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Study of Sharp-cut Decrease of Dead Sea

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Abstract: This study was planned to examine the clear-cut changes that have taken place in the Jordan Valley, specially the Dead Sea during the latest six decades. To do that various modern and technical means basically remote-sensing and GIS geographic information system applications were employed. Despite the imprecision, Satellite images were more efficient compared with other filed work photographs and maps in saving both money and time. Having known that most pools, lakes and dams are surrounded by forests, the delineation processes for these bodies by using remote-sensing and GIS techniques become easier and achieve better results. The reason that stands behind such an assumption is the chemical and physical composition of the water that makes the electromagnetic waves reacts in a different manner from other surfaces. In addition to their topographic forms, water body surfaces are in a sharp contrast with other surfaces, Vis, the earth. So due to the vital economical as well as environmental importance of the Dead Sea for Jordan and the region in general, this study was designed to explore the constant dangerous changes that take place in this area. Undoubtedly, the main dangerous systems from the notable decrease of water amount in this unique sea, were high evaporation due to its location at the lowest spot of land and dams and other irrigation projects at its tributaries.

Key words: Dead Sea, geographic information system, Jordan, remote sensing, short cut.

INTRODUCTION

One of the most historic sites in Jordan is the Dead Sea, which is located in the furrows of Jordan valley between Palestine and Jordan .The Dead Sea is salt lake having high concentration of minerals and salts as compared to other lakes and seas.

The Dead Sea extends around 75 km north to south and 16 km east to west with total area about 930 km^2 the deep of the sea 300 m and its surface about 400 m below sea level making it the saltest and lowest lake in the world.[1-3]

The southern part of the sea is dry nowadays due to the effect of inflow shortage, high evaporation, and industries established at both sides of this part, which reduces the length from 75 to 50 km and the width from 17 to 14 km.

The present study aims to explorate the validity of remote sensing and geographic information system for examination the sharp cut decrease of water, area and dimensions of the Dead Sea through last six decades and the expected environmental dangers which will take place in the light of such dangers.

MATERIALS AND METHODS

Figure 1 shows the site of study area which includes the Dead Sea and surrounded area commencing the first introduction of the plate tectonic theory, Dead Sea formation has been subjected to numerous studies and analyzed from different perspectives assuring that Dead Sea was located in syro-african rift and it composed of two parts; north and south separated by lisan island.

Based on the measurements of the Dead Sea which were taken at the end of fifties of last country, the length was about 80 km greatest width 17.5 km, surface area around 997 km^2, (757 km^2 north part and 240 km^2 south part), no salt pans, water surface 340 m below sea level, the deepest point in the north part was 400 m below sea level[4]

The study spots light on the water amount as well as the dangerous changes that have taken place during above mentioned period. Data used for study area were included topographic maps printed in 1946 and 1962. Also it involved landsat satellite images for years 1978, 1984 and 2002.[5]

Remote sensing as a technique used to collect data without physical contact with body or surface by using

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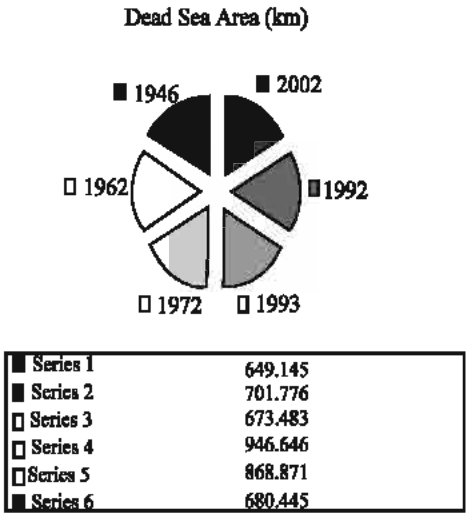

Fig. 1: The site of study area

sensors mounted or satellite in order to measure the energy reflected from that body or surface. This information can be displayed in digital forms or photographs. But, there are two ways of sensors used; passive and active. Passive sensors record radiation reflected during day light hours from earth or any surface; such as Thematic Mapper (TM) sensors which used in landsat satellite. Active sensors require energy within the sensor it self, for example lazer beam system which sends out light with known wavelength frequency. Processing of digital image analysis can be categorized in enhancement, classification, processing, and correction. To make it easier for visual interpretation and digital image understanding to manipulate the pixel values in an images. This involves identification of lower and upper bands from contrast stretch the histogram and applying a transformation to stretch this range to fill the full range. Classification of features in an image uses the elements of visual interpretation to identify homogenous group pixel which represent various features or land cover types of interest. Preprocessing involves depending on identification of image geometric registration coordinates of several points in the distorted images and matching them to their true positions in ground coordinates which measured from maps or field work by using global positioning system (GPS) technique. Correction of dark pixel was used, because data needed to quantify the effects of atmosphere and instrument error on record as digital numbers were not available.[6,7]

The printed maps were transformed also in digital form by scanning system, then geometric correction was performed for them as well as satellite images.

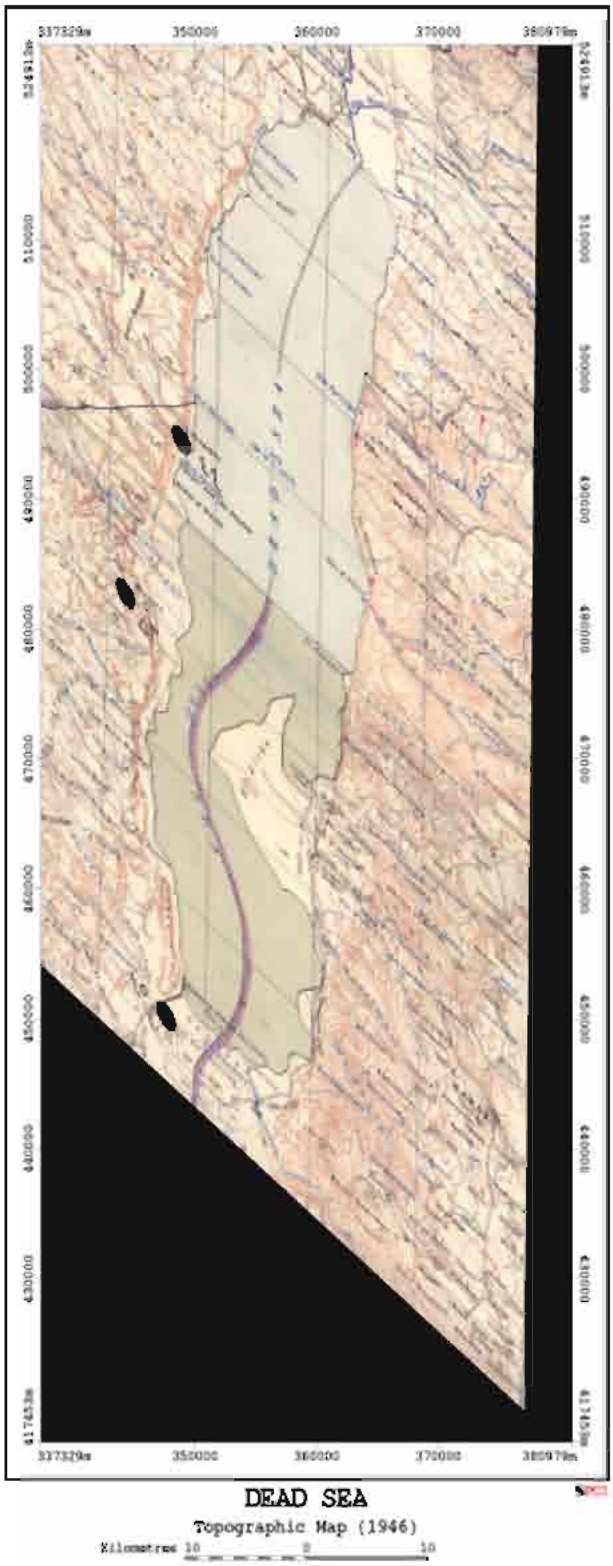

Fig. 2: Dead Sea, topographic map (1946)

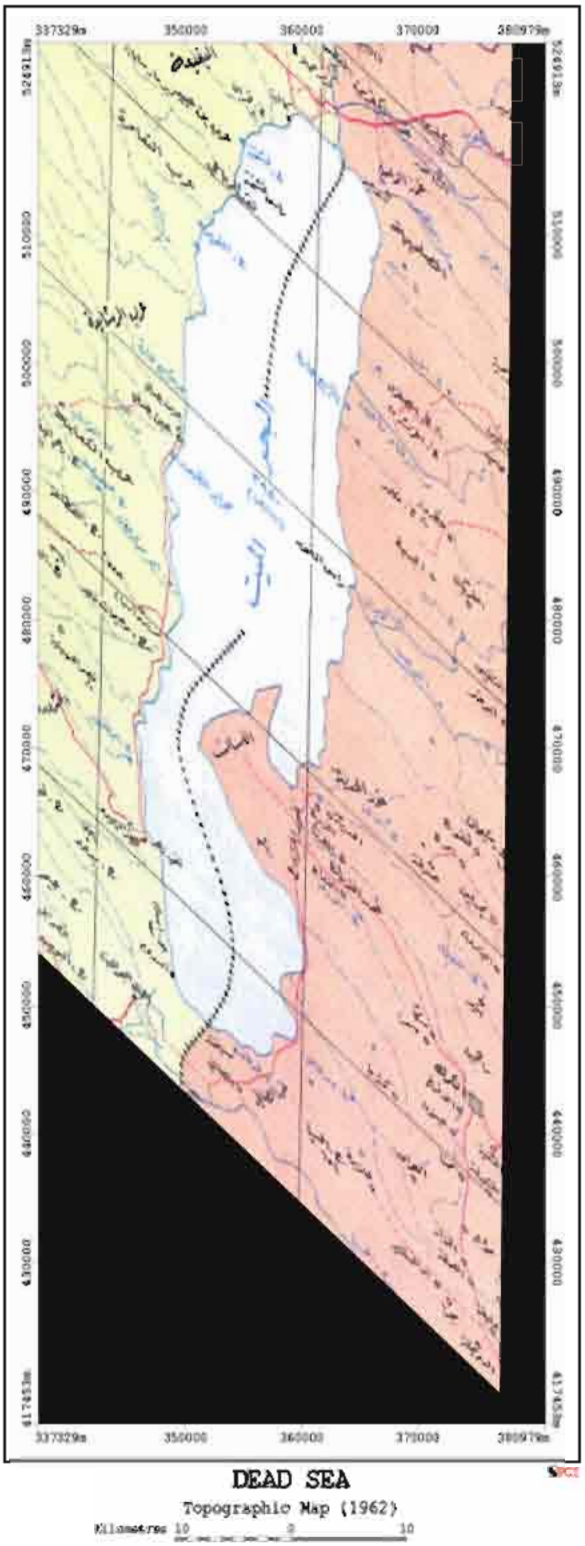

Fig. 3: Dead Sea, Topographic map (1962)

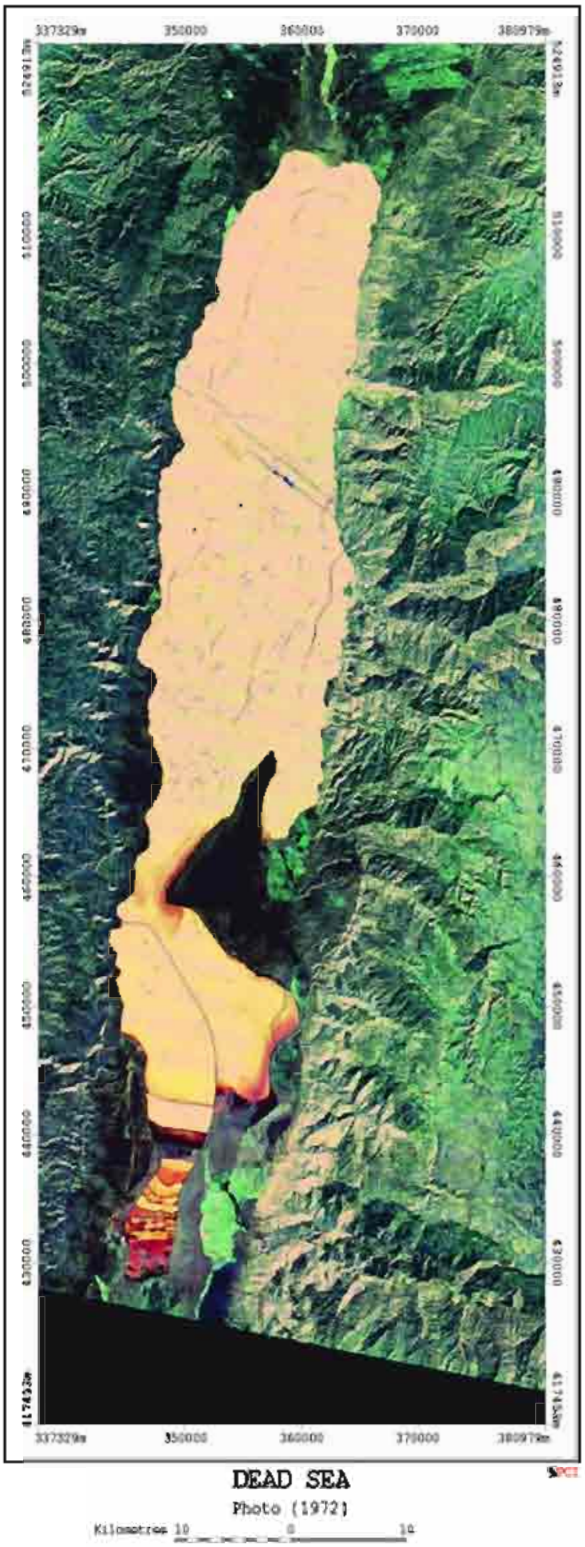

Fig. 4: Dead Sea, photo (1972)

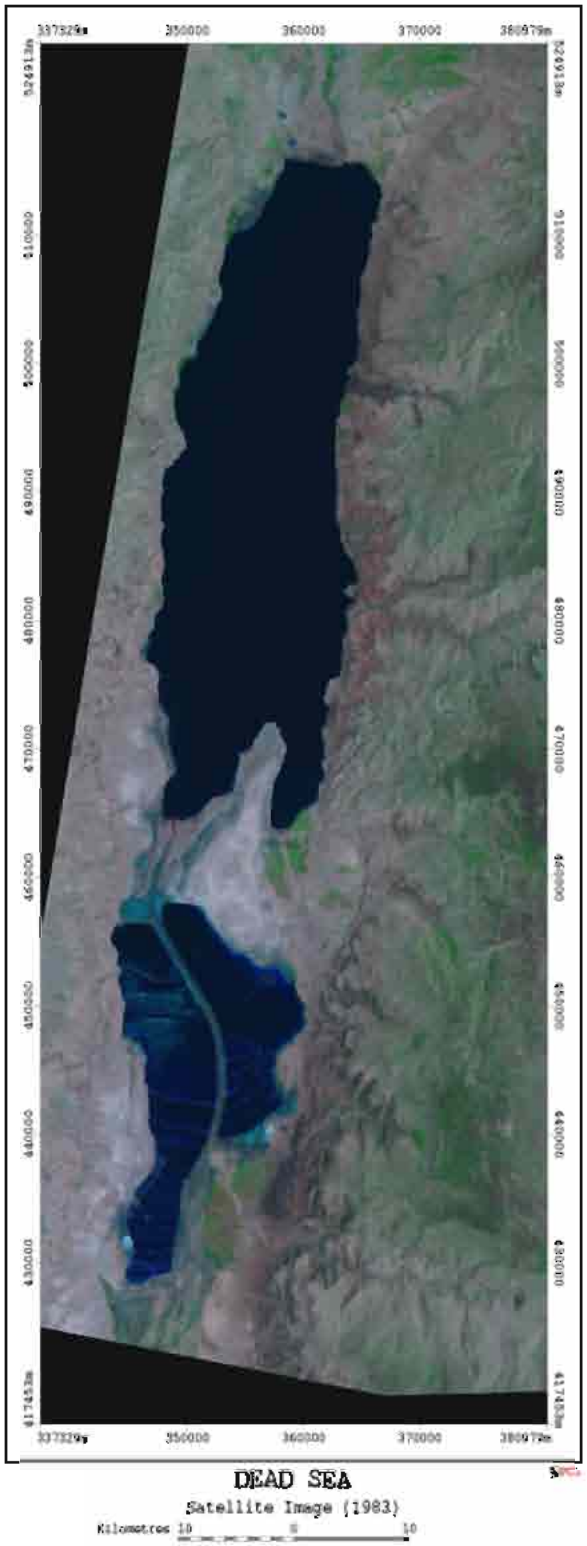

Fig. 5: Dead Sea satellite image (1983)

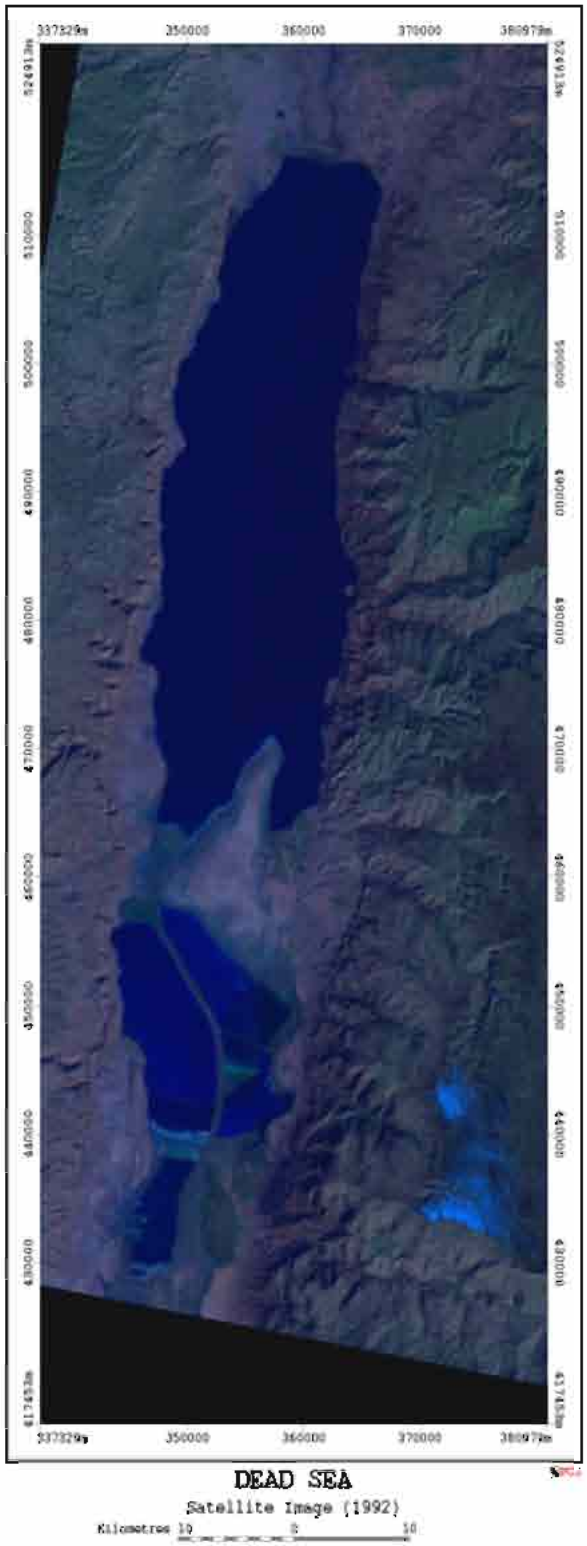

Fig. 6: Dead Sea satellite image (1992)

Fig. 7: Dead Sea satellite image (2002)

Geographic information system (GIS) was the tool of entering, analyzing and production of information obtained from maps and satellite images through computer hardware and software technology within integrated form. Most of software packages allow important data to overlay images, maps, and other spatial data. Besides that, variation of Dead Sea water amount and surface were measured and classified using detection and GIS technique for north part, south part and salt ponds separately.

RESULTS AND DISCUSSION

In order to apply the methodological processes mentioned above, identification of homogenous groups of pixels in an image that represent various features or land covers were classified by using elements of visual interpration which depend on specteral information related to digital numbers in one or more bands.[2] Based on that, the surface area of Dead Sea was computed from topographic map printed in 1946 was 868.87 km^2 (Fig. 2). But this area was decreased to 860.45 km^2 according to map 1962 (Fig. 3). Also the surface area became 763.48 km^2 with respect to image 1972 (Fig. 4). Besides that, the Dead Sea surface area was 746.46 km^2 depending on image 1983 (Fig. 5). Furthermore, the area became 701.78 km^2 according to image 1992 (Fig. 6). Finally, the Dead Sea area was 645.15 km^2 based on image 2002 (Fig. 7)

Based on that, the cut decrease of surface area happened due to the shortage of annual rainfall, incremental uses of Jordan river and its attributes to reply with various needs of domestic purposes, industries, and irrigation projects which was established at both sides of the river and Dead Sea.

CONCLUSIONS AND RECOMMENDATIONS

It was seen that the sharp cut of Dead Sea area was due to the natural or artificial causes. The former was because of the shortage rainfall, more uses of water, and high evaporation.

The latter was due to the absence of the planning, management, coordination, and cooperation of riparian countries of Dead Sea basin.

Therefore, it is recommended to apply the international water law for riparian countries to keep their rights of Jordan River water and stop or decrease the use of Dead Sea water for industries located near south part of the sea, or to look for other water resources to supply water for Dead Sea.

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