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Abstract

Degradation processes, especially of agricultural drylands, closely relates to both excessive human exploitation of land resources and inherent ecological fragility of such systems. Egypt has the largest population in the Middle East. Ninety-five per cent of the population lives on only 4% of the land. Agricultural conditions are harsh. Due to lack of rain, arable land represents only 3% of the total surface area of the country. About 70% of the arable land consists of traditional valley and delta (oldlands), while 30% is former desert area that has been reclaimed (newlands). The improvement in the agricultural productivity of the newlands has been slow and required considerable time for achieving sufficient productivity levels. Additionally, newly reclaimed desert soils are often vulnerable to degradation given their fragility. The main objectives of this study were assessment, qualifying, and mapping the most sensitive areas to degradation according to the MEDALUS approach. The objectives were accomplished via: a) analyzing multiple soil, climate, water irrigation, vegetation, and land management quality indicators as main factors that affect land degradation process; b) producing different raster layers in GIS for each indicator; and c) calculating the environmental sensitivity area index (ESAI) based on these indicators. The results indicate that ESAI for the Bustan 3 area, Egypt ranged from <1.3 to >1.5. Around 7% of Bustan 3 is considered a fragile agro-ecosystem (<1.3) with degree of limitation ranging from 1 to 2. About 85% of Bustan 3 is classified as critical ESAI (1.3-1.5) due to soil and climate factors. Finally, around 7% of the investigated area has the highest critical ESAI which requires more attention for sustainable management.

Keywords: Land Degradation, MEDALUS, GIS mapping

Materials and Methods

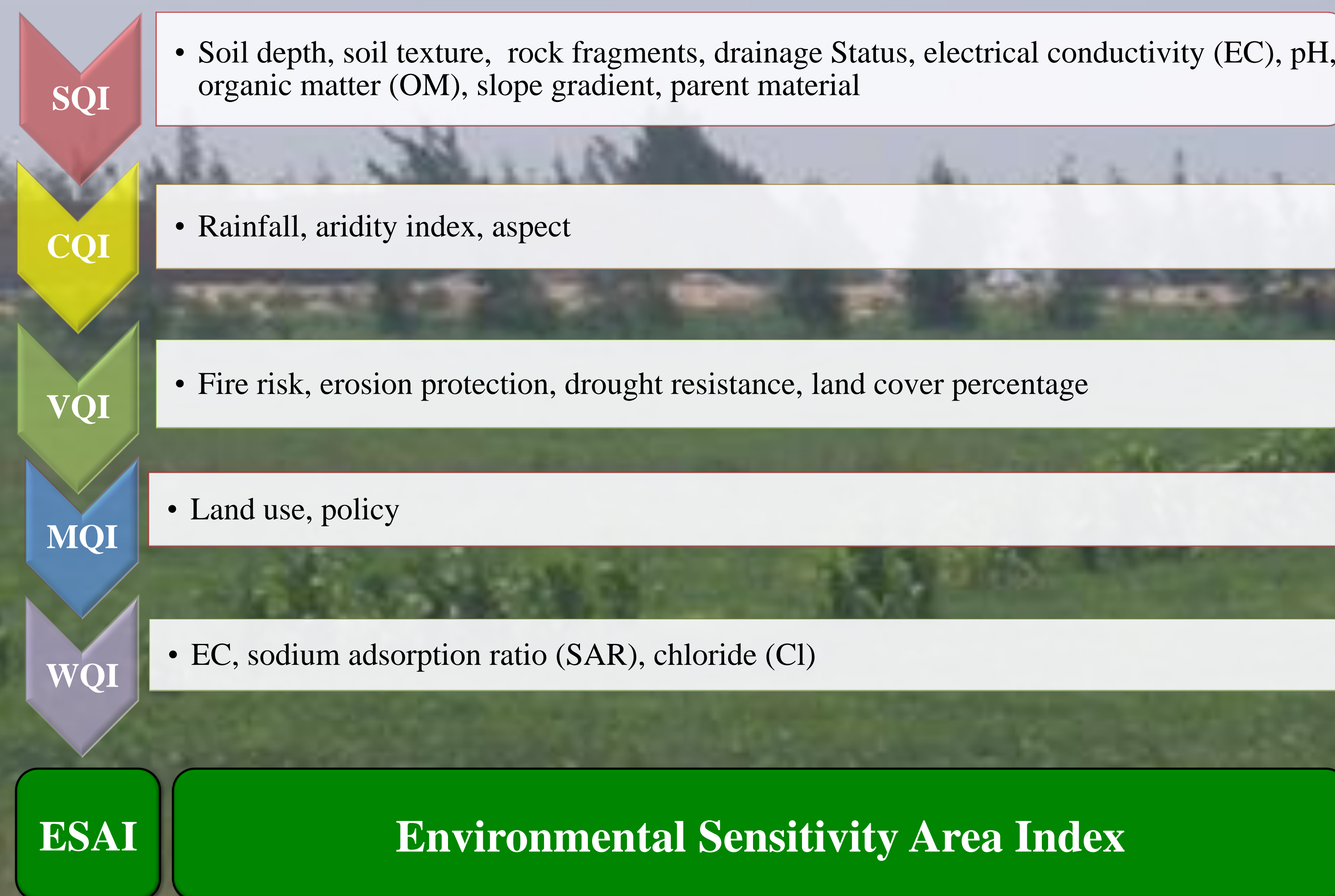
Five quality indices (soil, climate, vegetation, management, and water) were determined. The Mediterranean Desertification and Land Use (MEDALUS) approach (Kosmos et al., 1999) was used as a key indicator for mapping environmentally sensitive areas prone to desertification in the Bustan 3 area, Egypt. A sensitivity score system was applied, based on the estimated degree of correlation between various factors and the sensitivity of land degradation (Salvati and Bajocco, 2010). Quality indices were calculated using the equation:

$$Index_i = [(Parameter_1) \times (Parameter_2) \times (Parameter_3) \times \dots \times (Parameter_n)]^{1/n}$$

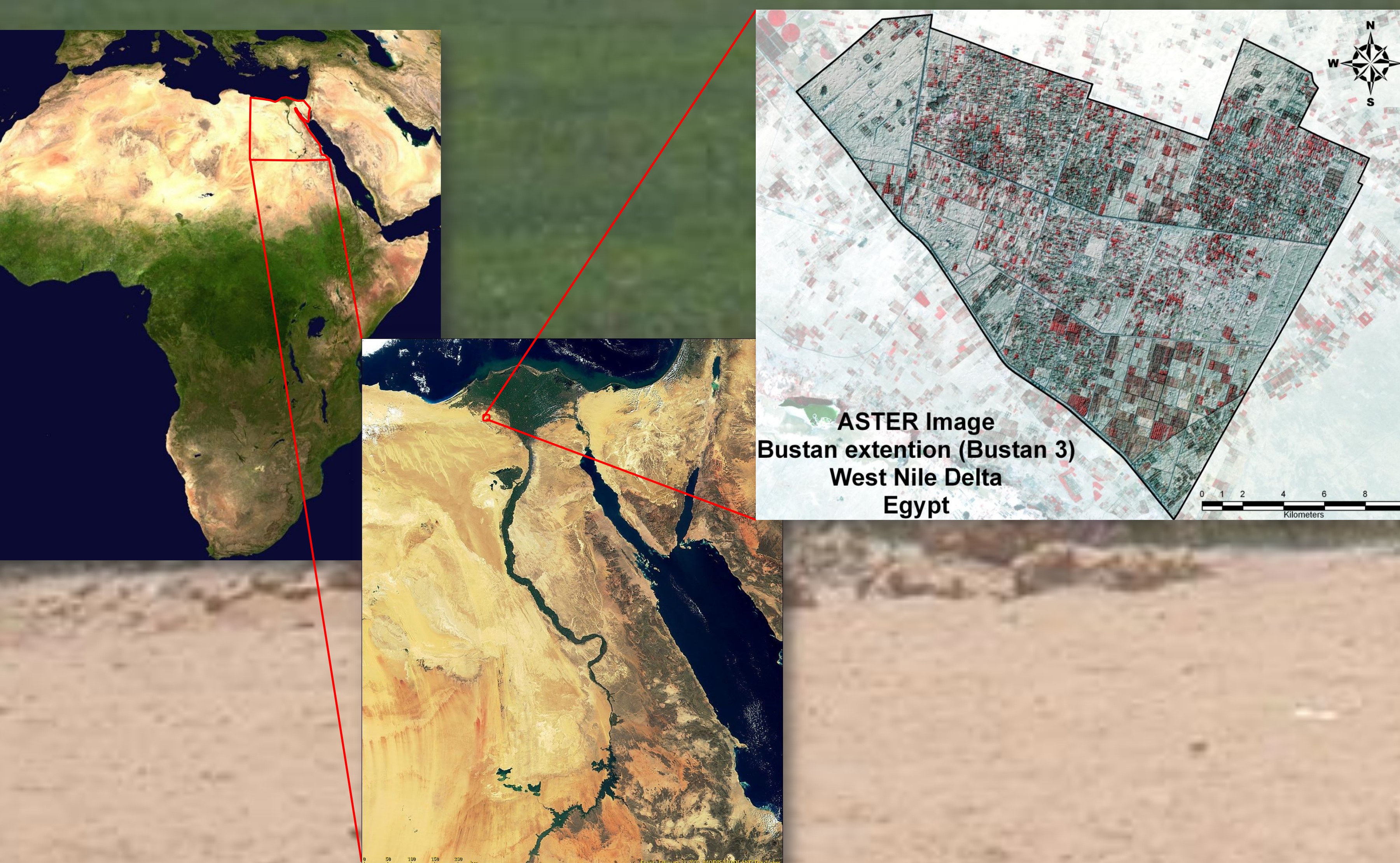
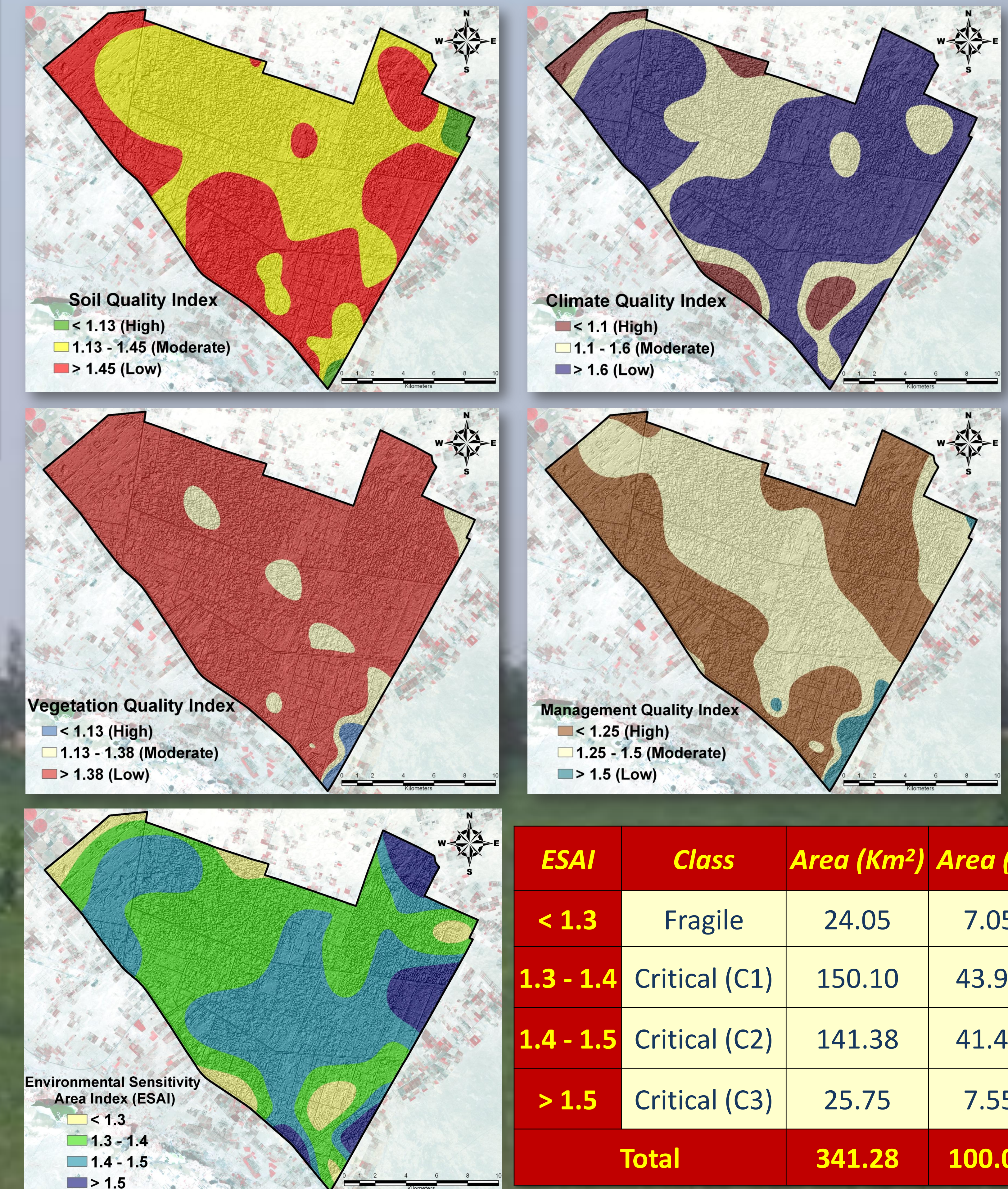
where, i represents quality indices and n represents the number of factors used to calculate each quality index. The final ESAI was calculated using the equation:

$$ESAI = (SQI \times CQI \times VQI \times MQI \times WQI)^{1/5}$$

All results were spatially distributed in a GIS environment using ArcMap.

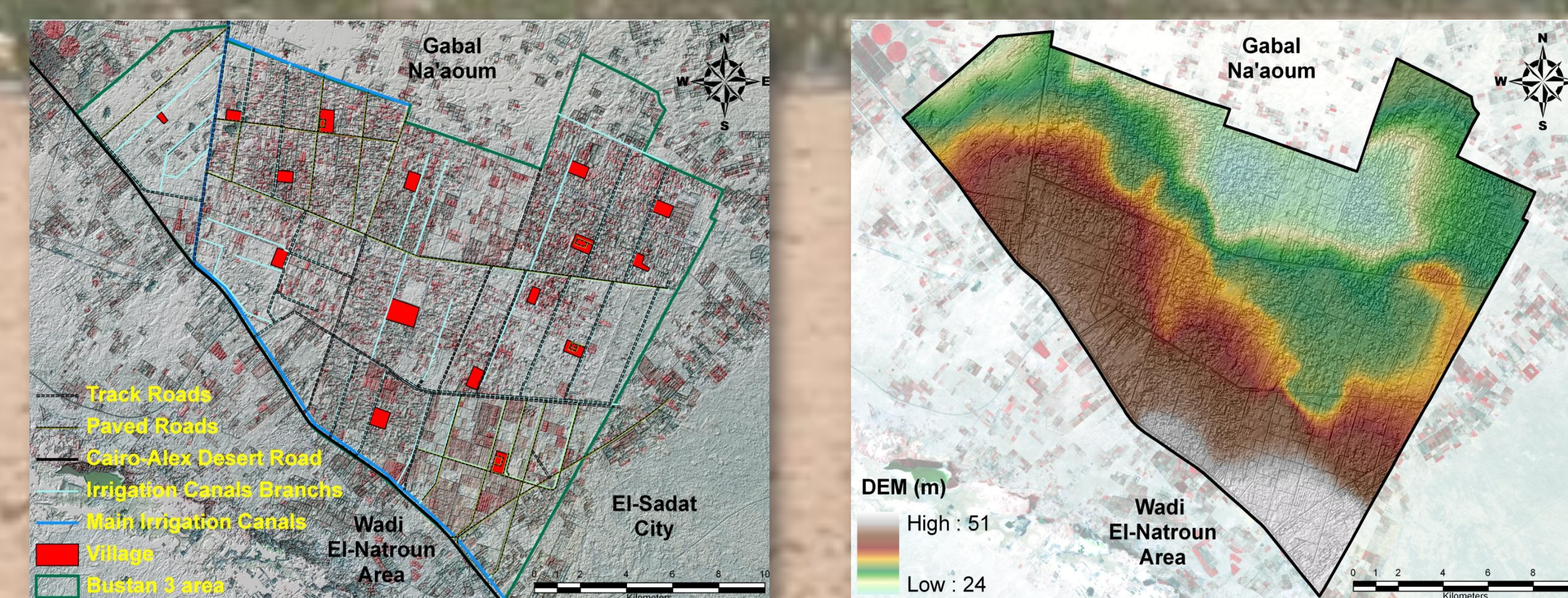


Results



Study Area

Bustan 3 area is one of the newlands in the western Nile Delta, Egypt, and is located between latitudes 3368500 to 3392000 N; and longitudes 226000 to 255500 E (UTM zone 36). It occupies around 341.28 km² (34,128 ha). The study area is characterized by a Mediterranean climate, and can be considered as a semi-arid to arid zone. Bustan 3 soils are classified as Typic Torripsamments and contain desert geomorphic units such as sand dunes and sandy plains. The main land use in the Bustan 3 area is crop production (grapes, bananas, citrus, pears, and peaches).



Conclusions

Much of the Bustan 3 area is susceptible to land degradation. Almost all Bustan 3 areas are environmentally sensitive due to their fragility. Thus, good management practices are required for sustainable agricultural land use.

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