**Sedimentation Dynamics Analysis in the Muda Dam Watershed Using the Universal Soil Loss Equation (USLE)**

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***ABSTRACT***

Dam sedimentation presents significant challenges to water resource management, impacting reservoir capacity and ensuring long-term functionality and sustainability of dam infrastructure. This study presents a comprehensive approach to monitoring dam sedimentation using the Universal Soil Loss Equation (USLE). USLE can provide valuable insights for predicting soil erosion processes in a watershed, and its application in the context of dam sedimentation offers a valuable tool for estimating sediment yield. Continuous monitoring of sedimentation trends allows for timely decision-making in dam management and sediment control strategies. The research involves integrating field data, remote sensing, and GIS techniques to assess the factors contributing to sedimentation within the Muda Dam watershed. Detailed soil characteristics, multi-temporal land use patterns, rainfall data, and topographical information are incorporated into the USLE framework to quantify soil erosion rates. The land use pattern from 2015 to 2021 was analyzed using multi-temporal Landsat 8 OLI images. The findings show the highest soil loss, ranging from 100 to 150 tons per hectare per year, occurred in the sub-catchment areas of Sungai Boho, Sungai Laso, Sungai Lasor, Sungai Muda 1, and Sungai Teliang for the years 2015, 2016, 2018, 2019, and 2021, respectively. While the annual soil erosion yield was 317,857.06 tons per hectare in 2015, 213,535.5 tons per hectare in 2016, 398,739.5 tons per hectare in 2018, 196,331.2 tons per hectare in 2019 and 6.9 tons per hectare in 2021. Bathymetric measurements reveal that the reservoir's volume decreased by nearly 13.55 million cubic meters (MCM) from 2015 to 2021, resulting in a sedimentation rate of approximately 2.26 MCM per year. The integrated approach presented in this study offers a robust framework for monitoring and predicting dam sedimentation, ultimately aiding in developing effective sediment management strategies for reservoirs.

**Keywords:** land use change, sedimentation, soil loss,