EVALUATION OF GRAIN LEGUMES AS BIOLOGICAL SOIL CONSERVATION MEASURES IN SLOPING LANDS UNDER ANNUAL CROP CULTIVATION

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Intensive annual crop cultivation on the steep slopes of Sri Lanka's central highlands generates over 70% of the nation's domestic supply but triggers severe soil erosion and nutrient depletion. Polyethylene mulches and structural controls are financially inaccessible and environmentally unsustainable for resource-poor smallholders. This study evaluated the potential of short-duration grain legumes as low-cost biological conservation alternatives to minimize erosion and preserve soil fertility. A field experiment was conducted using a Randomized Complete Block Design with three replications at the Natural Resources Research and Soil Conservation Demonstration Unit, *Kundasale* (40% slope). The field experiment was started from May 2025 and continued with laboratory analysis up to March 2026 and monitored soil response across six rainfall events. Treatments included two Green gram varieties (MIMB 7, MI 6), Black gram, and a bare land control. Soil properties (pH, EC, available phosphorus (P), available potassium (K), and organic matter (OM)) were monitored following rainfall events and analyzed using standard laboratory methods. Data analysis was done using GLM procedure in SAS. The bare land control suffered rapid degradation and nutrient stripping due to unshielded rainfall. Conversely, leguminous treatments successfully stabilized the soil chemical profile by reducing surface runoff and anchoring topsoil. Genotypic variations significantly influenced conservation efficiency. Green gram MIMB 7 and MI 6 varieties performed significantly better than other treatments ($P < 0.05$) due to rapid canopy closure and efficient rooting, with MIMB 7 performed best retaining the highest available P (6.34 mg kg^{-1}), available K (41.63 mg kg^{-1}), and OM (1.31%), while MI 6 retained available P (5.42 mg kg^{-1}), available K (38.70 mg kg^{-1}), and OM (1.20%) by trial termination. In contrast, bare land control showed the highest acidification at pH 5.11 with the lowest nutrient retention of available P (4.53 mg kg^{-1}), available K (31.20 mg kg^{-1}) and OM (1.02%). Erosion reduction is inferred based on improved nutrient retention and vegetative cover and rooting by legumes. Results suggest that integrating fast-growing grain legumes like Green gram varieties MIMB 7 and MI 6 can serve as an eco-friendly, highly accessible strategy to mitigate highland erosion, enhance nutrient retention, and secure smallholder farming resilience.

Keywords: central highlands, land degradation, soil fertility, soil nutrient depletion