IMPACT OF WATER QUALITY ON THE SPATIAL DISTRIBUTION OF VEGETATION COVER IN THE COASTAL REGIONS WITH REMOTE SENSING AND GIS METHODS

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ABSTRACT

The spatial distribution of vegetation cover on coastal area is always associated with degradation in water quality. In order to understand this relation, Remote Sensing satellite images, water quality data and GIS software was used. The study area was selected in high intensity of plant cover located in the north western part of Libya. A variety of data including filed investigation, groundwater quality for different period, and vegetation cover classification from satellite images for different period were collected. In the field, the location of forty groundwater wells was determined in the study area using GPS. Water quality data were collected for two periods. The first period (1970-2000) data was collected from the General Water Authority water quality databases. For the second period (2006) data was collected by sampling water samples from groundwater wells in the study area. Water quality data for the two periods were compared and the results show highly significant similarity between the two periods. Satellite images database for the period of 1972, 1990, and 2001 were selected for the study area to investigate the change of vegetation cover due to degradation of water quality. Supervised classification was carried out using ERDAS imaging software. The NDVI index outputs of two time periods were compared to derive information on changes that occurred over a period of time in the study area .Water quality database and Satellite images database were integrated and analyzed in GIS to evaluate the changes in plant cover under degradation in water quality in the study area. The approaches gives very good results that helps in monitoring environmental changes in the plant cover that effected by degradation in water quality in the coastal area.

Keywords: GIS, Remote sensing, Water quality, Vegetation monitoring

INTRODUCTION

In coastal area, spatial distribution of vegetation cover due to water quality change is an important component in understanding the interactions of the human activities with the environment. To monitoring and an understanding of the changes that occur, it is necessary to model these changes to provide for time-series data for these environmental changes, Alcamo et al. [1]. The transformations in the land cover, occurring at on large scale will lead to large scale changes in the global environment. These changes are complex and require analysis to be done at various other scales to put together the big picture. Monitoring of changes in vegetation cover due to change in water quality in coastal regions can be evaluated through land-cover classification maps calculated from satellite remotely sensed, Kumagai and Saito [2]. Data from remote sensing is very good for vegetation cover monitoring. It can provide very good information on where it was, Wu [3]. In order to monitor vegetation dynamics over a long time scale and on large spatial scale, a fundamental base data constituted by several indicators derived from satellite imagery, Hassan [4]. One of the most widely used indicators for vegetation monitoring is the Normalized Difference Vegetation Index (NDVI). Satellite derived NDVI as the basis for assessment, can be found in the Gibson's work [5]. Vegetation monitoring changes for large area can be predicted by comparative analysis of trend of derived NDVI, Malo and Nicholson [6]. Once the water quality is strongly related to the condition of vegetation cover, the objectives of the present study are to prepare maps showing the spatial distribution of vegetation cover and to evaluate the relationship between spatial distribution of vegetation cover and characteristics of water quality in coastal area.

METHODOLOGY

The study area was selected in high intensity of plant cover located in coastal zone along the North West part of Libya. It lies between 13° 58′ 14° 27′ E and 32°19′ 32° 45′ N as in Figure (1). In the field investigation, location of forty groundwater wells was determining using GPS equipment Figure (2). Water quality data were collected for two periods. The first period (1970-2000) was collected from the General Water Authority (water quality databases). The second period (2006) was collected by sampling water samples from groundwater wells in the study area.

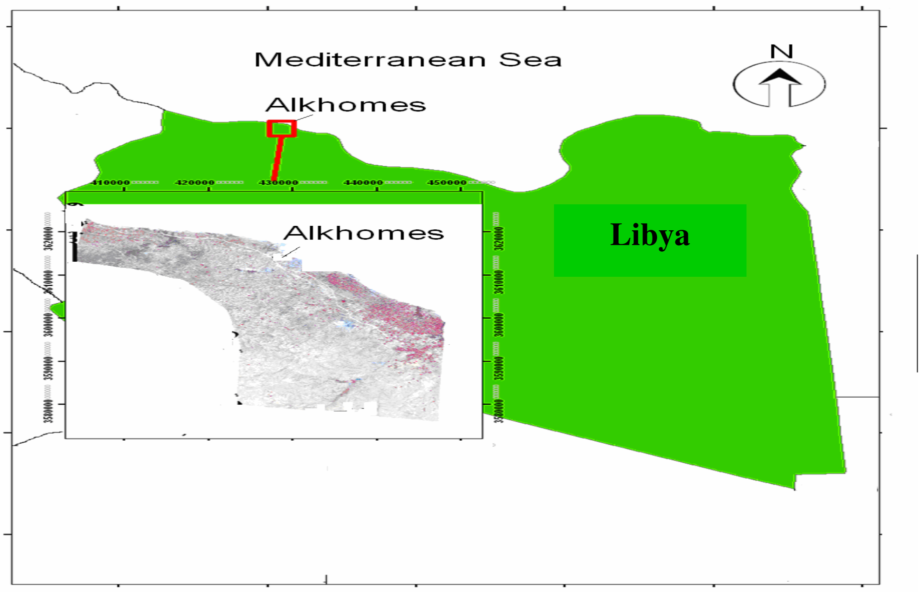

Figure (1). Location of the study area

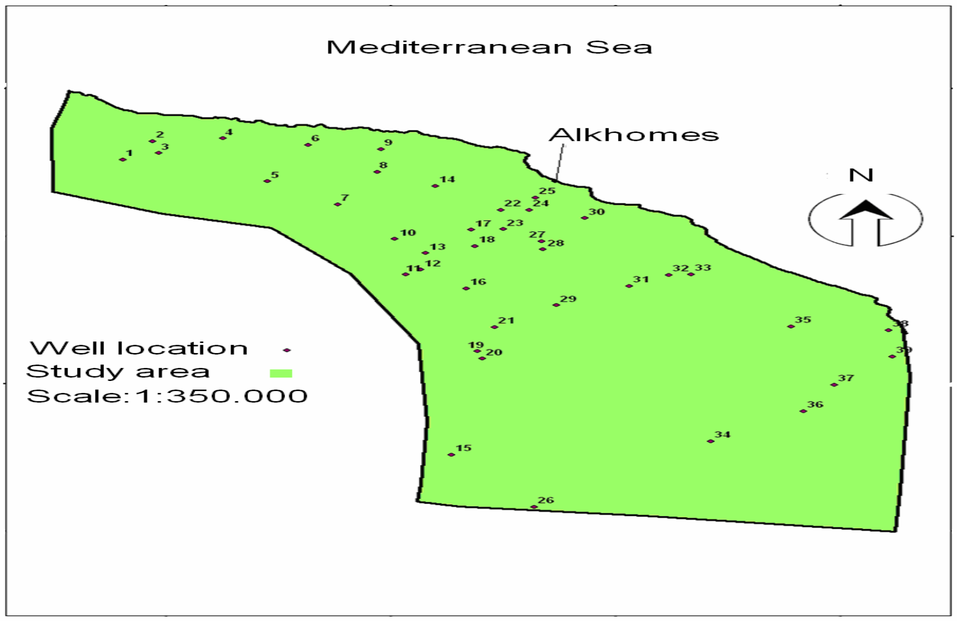

Figure (2). Location of groundwater wells in the study area

Satellite images database for the period of 1972, 1990 and 2001 were selected for the study area to investigate the spatial distribution of vegetation cover. Supervised classification was carried out using ERDAS imaging software and Normalized Difference Vegetation Index (NDVI) outputs of the study periods were compared to derive information on changes that occurred over a period of time in the study area.

Water quality database and Satellite images database were integrated and analyzed in GIS to evaluate the spatial distribution of vegetation cover under degradation in water quality.

3. RESULTS AND DISCUSSION

The data present in Figure (3) show the spatial distribution of TDS in (mg/l) in the first period. The values range from (800-3600 mg/l). Low concentration was observed in the west part of the study area, where the relative high concentration was observed in east part of the study. The second period (2006) was collected by sampling water samples from groundwater wells in the study area. The data present in Figure (4) show spatial distribution of TDS (mg/l) of the second period. The values range from (787-4300 mg/l). The two periods was compared and the finding results show relatively significant degradation between the two periods .In general, the trend in the spatial distribution of water quality show that the TDS concentration increase along the east direction of the study area.

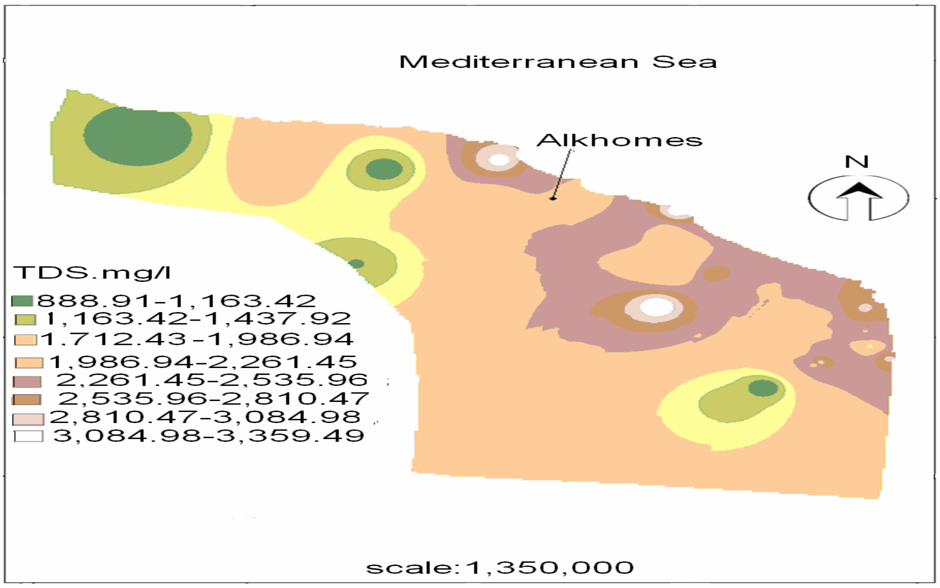

Figure (3). Spatial distribution of TDS (mg/l) in the study area (1970-2000)

In the first period of the study the changes in water quality were relatively low and the high concentration of the water quality parameters are limited in some area near the sea trend in the east direction, where in the second period, the changes in water quality show relatively high concentration in the most water quality parameters. According to USA water salinity classification, the finding results suggest that relatively high degradation in water quality in the study area Figures (5, 6).

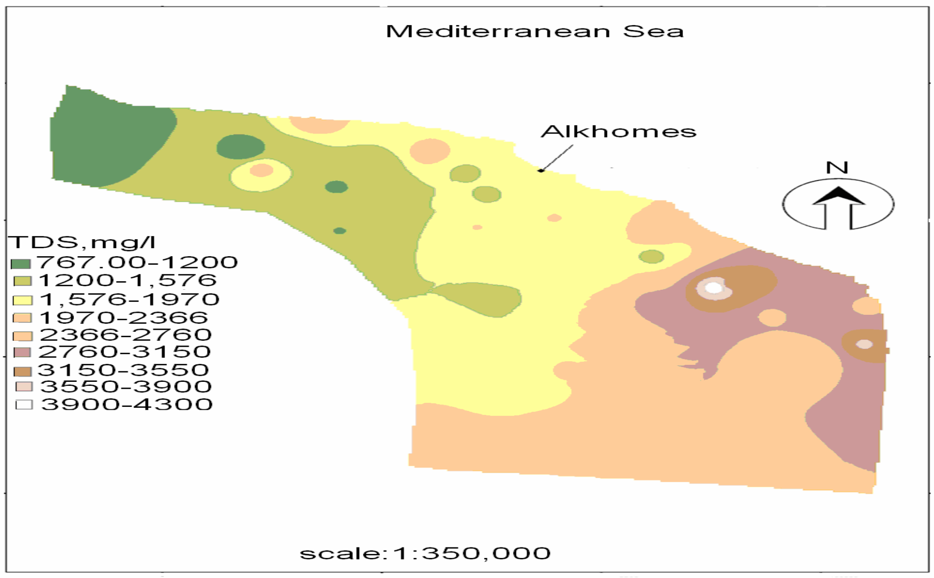

Figure (4). Spatial distribution of TDS (mg/l) in the study area (2006)

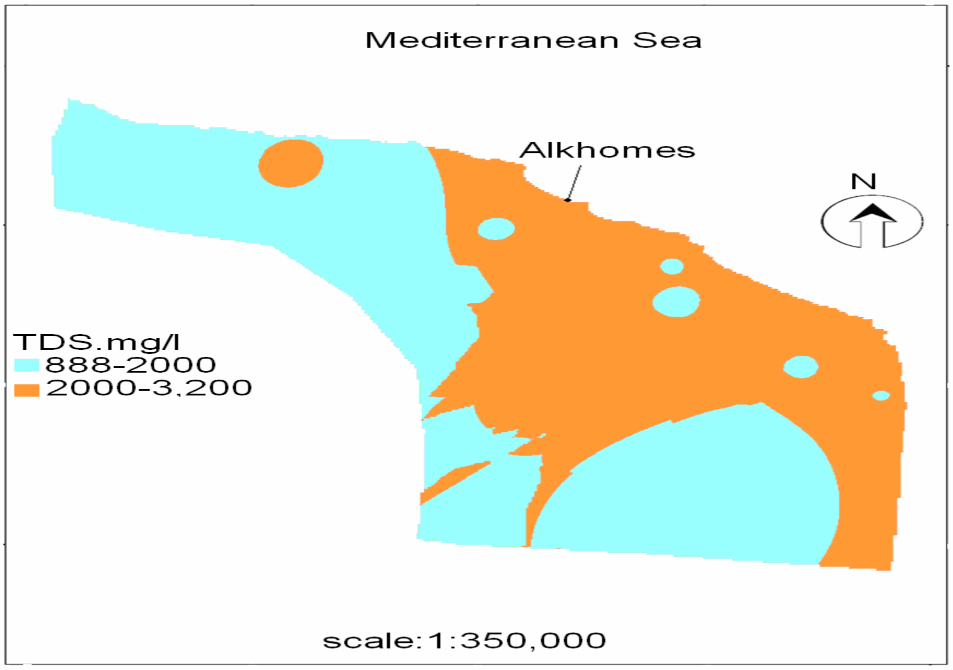

Figure (5). TDS mg/l according to USA salinity classification (1970-2000)

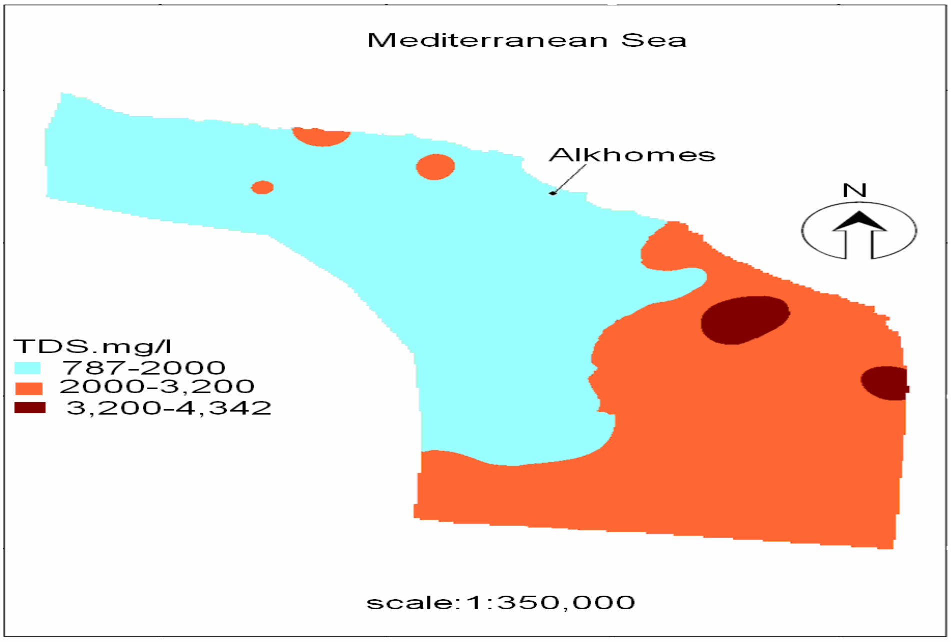

Figure (6). TDS mg/l according to USA salinity classification (2006)

Satellite images database for the period of 1972, 1990 and 2001 were selected for the study area to investigate the spatial distribution of vegetation cover. The outputs of NDVI index of the study periods were compared to derive information on the plant cover changes that occurred over a period of time in the study area Table (1) and Figure (7). Based on the results obtained by analyzing the NDVI data, it is observed that the spatial distribution of vegetation cover is significantly different during the study period. It is show that the vegetation area reduction from 48% to 26% during the study years.

Table 1. Plant covers area as indicated by NDVI

Year	Plant cover area (ha)	Total percent
1972	9303.837	-
1990	13770.318	+ 48%
2001	10163.071	- 26.2%

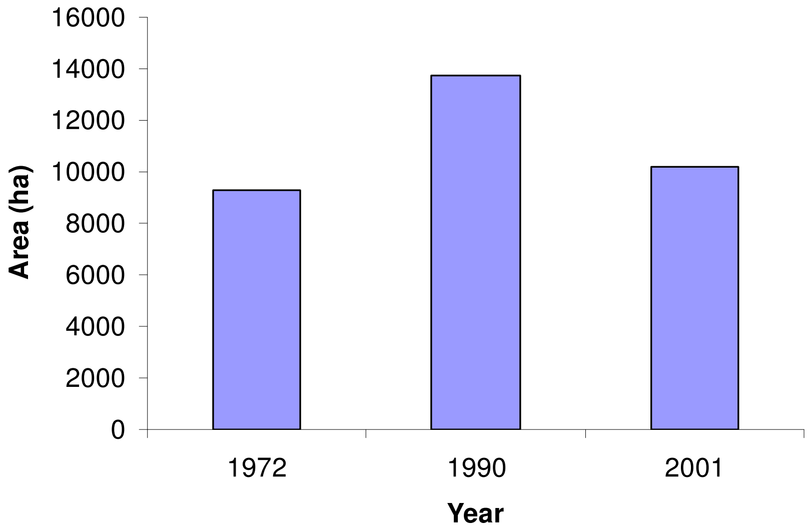

Figure (7). Change in the vegetation area as indicated by NDVI index

In order to get a better idea about the nature of the spatial distribution of the vegetation cover, supervised classification was carried out using ERDAS imaging software. The interpretation of images and GIS analysis are summarized in Figure (8). The interpretation of satellite images resulted into three vegetation classes and GIS analysis indicates significantly difference in the spatial distribution of vegetation cover during the study years. The results also show that the sparse of vegetation cover is confined to some locations in the study areas spatially in the annual vegetation along the coastal areas. Figure (9) shows the spatial distribution of annual vegetation in the study area which simply help to identify areas may subject to vegetation degradation due to decline in water quality. Several observations can be made in Figure 9 regarding the effects of water quality on the vegetation distribution in the study area. It is clearly seen that the water quality is the main controlling factor in the spatial distribution of vegetation cover. The impact of water quality on vegetation distribution is significant in irrigated area. In other words, the best vegetation where distributed in the area with good water quality. Figure 10 shows the spatial distribution of vegetation and annual-agro as affected by degradation in water quality along the study area.

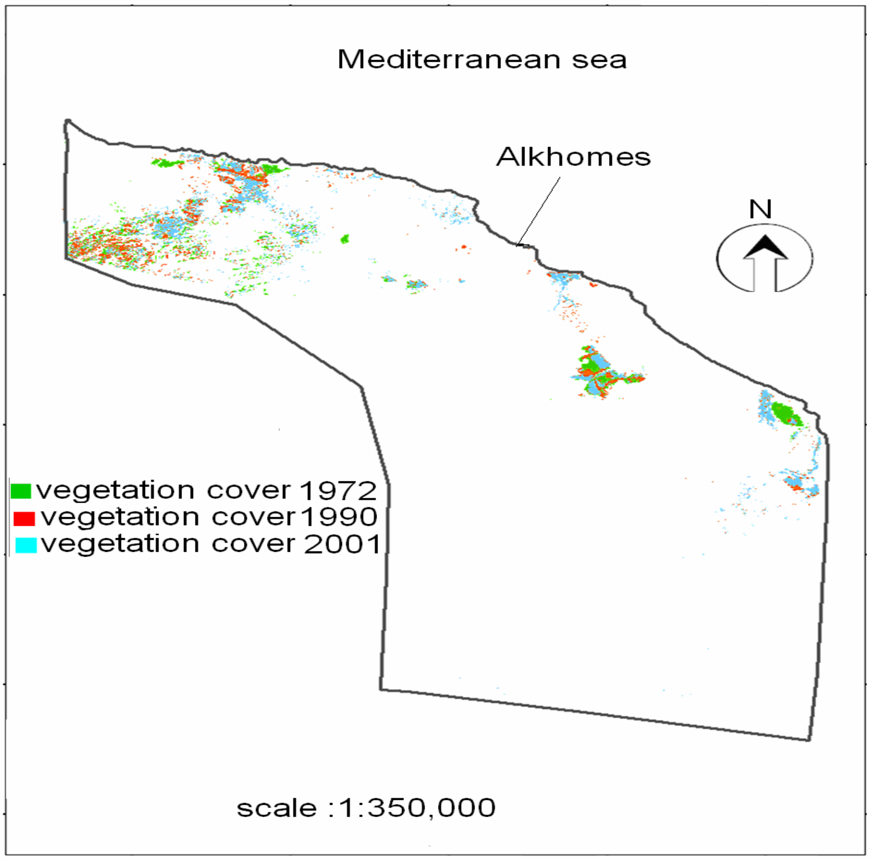

Figure (8). Change in the vegetation cover in study years (1972, 1990, 2001)

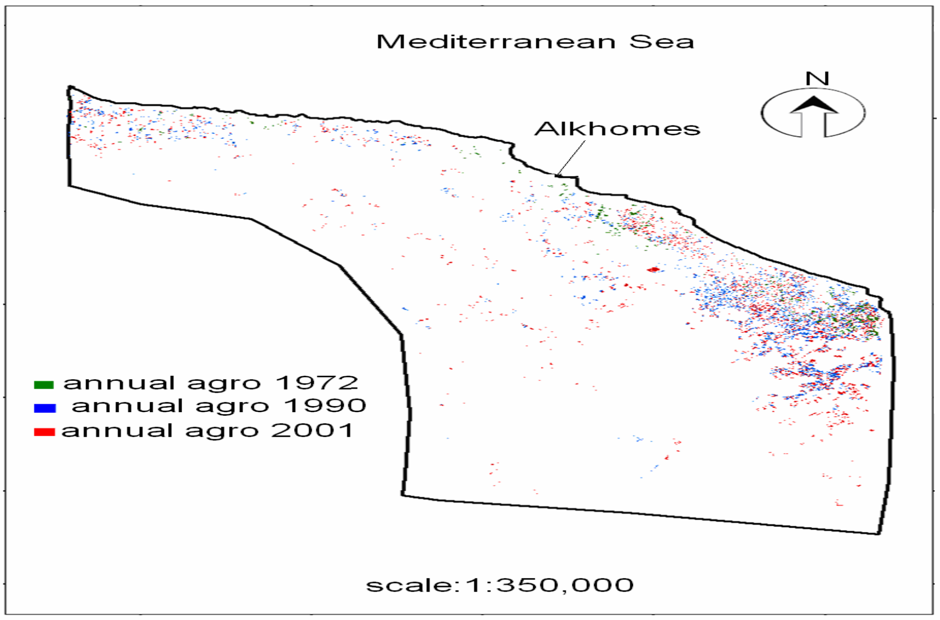

Figure (9). Change in the annual-Agro in study years (1972, 1990, 2001)

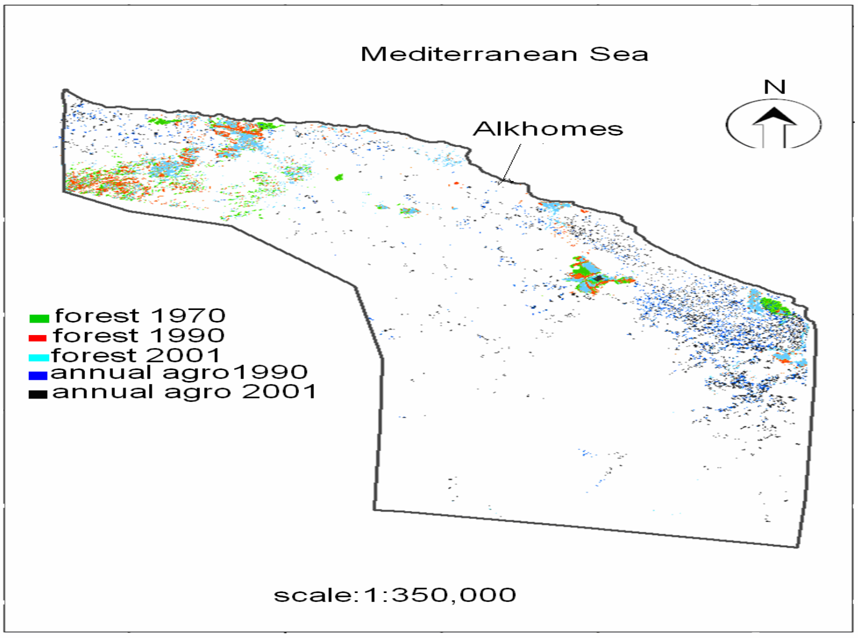

Figure (10). Spatial distribution of vegetation and annual-agro (1970, 1990, 2001)

CONCLUSION

The spatial distribution of vegetation in the study area was quantified with remote sensing and GIS methods. The analysis of NDVI for different periods in the study area was carried out. Water quality data and Satellite images data were integrated and analyzed to evaluate the spatial distribution of the vegetation cover. The impact of water quality on vegetation distribution is significant in irrigated area. In other words, the spares vegetation was common distributed in the area with good water quality.

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