A GIS-BASED PLANNING STUDY FOR A GEO-ENVIRONMENTAL DISTRICT SELECTION IN NORTH JORDAN

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ABSTRACT: Jordan is witnessing an active process of land development in major cities and surrounding rural areas associated with the prosperous and open investment environment. This is applied also to north Jordan area that is involved in such excessive development process related to the fast growth in population and demand on infrastructure services. One target of land development planning in north Jordan is to reserve important environmental areas/districts for parks establishment within the master plan of the area to provide open spaces for recreational activities for citizens and at the same time to preserve the geo-environmental diversity existing at such areas. This paper focuses on using multi-criteria approach and GIS to select a geo-environmental district in north Jordan within the richest bio-geo-diverse system (Wadi Zeglab area) to be marked on the area’s master plan for future land development. Multiple criteria for district selection including accessibility to major roads, slope, and location from natural & urban areas were used. All selection parameters were mapped and digitized in GIS to perform the selection among all available layers of data. Results indicated the existence of a number of candidates that can be selected as protected geo-environmental districts in north Jordan that were highlighted on the final GIS maps. These suggested areas need to be included in future land development plans of the region.

KEYWORDS: Multi-Criteria Selection, GIS, Geo-Environmental District, Land Development, Planning.

1. INTRODUCTION

With the fast pace of land development activities taking place mainly in major urban areas and extending to various rural areas, it becomes so vital to highlight districts of environmental importance for protection. This usually done as a part of land development planning to provide proper enforcement level for preserving such important districts in any future development plans. However, it’s important first to identify the locations of such environmental areas with high importance according to predefined set of selection criteria.

Multi-criteria analysis as integrated with GIS techniques provide unlimited capabilities for land management and planning purposes. Much literature can be found on using such integrated techniques for criteria-based site selection. A major area of application is land suitability mapping for different purposes (Hopkins [10]). Collins et al. [7] and Malczewski [18] presented a review of the application of multi-criteria analysis and GIS in land-use suitability analysis. Joerin and Musy [12] developed a GIS-based multi-criteria model (MAGISTER) that was used, with a set of 8 criteria, to generate a

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land suitability map for housing purposes taking into account the decision-makers’ perception of land management principles. Land-use suitability analysis was also performed using GIS and outranking multicriteria analysis to select most suitable areas for housing activities in a selected district in Switzerland (Joerin et al. [13]).

Malczewski [19] preformed an in-depth recent review of the rich literature available regarding GIS-based multi-criteria decision analysis. The review regarding the strong connectivity between GIS and multi-criteria analysis techniques as can be seen in the work of Laaribi et al. [16], Malczewski [17], Thill [31], Chakhar and Martel [6] showed clearly the different types of applications of such integrated techniques in the literature. Malczewski [19] classified the application arenas of such integrated techniques into a number of major categories including: environmental modeling as in the work of Noss et al. [26] and Seppelt and Voïnov [30], transportation studies as shown in the work of Jha et al. [11] and Bowerman et al. [5], water and waste management (Martin et al. [20]; Leaño et al. [15]) and many other application areas.

Land management planning is a necessary tool of interest for engineers and urban planners in Jordan to specify the different land uses and reduce the degradation of certain important environmental districts in the country especially in the northern area (Wadi Zeglab district). Many efforts can be seen in this direction starting by the 1965 soil survey done by a team from Durham University (Fisher [9]). The survey provided primary information regarding the watershed management system at Wadi Zeglab district and produced detailed soil, land-use and land-suitability maps for the area (Fisher [9]). Later in 1995, a hydro-geological study was performed to assess the water resources, in terms of rainfalls, runoff, evaporation and infiltration, in Wadi Zeqlab catchment area besides investigating the sedimentary rocks formations that precipitated in the marine environment (Al-Za’bi [4]). Nuafleh [27] studied the different types of mass wasting features in Wadi Zeglab drainage basin such as soil and rock creep related landslides beside the human factors that contribute to such mass wasting. Such landslides were further investigated by Field and Banning [8] focusing on studying their Geomorphologic and sedimentological characteristics. In a recent study (Ziadat et al. [33]), high resolution suitability maps were produced for the region, based on a detailed soil map, through the use of remote sensing and GIS technologies. Radaideh [28] performed a research through which he evaluated the woodlands and ranges in Wadi Zeglab district besides identifying the effect of natural and human factors on such resources.

The importance of Wadi Zeglab district reflected in its important geographic location in the northern region of Jordan and its unique bio-geo-diversity system raises the issue of designating a protected area within the district to be marked on the area’s future development plans as a part of a sustainable land development planning scenario. This will protect the area from different kinds of environmental threats that already taking place at some parts of the Wadi such as turning certain places into liquid/solid landfills besides the unplanned excavation of the region to use its valuable materials in different construction industries (Al-Malabeh et al. [2]).

2. RESEARCH SIGNIFICANCE

This work identifies the GIS application of multi-criteria decision making. The study area is in northern Jordan and represents an important region of the country for agricultural and eco-tourism activities. The fact that there is a lot of literature on the GIS application of multi-criteria modeling, the advancement of knowledge in this research is on the application of the method in Jordan. There is a lot of published literature about the use of GIS, Multi-criteria or suitability analysis. However, none of the published work focus on an area similar to the one used in our case study. The study area is witnessing a clear practice
of improper planning of land use as can be seen in uncontrolled urban sprawl, mixed land uses, absence of regulatory laws regarding land management and the increasing threats to the natural environment through man-made projects. Implementing this methodology to this area for proper and sustainable management of the available natural rich bio-diversity environment, through Geopark protection area selection, is unique to the area and will highlight these areas for protection from external human threats on the area’s master plan. Building such extensive GIS database will also provide a benchmark for temporal and spatial monitoring of the study area over time to assess the positive and negative changes in the landscape and to design and implement suitable mitigation plans to respond to these changes.

3. STUDY AREA FEATURES

North Jordan holds marvelous and unique bio-geo-diverse environments scattered all over the area (Al-Malabeh and Al-Shreideh [3]). Among these is Wadi Zeglab district (an approximate total area of 107 km2) that is located at about 80 km to the north of the capital city of Jordan (Amman) and 25 km northwest of Irbid (a major city in north Jordan) as can be seen in Figure 1. Wadi Zeglab is part of the north rift basin (Figure 2 (Ministry of Water & Irrigation [22]) & Figure 3) with a lowland zone at the west side (lands with elevations less than 400m above MSL) (Mohammad [23]). The Wadi contains distinguished natural land cover of forests and agricultural crops, waterfalls (three major ones with an approximate total water discharge rate of 8 MCM) and dams, and unique geological formations of various sedimentological, structural and geomorphologic features (Al-Malabeh and Al-Shreideh [3]). Wadi Zeglab geomorphology is a result of the headward erosion of the major Wadis into the Arabian plate following the subsidence and faulting of Dead Sea-Jordan Valley area (Mohammad [23]).

Regarding the Wadi climate, it is considered a part of the Mediterranean climate and usually categorized as semi-humid climate with all precipitations take place in winter (Fisher [9]). Its climate is located between upland climate in the east (moderate temperatures in summer, and cold winter) and Ghor climate in the west (high temperatures in summer and warm winter). Metrological data for the 1986 to 2003 period taken from the two closest station to the study area, one located at upland area (Ras Munief station) and the other at Ghor area (Der Alla station), regarding monthly variation (starting January (denoted on the graph as 1) to December (denoted on the graph as 12)) of the average temperatures (Figures 4.1 & 4.2) and relative humidity (Figures 4.3 & 4.4) are shown (Meteorological Department [21] and Jordan Valley Authority [14]).

4. RESEARCH OBJECTIVES AND METHODOLOGY

Due to the scarcity of research directed to study such important region, this work comes to fill the gap in this regard. The main research objectives are to use GIS to create a complete digital database of all natural (geological, hydrological and biodiversity spatial data) and man-made features in the study area and use it along with Multi-criteria analysis to select a geo-environmental district in Wadi Zeglab area as a protected area to be marked on the future land development masterplans. This selection is based on a set of expert-based predefined criteria implemented on the geo-referenced GIS multi-layered system including data on topography, road network, water resources, soil, and land use. Such selection of the geo-environmental protected area will ensure a suitable environment to conserve the diverse and valuable ecosystem resources available in Wadi Zeglab. This action will contribute significantly in protecting these natural resources especially vegetation from different environmental threats such as blazing, trees overcutting, over grazing, pollution, and human consumption of agricultural lands for construction activities such as roads and housing.
Fig. 1. A location map of Wadi Zeglab
Fig. 2. Wadi Zeglab location according to main water basins
Fig. 3. Google Earth images showing the Wadis
Fig. 4.1. Monthly average temperatures in Ras Munief - Ajlun station for the period 1986 to 2003

Fig. 4.2. Monthly average temperatures in Der Alla station for the period 1986 to 2003

Fig. 4.3. The monthly average humidity in Ras Munief - Ajlun station for the period 1986 to 2003

Fig. 4.4. The monthly average humidity in Der Alla station for the period 1986 to 2003
4.1 Multi-Criteria Decision Making and GIS

According to the International Society on Multiple Criteria Decision Making [36], Multi-Criteria Decision Making is defined as “the study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process”. Drobne and Lisec [37] provides in depth review of the theory behind spatial Multi-Criteria Decision Making. They show comparison between Classic and GIS-based spatial decision-making procedures. GIS-based spatial decision-making procedure (Figure 5.1) is the one that was followed in this work.

![GIS Approach in Spatial Decision Making](image)

**Fig. 5.1.** GIS-based multi-criteria spatial decision-making procedure (Drobne and Lisec [37])
4.2 Data Collection and Processing

The main raw spatial data used in this research were gathered from different sources as shown in Table 1. Further data were collected from hydro-geo-spatial data archives, Aerial photographs, through field investigation, and through GIS digitization of topographical and geological maps, roads, drainage networks, biodiversity, and other types of maps. Most of the collected spatial data layers were in Palestine Grids and Jordan Transverse Mercator (JTM) coordinate systems, so they were registered to Universal Transverse Mercator (UTM) to be used as the standard reference system for this work.

<table>
<thead>
<tr>
<th>Layer Name</th>
<th>Layer Preview</th>
<th>Details</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geologic Map</td>
<td></td>
<td>Resolution = 1:50,000</td>
<td>Natural Resource Authority (NRA) (Jordan)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Format: Raster</td>
<td></td>
</tr>
<tr>
<td>Topographic Map</td>
<td></td>
<td>Resolution = 1:50,000</td>
<td>Royal Jordanian Geographic Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Format: Raster</td>
<td></td>
</tr>
<tr>
<td>Catchment Area</td>
<td></td>
<td>Format: Vector</td>
<td>Ministry of Water and Irrigation, Jordan</td>
</tr>
<tr>
<td>Landuse</td>
<td></td>
<td>Format: Vector</td>
<td>Mohawesh [24]</td>
</tr>
</tbody>
</table>

As our study area is covered by four topographical maps with a scale of 1:50000, mosaic process was used to get them as one layer as shown in Figure 5.2 (RJGC, 2008). A contour map, with a 50 m contour
interval, was generated for the study area through digitizing the topographic map in ArcGIS as shown in Figure 6. Huge variation in elevation can be easily noticed that ranges from as low as 100 below MSL for certain areas to reach an elevation as high as 1050 above MSL.

Fig. 5.2. Topographic maps mosaic for the study area
Fig. 6. A contour map of the study area resulted from digitizing the topographic map

Using 3D analyst, the contour map was converted to TIN surface to better understand the topography and hydrology of the study area as shown in Figure 7. Spatial analyst was used then to convert the TIN to a slope layer as can be seen in Figure 8.

Through digitization process in ArcGIS, simplified and detailed versions of geologic maps were produced as shown in Figure 9 (reproduction after NRA, 2006). These figures show that the study area is mainly composed of three geological groups: Ajlun Group, Belqa group and Jordan Valley Group. These groups are presented in details in Table 2 (different references such as Mohammad [23] and Abed [1]). These groups refer to the Mesozoic (upper cretaceous) Mohammad [23]. Also, it can be clearly seen that Wadi Al-Sir Formation is the dominant formation in the study area.
**Fig. 7:** TIN model for the study area

**Fig. 8:** Slope layer of Wadi Zeglab in degrees
Fig. 9.1. Simplified geological map of the study area

Fig. 9.2. Detailed geological map of the study area
Table 2. Geological groups and formations in Wadi Zeglab

<table>
<thead>
<tr>
<th>Group</th>
<th>Formation</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleistocene and Holocene Sediment</td>
<td>Soil over bedrock, Calcrete</td>
<td>Pleistocene- Holocene</td>
</tr>
<tr>
<td>Jordan Valley Group</td>
<td>Irkheim</td>
<td>Lower Pleistocene</td>
</tr>
<tr>
<td></td>
<td>Waqqas Conglomerate</td>
<td>Lower Pleistocene</td>
</tr>
<tr>
<td>Belqa Group</td>
<td>Shalala Chalk</td>
<td>B5</td>
</tr>
<tr>
<td></td>
<td>Umm Rijam Chert</td>
<td>B4</td>
</tr>
<tr>
<td></td>
<td>Muwaqqar chalk Marl</td>
<td>B3</td>
</tr>
<tr>
<td></td>
<td>Al-Hisa Phosphorit</td>
<td>B2b</td>
</tr>
<tr>
<td></td>
<td>Amman Silicifed</td>
<td>B2a</td>
</tr>
<tr>
<td></td>
<td>Wadi Umm Ghudran</td>
<td>B1</td>
</tr>
<tr>
<td>Ajlun Group</td>
<td>Wadi Al-Sir</td>
<td>A7</td>
</tr>
<tr>
<td></td>
<td>Wadi Sheib</td>
<td>A5-A6</td>
</tr>
</tbody>
</table>

Based on the Geological maps, a structural geology map was digitized as shown in Figure 10. Three main faults sets can be identified in Wadi Zeglab area: the NNW and NNE, N-S and E-W faults that are mostly normal faults (Nuafleh [27]).

Regarding the hydrology of Wadi Zeglab, two GIS layers were produced presenting the rainfalls stations (Figure 11 (Jordan Valley Authority [14])) and the stream system in the Wadi (Figure 12). Figure 12 was produced through digitization of the topographic map. Part of the hydrology system in the area is Wadi Zeglab dam shown in Figure 12 that has a maximum height of about 47.5 m and original reservoir volume of about 4.3 MCM (Mohammad [23]). Figure 13 shows some photos for the dam.

Fig. 10. Structural geology map of the study area
Fig. 11. Wadi Zeglab rainfalls station

Fig. 12. Stream system of Wadi Zeglab
Due to the important role of soil characteristics in selecting the best candidate site for geo-environmental district area, a GIS layer for Wadi Zeglab soil classification system is needed. This layer was obtained from the database of the Jordanian National Soil Map and Land use Project [25] as can be seen in Figure 14. The soil classification system divides the soil into map units where each unit is given a number associated with the properties of the soil it represents. The map units’ scale ranges from map unit No. 1 to map unit No. 82 with map unit No.0 being bare soil, and map unit No.999 being urban area. Wadi Zeglab area includes the following map units’ numbers with a brief description of their soil characteristics (National soil map [25]):
Fig. 14. Soil map for the study area

- **Map unit No. 1**: Extremely deep soil having mature profiles with about 120cm of brown silty clay to clay overlaid by extremely indurate red brown clay with parent rock being cherty limestone. Calcium carbonate concretions are noticeable in lower horizons. Such soil exists in areas with 300m to 670m altitudes and 0 to 16% slope (National soil map [25]).

- **Map unit No. 7**: Thin soil categorization associated with outcrops of more cherty limestone that exists at areas with 400m - 1150m elevations and 0-25% slope. The texture of this soil class ranges from clay loams through silt loams to silty clays that are dominantly brown in color. This soil type has a 44-62% clay content range, 27-43% silt content, PH range of 7.1 to 7.8, and cation exchange capacities between 39 to 55 m.e.q/100g. The parent rock of this category is cherty limestone (National soil map [25]).

- **Map unit No. 10**: This soil category, moderate to shallow depth, is available in areas with 450m to 1000m elevation and slope range of 5 to 40%. The parent rock of this soil class is limestone (National soil map [25]).

- **Map unit No. 17**: Moderate deep to shallow soil, of alluvial and colluvial origin that usually overly slope deposit. Soil ranges from loosely massive loams at surface to heavily compacted clays lower down
with limestone being the parent rock. Such soil can be found in areas with 400m-1000m elevations and 9-60% slope (National soil map [25]).

- **Map unit No. 23**: Soil in this class is characterized by heavy texture with clay content of about 55% to 73%, 21% to 64% Silt content, and low uniform sand content. Parent rock for this soil is limestone and its PH ranges between 7.2 and 7.8, and the cation exchange capacities ranges from 39 to 57 m.e.q/100g. This soil exists in areas with elevations of 250m to 600m and 600m to 1100m and with slope range of 0% to 40% (National soil map [25]).

- **Map unit No. 25**: This type of soil exists at 669m to 690m elevations and slope between 0 and 16 percent. The soil has a moderate to shallow depth with a fine particle size and limestone parent rock (National soil map [25]).

Another GIS data layer was created to show the 22 administrative divisions within the study area associated with the main villages existing within each division as can be seen in Figure 15 (after Mohawesh [24]).

![Fig. 15. Wadi Zeglab administrative divisions](image)
The land use shapefile (see Table 1 and Figure 16 (Mohawesh [24])) is one of the most important layers that were obtained. The study area consists mainly from forest, farms, range and urban as can be seen in the land use map.

Another important layer that was produced is the roads network as can be seen in Figure 17. This layer, digitized from the topographic map, presents the road networks that cover the study area that can be classified mainly into main roads (divided/undivided) and secondary roads.
4.3 Geospatial Analysis and GIS-based Multi-Criteria Site Selection

Based on the complete geospatial database collected in the previous section, the main objective of this section is identified in selecting the best area for a geo-environmental protected district or what’s known as ‘Geopark’ (UNESCO [32]). Geopark is usually classified into three types according to the covered area namely, mega, macro or micro Geopark. Wadi Zeglab as a whole with a total area of 107 Km2 can be considered as a mega GeoPark, but it is not possible to assign it as mega GeoPark because it includes certain land uses (e.g., urban areas) that need to be excluded from such classification. Therefore, some areas suitable for establishing a macro GeoPark need to be selected within Wadi Zeglab area that represent the most valuable resources in the Wadi (e.g., geological, natural, etc.) For these reasons the suggested GeoPark location is best to be selected in forest and range land uses within Wadi Zeglab area because these areas include a rich biodiversity system (see Figure 18 (after Mohawesh [24])). So, since these forest and range areas are considered suitable locations for Macro-GeoPark, this will be one of the selection criteria for the best candidate site.
A GIS-BASED PLANNING STUDY FOR A GEO-ENVIRONMENTAL DISTRICT SELECTION IN NORTH JORDAN

Fig. 18. Suitable land uses for Geopark (from land use layer)

The rest of the selection criteria are identified based on our experience in the area and through consultation with some experts in the field and can be summarized as following (UNESCO [34] and Frey et al [35]):

A. Geopark shouldn’t be located at steep slopes areas, slopes between 0 to 25 degrees are recommended.

B. Geopark shouldn’t be so close to roads to avoid pollution resulted from vehicles, a distance of 50m to 100m from the highway is recommended.

C. Geopark should be little bit faraway from main streams to avoid flooding, being away of a distance of at least 30m is recommended.

D. Geopark should be located at forest and range land uses and away from farms and urban areas.

Collected data over which such criteria are implemented included: main and secondary roads layer, main Wadi streams and minor streams layer, contour map layer and land use layer.

The major step in the multi-criteria Geopark site selection is represented in identifying all unsuitable areas for Geopark (e.g., urban areas). After highlighting such areas in separate layers, overlaying for all of these unsuitable areas was done. Once unsuitable areas for Geopark in Wadi Zeglab are identified, the remaining areas represent potential locations for Geopark establishment. The following steps show clearly the detailed process of selecting the best candidate site for Geopark using mainly the layers of roads, elevation, streams, land use and soil:
Based on the contour map, the digital elevation model (DEM) surface was developed as shown in Figure 19 along with the slope layer (see Figure 8) that was reclassified into nine intervals with classes six to nine being considered as unsuitable areas for Geopark as can be seen in Figure 20. Class six has slope range between 25° to 30°, number seven between 30° to 36°, number eight between 36° to 45° and number nine ranges between 45° and 66°. All of these areas were excluded from being candidates for Geopark area as they don’t match the slope criterion.

Fig. 19. Digital Elevation Model for the study area.
The land use layer is grouped into 4 land uses: Forest, Range, Farms (tree crop, olive trees, orchard and irrigated area), and Urban area. The early mentioned land use criterion was weighted based on the fact that the Geopark should be away from urban area and farm area. Therefore, farms (Figure 21 (modified after Mohawesh [24])) and urban (Figure 22 (modified after Mohawesh [24])) layers are unsuitable for Geopark establishment and were excluded.
Fig. 21. Farms in the study area (from landuse layer)

Fig. 22. Urban area in the study area
• For roads layer, the criterion was defined as that Geopark should not be close enough to roads. Geopark needs to be away from main roads by about 100 m and from secondary roads by about 50 m. Therefore, buffer for the roads was developed to exclude the areas within these specified distances form roads as can be seen in Figure 23.

• Regarding the streams criterion, Geopark should be away from main streams by about 30 m and from minor streams by 5 m. Therefore a buffer for the Wadi was generated to exclude these areas from Geopark selection as can be seen from Figure 24.

All layers including the excluded areas based on the early defined criteria (high slope, farm layer, urban layer, road buffer layer, and Wadi buffer layer) were overlaid to identify all areas within Wadi Zeglab than are unsuitable for establishing the Geopark as can be seen in Figure 25. The available gaps among Figure 25 are suitable areas for Geopark but still need to be investigated further.
From Figure 25, we conclude that there are seven potential areas that can be used as a Geopark highlighted in a separate shape file as can be seen in Figure 26. These seven possible areas for Geopark are located at lower, middle and upper part of the catchment area and stand in forest and range areas. All of these candidate sites satisfy the earlier defined criteria for Geopark selection but we still needs to select the most appropriate site. Table 3 summarizes the attributes associated with each one of the seven potential sites for Geopark establishment. These site attributes include: elevation range, location, area, type of climate zone, and accessibility to road network.
Fig. 25. All unsuitable areas for Geopark.

Fig. 26. Potential Geopark locations in Wadi Zeglab that satisfy the defined criteria.
Table 3. Attributes of the seven potential Geopark sites

<table>
<thead>
<tr>
<th>Geopark</th>
<th>Elevation (m)</th>
<th>Accessibility to road network</th>
<th>Climate zone</th>
<th>Area (Km²)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>820m to 900 m</td>
<td>Linked with roads</td>
<td>highlands</td>
<td>2.06</td>
<td>Forest</td>
</tr>
<tr>
<td>2</td>
<td>350m to 420m</td>
<td>Linked with roads</td>
<td>highlands</td>
<td>0.44</td>
<td>Range</td>
</tr>
<tr>
<td>3</td>
<td>850m to 920m</td>
<td>Linked with roads</td>
<td>Ghor Zone</td>
<td>0.4</td>
<td>Forest and Range</td>
</tr>
<tr>
<td>4</td>
<td>800m to 880m</td>
<td>Linked with roads</td>
<td>highlands</td>
<td>1.9</td>
<td>Forest</td>
</tr>
<tr>
<td>5</td>
<td>250m to 310m</td>
<td>Linked with roads</td>
<td>highlands</td>
<td>1.42</td>
<td>Forest</td>
</tr>
<tr>
<td>6</td>
<td>490m to 650m</td>
<td>Linked with roads</td>
<td>highlands</td>
<td>1.48</td>
<td>Forest and Range</td>
</tr>
<tr>
<td>7</td>
<td>240m to 400m</td>
<td>Linked with roads</td>
<td>Ghor</td>
<td>0.58</td>
<td>Range</td>
</tr>
</tbody>
</table>

Based on the data presented in Table 3, Geoparks number one, four, five, and six are most likely the best candidates for the Geopark site mainly because they have adequate large area, they are located in highlands and Ghor zones’ climate with elevation reaches about 900 m above MSL, and they are linked with roads grids in addition to their location at forest and range area. According to these reasons, Geoparks number one (best option), four, five, and six are the most suitable areas for Macro Geopark that still needs further investigation to identify the best candidate among these four.

5. CONCLUDING REMARKS

The work presented in this paper emphasizes on the important role of GIS and multi-criteria analysis in land management using Wadi Zeglab in northern Jordan region as a case study. Wadi Zeglab area holds a unique and valuable geo-bio-diversity system that needs to be protected and highlighted on any future development plan for the area. For this reason, this paper aimed to select the best suitable locations for establishing a geo-environmental protected area ‘Geopark’ in Wadi Zeglab. Spatial data was collected from different sources and the rest of the data were produced using GIS analysis capabilities. Multi-criteria analysis was run on the GIS spatial layers using the predefined selection criteria to identify the potential candidates to establish the Geopark. Four potential locations satisfied the selection criteria and hence proposed as suitable sites for a Geopark. Future work is still needed to merge such sites with the masterplans and future development scenarios for the area and how this will affect the area future planning. Designing the necessary environmental standards to ensure the region sustainability is another target that needs to be covered in the future.

6. REFERENCES


