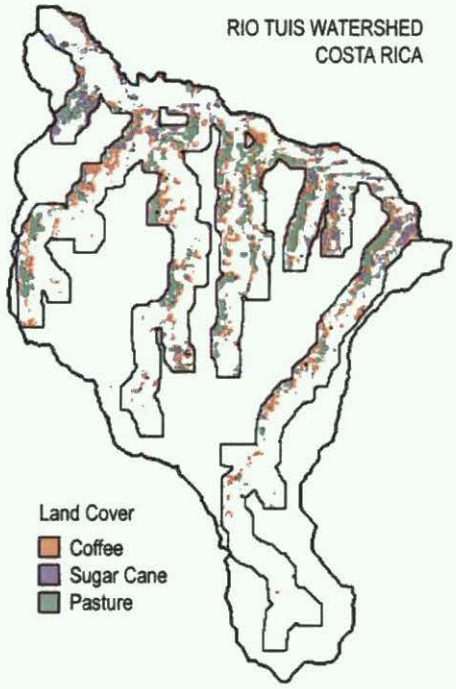
Riparian Buffer Delineation Equations (any units of measure are acceptable)

(1) Hydraulic Model $B = (n_b/n_r)^{0.6}(L_b/L_r)^{0.4}(K_b/K_r)\,(S_r\ /S_b)^{1.3}$

(2) Detention Time Model $B = (n_b/n_r)^{0.6}(L_b/L_r)^{2}(K_b/K_r)^{0.4}(S_r/S_b)^{0.7}\,(C_b/C_r)$

B = buffer effectiveness ratio
K = saturated hydraulic conductivity of the soil
L = buffer width or slope length
S = slope
n = Manning's roughness coefficient
C = soil moisture storage capacity
b = value for the proposed buffer
r = value for the reference buffer





Above: *Results of the RBDE model applied in a raster GIS. The values indicate the riparian buffer effectiveness of a given area compared to a selected reference buffer.*
Right: *Areas in the Tuis Watershed with non-forested land covers and buffer effectiveness ratios less than 1 (less effective than the reference buffer).*

Result

The resulting maps give land managers an objective basis to evaluate the need for establishing riparian buffer strips. The model results can be used as a guide for determining erosion susceptibility and pollution potential of riparian areas.

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