Effective slope lengths for buffering hillslope surface runoff in fragmented landscapes in northern Vietnam

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Abstract: We use field observations and diagnostic computer simulations (KINEROS2) to estimate the effective slope lengths (ESL) for buffers on disturbed hillslopes in two fragmented basins in northern Vietnam. Grassland, disturbed forest, and intermediate forms of secondary vegetation are the most effective buffering vegetation in the study area because these surfaces tend to have the highest saturated hydraulic conductivity. The ESL (m) is described by the following function of slope (m m^{-1}): ESL = 98 + 15 ln(slope). This non-linear relationship predicts comparatively longer buffer lengths at gentle slope gradients than guidelines/practices currently in use. The predicted buffer lengths range from roughly 30 to 100 m for slope gradients ranging from 0.01 to 1.0 m m^{-1}. However, for large storms, steeper slopes, and/or more degraded conditions, buffer lengths greater than those predicted by the ESL criteria may be needed to minimize impacts from overland flow. On slopes with particularly large contributing areas, multiple or staggered buffers may be required. For the occurrence of concentrated overland flow, no practical buffer length may be sufficient. The ESL estimations provide a starting point for determining appropriate buffer dimensions needed to infiltrate upslope surface runoff in disturbed montane watersheds at the study site. Final determination of buffer dimensions should consider the physical characteristics of contributing hillslopes, the nature of the material to be filtered (e.g., water, sediment, chemicals, nutrients), and the likelihood of adoption of any buffering practice. Finally, buffers should be regarded as complementary practices to other hillslope conservation activities. Recognizing that the use of long buffer lengths may not be feasible for steep terrain in intensely managed tropical watersheds, we derive a second equation to predict the minimal effective slope length (MESL) for buffers: MESL = 32 + 4 ln(slope). MESL values range from approximately 15 to 30 m over the same slope gradients, but they are less effective at reducing HOF than ESL buffers, particularly for large storms when erosion risk is highest. ?? 2005 Elsevier B.V. All rights reserved.

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