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The effects of multiple factors on spring meltwater erosion on an alpine meadow slope

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Serious soil erosion is observed during the spring because soil thawing coincides with the period of snowmelt and low meadow coverage at this time. Studies relating to soil erosion caused by spring meltwater are limited and controversial. In this study, a field experimental study was conducted in an alpine meadow slope in the Binggou watershed on the northern edge of the Tibetan Plateau to assess the impact of multiple factors on spring meltwater erosion. The multiple factors included three flow rates, four slope gradients, and three underlying surface conditions (meadow, disturbed meadow, and alluvial soil). An equal volume of concentrated meltwater flow was used in all experiments. The results showed that rapid melting at a high flow rate could accelerate soil erosion. The influence of the slope gradient on the amount of runoff was positively linear and the influence was relatively low. However, the slope gradient had a strong impact on soil erosion. The meadow could effectively reduce soil erosion, although when the meadow was disturbed, the total runoff increased by 60% and the sediment yield by a factor of 1.5. The total runoff from the alluvial soil doubled in comparison to the meadow, while the sediment yield increased nearly 7-fold. The findings of this study could be helpful to understand the characteristics and impact of multiple controlling factors of spring meltwater erosion. It also aims to provide a scientific basis for an improved management of alpine meadows as well as water and soil conservation activities in high-altitude cold regions.