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Impact of Clear Cutting on Sedimentation Dynamics: A Case Study in Naturalized Mature Pine Plantation, Tropical Lowland, Sri Lanka

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Abstract

Vegetation plays a crucial role in regulating soil erosion through its roots, canopy, and litter layers, reducing surface runoff and sediment transport. However, removal of vegetation through clear-cutting amplifies soil erosion, increasing the frequency and magnitude of sediment yield. However, limited research has been conducted on the specific effects of clear-cutting on sediment yield. This study investigates the impact of clear cutting and replanting on sediment yield in a naturalized mature *Pinus caribaea* plantation in the tropical lowlands of Sri Lanka. Three surface runoff plots (10 m × 3 m) were established on slopes within the plantation, representing overall site characteristics. Slope, canopy cover, ground vegetation cover, and litter thickness within each plot were measured. The before-felling (BF) period was considered the control, while after-felling (AF) and after replanting (AR) periods were considered the treatments. Rainfall and sedimentation were recorded for individual storm events from July 2023 to February 2024, covering the southwest monsoon period, second inter-monsoon period and north-east monsoon periods. Out of 92 storm events, 46 events with rainfall between 1 mm and 18 mm were used for the data analysis. Sediment samples were oven-dried at 105°C for 24 hours, and sieve analysis was conducted to assess grain size distribution. The average sediment yield was 1.50 g/m², 2.48 g/m², and 0.42 g/m² during BF, AF, and AR periods, respectively. Clear cutting increased sediment yield by 65.3% while replanting reduced it by 83.1%. The results indicate a significant difference *($P<0.05$)* in sediment yield among the three periods. Positive correlations were found between rainfall and sediment yield, while canopy cover, ground vegetation cover, and litter thickness were negatively correlated with sediment yield. Sieve analysis revealed that coarse grains constituted the highest sediment output, with fine grains being the least represented across all phases. Loss of vegetation cover and canopy cover and soil compaction through forest clear-cutting increases sedimentation yield. Sieve analysis results indicate that the quantity of sediment yield was affected by the felling practices, rather than the texture of the resulting sediment. These findings highlight the importance of forest management practices to mitigate soil erosion and sedimentation in *Pinus caribaea* plantations in tropical lowlands, ensuring sustainable forest management practices.

Keywords: *Clear-cutting, Forest management, Pinus caribaea, Sediment yield, Sieve analysis*