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The Use of Empirical Models to Estimate Soil Erosion in Arid Ecosystems and the Importance of Native Vegetation

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Abstract : When humans mismanage arid landscapes, soil erosion can become a primary mechanism that leads to desertification. This study focuses on applying soil erosion models to a disturbed landscape in Umm Nigga, Kuwait, and identifying its predicted change under restoration plans, The northern portion of Umm Nigga, containing both coastal and desert ecosystems, falls within the boundaries of the Demilitarized Zone (DMZ) adjacent to Iraq, and has been fenced off to restrict public access since 1994. The central objective of this project was to utilize GIS and remote sensing to compare the MPSIAC (Modified Pacific South West Inter Agency Committee), EMP (Erosion Potential Method), and USLE (Universal Soil Loss Equation) soil erosion models and determine their applicability for arid regions such as Kuwait. Spatial analysis was used to develop the necessary datasets for factors such as soil characteristics, vegetation cover, runoff, climate, and topography. Results showed that the MPSIAC and EMP models produced a similar spatial distribution of erosion, though the MPSIAC had more variability. For the MPSIAC model, approximately 45% of the land surface ranged from moderate to high soil loss, while 35% ranged from moderate to high for the EMP model. The USLE model had contrasting results and a different spatial distribution of the soil loss, with 25% of area ranging from moderate to high erosion, and 75% ranging from low to very low. We concluded that MPSIAC and EMP were the most suitable models for arid regions in general, with the MPSIAC model best. We then applied the MPSIAC model to identify the amount of soil loss between coastal and desert areas, and fenced and unfenced sites. In the desert area, soil loss was different between fenced and unfenced sites. In these desert fenced sites, 88% of the surface was covered with vegetation and soil loss was very low, while at the desert unfenced sites it was 3% and correspondingly higher. In the coastal areas, the amount of soil loss was nearly similar between fenced and unfenced sites. These results implied that vegetation cover played an important role in reducing soil erosion, and that fencing is much more important in the desert ecosystems to protect against overgrazing. When applying the MPSIAC model predictively, we found that vegetation cover could be increased from 3% to 37% in unfenced areas, and soil erosion could then decrease by 39%. We conclude that the MPSIAC model is best to predict soil erosion for arid regions such as Kuwait.

Keywords : soil erosion, GIS, modified pacific South west inter agency committee model (MPSIAC), erosion potential method (EMP), Universal soil loss equation (USLE)
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