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INTEGRATION OF DIGITAL TERRAIN MODEL, THMATIC MAPPER, AND SOIL QUALITIES FOR LAND DEGRADATION AND SUITABILITY MODELING: EL-OMYED-NW COAST, EGYPT.

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Summary

The present study aims to integrate GIS and RS technologies in assessing and modeling runoff, land degradation and land suitability of land resources in NWC in order to help the planners and the decision makers to organize the environmental data, and understanding their spatial association. At a representative area at Omyed, NWC, the specific objectives are:

1- Spectral analysis of TM Satellite Image in order to assess the most informative bands, the optimum spectral classes, and the accuracy of the different spectral classification techniques.
2- Topographic analysis to assess the Digital Terrain Model and surface characteristics.
3- Soil Units Assessment to define the main physical, chemical, and spatial characteristics of the main soil taxonomic and soil mapping units.
4- GIS modeling in order to assess rainfall-runoff, soil water erosion hazard, and land suitability for specific uses.

The study area lies in the northern part of the Western Desert of Egypt, situated about 68 km to the west of Alexandria City. It is bounded to the north by the Mediterranean Sea and extends about 25 km in the north south direction. The study area is bounded by longitudes 29° 00′ 00" & 29° 22′ 30" E and Latitudes 30° 37′ 30" & 30° 52′ 30" N. The total area of the study area is of about 860.6 Km^2. the area characterized by a the short rainy season begins during the latter part of October with 75% of the annual rainfall occurring in November through March and the long hot summer that characterize the North Western Coast which has a Mediterranean climate. The geological formation of the North Western Coast shows that it is essentially covered by sedimentary rocks belonging to the Tertiary and Quaternary periods. The most of the soils are young and characterized by the absence of diagnostic horizons and the only prominent features of development are calcic, gypsic, and salic horizons. The main source of surface water in the study area is precipitation. The surface runoff occurs during and immediately after the rainy periods and depending on some factors such as slope of the

ground surface and areal extend of the catchment area. The ground water occurs under both free water table and perched conditions. The Coastal strip region of the western desert of Egypt is recognized as one phyto-geographical region, Mediterranean. Most of the vegetation species in this area are annual weeds that flourish during the rainy season, giving the area a temporary chirpy grassland appearance. Most of the study area is unused land, the land uses in the study area are cultivated areas, Urban areas, and Quarries. Cultivated areas are irrigated by Bahig canal extension or as scattered small areas depending on rainfall and wells. Urban areas presented as village (Roysat village), tourism area comprises of resorts located at the north along the Mediterranean sea shore line, protectorate (Omyed protectorate), and military city (Mobarak military city). Quarries are located mostly at south and as few small scattered quarries at north and these quarries are for Gypsum, Limestone extraction, and also for cutting of the ridges which are of limestone. The raw TM image was geometrically corrected using six topographic maps scale (1:25,000) covering the study area namely ;Roysat, Ammied, Kasaba Sharkya, Madinate Mobarak, Alam El Haolfa, and been Gaber. The obtained Root Mean Square Error (RMSE) was 0.175. Image enhancement is done by digital image histogram manipulation. The Soil Adjusted Vegetation Index (SAVI) used to identify the variation in natural vegetation cover and agricultural land in the study area. Five vegetation categories were identified which are: no natural vegetation, slight natural vegetation, slightly dense natural vegetation, crops, and fruit trees. For an accurate multivariate classification of the TM image, the most informative bands and the thresholds of the spectral classes are determined. The most informative bands were qualitatively determined by studying radiometric transects and feature spaces. This determination was confirmed by the calculation of the bands intercorrelation matrix and the optimum index factor (OIF). The results of these analysis revealed that TM1, TM2, and TM7 compose the informative bands combination because they have the contrary spectral behavior, have the widest spread area of pixels, and have the lowest bands intercorrelation. the spectral classes centers were determined by the statistical characterization of test zones which represent all spectral variation of the studied area. One hundred test zones were located on the TM image of the study area by studying the radiometric horizontal, vertical and oblique transects of the digital image. These test zones were ranked and based on the mean and standard deviation in order to determine the highest fifty spectral non-uniformity test zones. The hierarchical clustering grouped these fifty test zones into 15 clusters and each cluster, which consisted of test zones having maximum spectral uniformity, was represented by a selected test zone. These selected test zones were assigned as the thresholds of multiband classification. Four image classification approaches were performed and assessed for accuracy to select the most accurate technique for mapping the spectral soil surface units of the study area. These classification techniques are unsupervised, hybrid, principal components, and biased principal components classification techniques. the accuracy assessment analysis was done by the interpretation of the confusion matrices for these classification techniques. The results of the accuracy showed that, the unsupervised

classification produced the lowest overall accuracy which is 73.97%, The hybrid classification produced an overall accuracy of 88.78 %, the classification of the principal components analysis produced an overall accuracy was 80.87 %, and The biased principal component classification produced the highest overall accuracy, for mapping the soil surface units, which is 97.93 %. The six topographic maps of the study area were scanned for digitizing the lines, points, and polygons features, geo-referenced to the Universal Transverse Mercatore (UTM) projection. And finally edge matched and merged to be prepared for analysis. The Digital Terrain Model (DTM) then obtained from the contour lines and spot heights by the thin –plate spline exact interpolation technique. The validation statistical procedure of this technique predicted a mean value of 2E-05 and a Predicted Root Mean Square Error (PRMSE) value of 0.011 and. These results of the validation procedure gives a very good assumption that the decision about choosing the interpolation technique is good, the predicted values centered on the true values, and the resulted Digital Terrain Model (DTM) is unbiased and valid for the further analysis. A filling operation were performed to produce a corrected Digital Terrain Model (DTM). Shaded relief maps were produced to present the terrain, use in the landform analysis, and enhance the final produced maps. A terrain analysis on the Digital Terrain Model (DTM) were performed to obtain valuable information about the land surface. The slope analysis revealed that, 85.07 % of the area are flat to nearly level (0 – 1%), 14.7 % of the area are very gently slope to sloping (1 – 10 %), 0.23 of the area are strongly sloping to moderately steep (10 15 %), and 0.01 of the area are steep (>30 %). The directions of the slopes of the study area were determined by the aspect which result that the directions of the area are flat (5.2%), north (22.95%), northeast (8.21%), east (7.2%), southeast (12.7%), south (13.36%),southwest (6.2%), west (6.24%), and northwest (17.95%). The directions of flow in the study area obtained by the flow direction which resulted that the direction are north (24.04%), northeast (6.59%), east (15.11%), southeast (10.10%), south (14.75%), southwest (4.72%), west (9.66%), and northwest (15.03%). The flow accumulation is calculated for determining the stream networks and watersheds of the study area. The stream networks are defined and ordered to the fifth order. The watersheds are defined and the result is 49 defined watershed in the study area.

Four sample areas were selected representing the different mapping units. The soil profiles were carefully described in Situ, their morphological features were recorded and samples were collected for laboratory analysis. The soil analysis aimed to evaluate the physical and chemical properties of these soils for the purpose of their mapping, classification, water erosion hazard, and evaluation. The results showed that……

The soil classification was performed on the bases of the American Soil Taxonomy (1999). The studied soils were classified to sub great group for mapping units.

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