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Spatial and Temporal Distribution of Runoff Generation Areas and their Hydrologic Connectivity on a Pasture Hillslope

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Abstract Text:

Spatial and temporal variations in hydrologic behavior of a watershed directly impact nutrient, such as phosphorus, nitrogen, and other pollutant transport from land to water. To understand hydrologic response of a natural landscape, it is important to study hydrologic connectivity of surface runoff generation areas. Hydrologic connectivity refers to the water movement from one location to another on a landscape and which can generate some surface runoff response. In this study, a complete understanding of hillslope surface runoff response during a rainfall event, with respect to runoff generation mechanisms, spatial and temporal distribution of runoff generation areas and their hydrologic connectivity is being developed in a North Alabama pasture hillslope. A pasture hillslope (0.12 ha) has been intensively instrumented in the Appalachian Plateau region of North Alabama using distributed sensors, tipping bucket rain gauge, and HS-flume. Surface runoff response from three rainfall events of different intensities and durations will be presented. Results from all three rainfall events show that infiltration-excess is the dominant surface runoff generation mechanism on pasture hillslopes in this region. The data also demonstrated considerable spatial and temporal variability in runoff contributing areas within the hillslope. Study suggested that high-intensity, short-duration rainfall events were crucial in producing connectivity of runoff contributing areas as compared to low-intensity, long-duration events. Hydrologic characteristics such as rainfall intensity and soil hydraulic conductivity seem to play dominant roles in surface runoff generation. This study demonstrated that since rainfall intensity and soil hydraulic conductivity dictate runoff generation, only connected areas of low hydraulic conductivity generate surface runoff during high intensity rainfall events. Field data are being analyzed to quantify spatial and temporal distribution of the areas that contribute dynamically to surface runoff generation. Quantification of these areas would serve as an important foundation in development of watershed management plans to alleviate water quality problem.

Impact Statement:

This study showed that knowledge of relevant hydrologic processes and runoff-generation mechanisms are important for devising solution to fully address P and other water quality issues at the watershed-scale.