P09

Simulation of erosion susceptibility in the Medjerda-Mellgue Watershed under different climate change scenarios

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The Medjerda-Mellgue basin in North of Algeria (Fig.01) encounters considerable issues with soil erosion and sediment transport, affecting dam efficiency and reservoir sedimentation rates. Algeria has recorded more than 50 million hectares of eroded land (Bouamrane et al., 2021). The region experiences frequent flash floods, possesses fragile soil composition, and exhibits insufficient vegetative cover, all contributing to elevated sediment discharge rates. These characteristics make the watershed more vulnerable to erosion, highlighting the importance of understanding and predicting these patterns for effective management. This research is crucial for establishing measures to mitigate the effects of erosion and sedimentation on water resource infrastructure, especially considering that these challenges may worsen due to climate change (Boulmaiz et al., 2024).

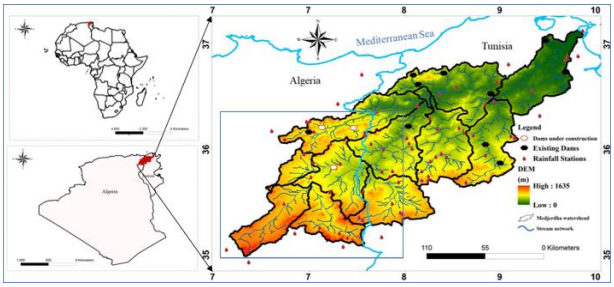

Figure 01: Geographic location of Medjerda-Mellgue basin.

Advanced machine learning techniques were employed to address this, specifically Gradient-Boosted Decision Trees (GBDT) and Deep learning neural network (DLNN) (Bouamrane et al., 2024). These approaches were used to forecast the vulnerability to erosion and potential sediment yield in the basin under different climate change scenarios, including changes in vegetation cover management. The study integrated eight primary variables **(Fig.02)** into its research: digital elevation model, stream power index, slope length, topographic wetness index, rainfall erosivity, soil erodibility factor, cover management, and distance from the river basin. These variables were derived from extensive field research, grid data analysis, and digital elevation models (DEMs) examination.

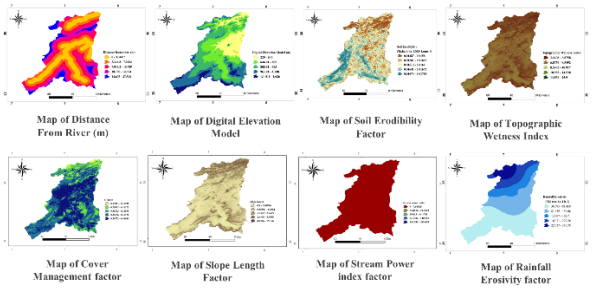

Figure 02: Input data.

The study utilized the most recent CMIP6 data to incorporate different climatic scenarios, focusing on monthly total precipitation for three selected future periods: 2021 to 2080 **(Fig.03)**

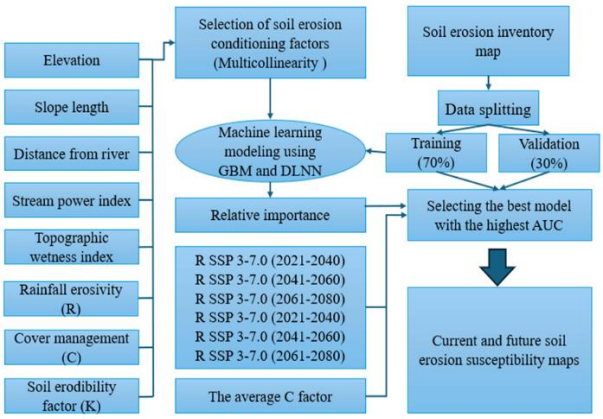

Figure 03: research methodology.

The investigation considered the SSP126 and SSP370 scenarios . According to the forecasts, climate change is expected to intensify current conditions by increasing the frequency and severity of hydrologic extremes, worsening concerns related to soil erosion and sediment transport. The research conducted systematic dataset partitioning, allocating 70% of the data for model training and reserving the remaining 30% for testing. An assessment of model performance using Receiver Operating Characteristic (ROC) curves showed high precision for both models however the GBDT**(Fig.04)**

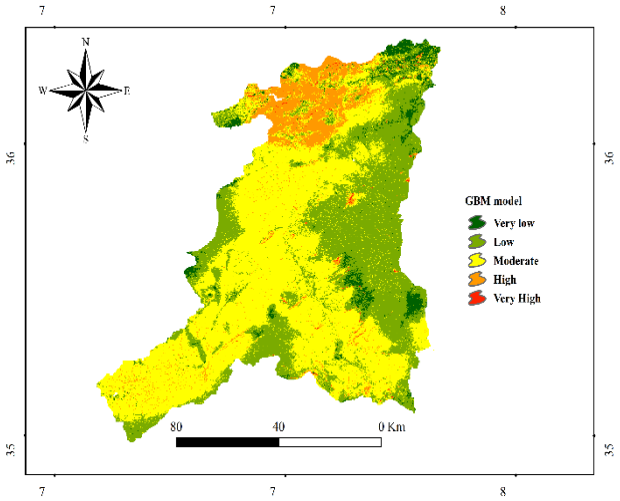

Figure 04: Soil erosion susceptibility using GBM model .

model achieved the highest level of accuracy, followed by the DLNN **(Fig.05)** model.

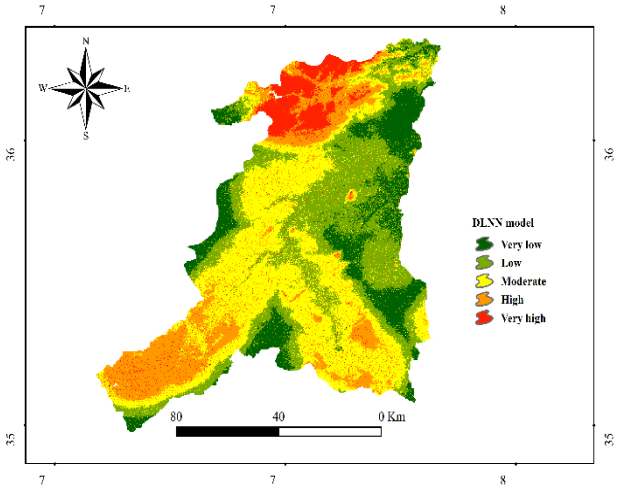

Figure 05: Soil erosion susceptibility using DLNN model.

The study identified slope length and cover management as the most significant predictors of erosion vulnerability, highlighting their critical influence on soil erosion dynamics within the basin.

In conclusion, the findings of this research emphasize the critical role of the GBDT model in accurately predicting soil erosion within the basin, offering valuable insights for dam operators and water resource managers. The study underscores the pressing need for adaptive management strategies to address the growing risks posed by climate change and to mitigate the impacts of erosion and sediment transport in this ecologically vulnerable watershed. By leveraging these predictive capabilities, stakeholders can enhance sustainable water resource management practices, ensuring long-term resilience and environmental protection.

References:

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