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Land use planning using the Geographic Information System (GIS) in Tandoreh National Park (Iran)

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Abstract-**Land use planning is the science that determines land use through the studyofthe ecological character of land as well as its socio-economic structure.It is possible to plan for the appropriate use of the land and to enhance the present management of the land use by utilizing Geographical Information System (GIS).This study identified and took steps toward developing maps to determine the ecological and socio-economic resources of Tandoreh national park that encompasses an area of 356.58 km2. Digital mapswere inputted along with explanatory data into an ArcGIS software application. In addition, all digital maps of layers including, elevation, slopes and aspects, soil texture, geology, soil erosion, vegetation or canopy percentage, climate and water resources have been integrated-superimposed in the ArcGIS environment based on the Makhdoom analytical and systematic analysis model. Finally, land use planning maps of the Tandorehwere developed considering the ecological and socio-economic characteristics of the area. The results of the evaluation of the area indicated land use appropriateness and allocation as follows: Strict Nature Zone 30.58percent, Protected Area Zone 58.18 percent, Extensive Use Zone 6.64 percent, for Historical Culture Zone 0.2 percent, Recovery Zone 1.69 percent and 2.68 percent for Special use Zone.**

Keywords—Land use planning, Geographic Information System,TandorehNationalPark

I. Introduction

Land use changes are altering human and natural systems globally and regionally. Globally, nearly 1.2 million km2 of forest and woodlands areas and 5.6 million km2 of grasslands and rangeshave been converted to other uses, and over the last three centuries, 12 million km2 of cropland were lost [8]. Land degradation and the loss of land productivity are two important environmental problems. These problems relate to the reduction of land resource potential by either one or a combination of processes acting on the land such as water and wind erosion, sedimentation, loss of soil structure and fertility, salinization and other acts of nature that result in long-term reduction of diversity of vegetation and net primary production [11].

The intensity of land use changes in response to world population growth and their consequences for the environment warrant in-depth studies of these transformations.Several organizations have initiated various international interdisciplinary research projects during the past two decades for this purpose. These include the International Geosphere-Biosphere Project [3] and the land use and cover change program [6]. Both of these projects indicated the need to construct an accurate and up-to date database concerning these changes, their meaning or pace and other explanatory factors prompting their appearance [5]. All of these changes, especially the loss of agricultural land have the potential to undermine food security andthe long-term harmonious relationship of humans withtheirenvironment[12].

Land use, in general, consists of the coordination of the relationship between humans and the landscape. It also involves their activities on the land, the proper and long-term use of provisionsfor the improvement of the material and spiritual condition of the society over time. Land planning requires extensive infrastructural research and keeps the economic condition of the area under study in mind. It can be undeniably stated that land use planning of an area without considering the socio-economic condition of that area is virtually impossible [4]. Remote sensing and Geographic Information Systems (GIS) have been widely applied in identifying and analyzing land use and land cover changes [9]. These days, it is possible to combine various ecological and socio-economic data through the utilization of GIS, which results in using less time and expense [10]. This tool enables us to gather and process different data with the precise and calculated outputs needed for land use planning.

II. Material and methods

2.1 Case study

The study area, Tandorehhas an area of 356.58 km2 located North-East of IRAN. This areais located between longitudes 58°33'' and 58°54'' east and geographical latitudes 37° 19'' and 37° 33'' north. The highest point in this areaislocated in south with an altitude of 2586 meters (Ganbarali peak) and the lowest is in north with 884 m height. The location and typical landscape of the case study area is shown in Fig1 & Fig 2.

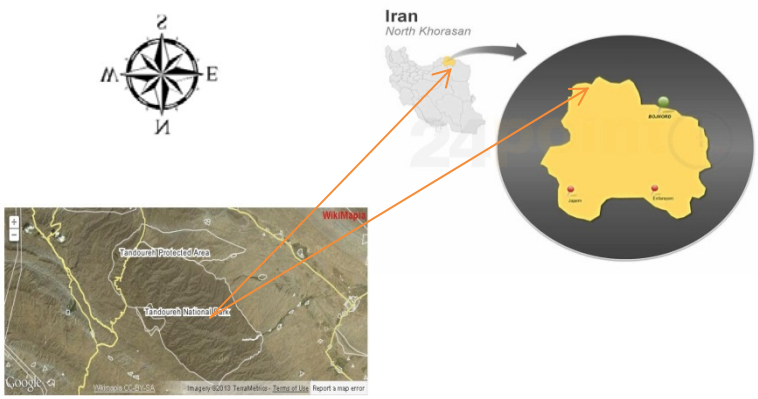

Figure1: The Location of the study area

Figure 2: The Typical landscape of the study area

The average annual precipitation in the national park is between 250 to 300 mm, and rainfall distribution is remarkably different in various seasons. The temperature in wintergoes downto -20 degreesCelsiuswhich lasts up to four months of the year. The study area also experiences seasonal snow.The climate of the national park as determined by the DeMartin method is Semi-Arid and Cold Semi –Arid.

In this study, a systematic method known as the Makhdoom Model [4]was used for the analysis of maps in relation to the ecological and socio-economic resources of theTandoreh National Park. The maps used to determine the ecological resources of the area under study were Digital Elevation Model (DEM), slope and aspect, soil texture and erosion, geology, canopy percentage and climate. The socio-economic resources of the area under study consisted of population composition, immigration condition, present land utilization, agriculture and animal husbandry conditions, hygiene, health, education and other public services.To achieve a systematic analytical model,all maps layers were converted from a vector format to a raster format in the ArcGIS software environment. This led to the step all raster layers were obtained for the study of the basin. These maps were operated using ArcGIS, and the appropriate utilization of each section was determined and prioritized.Finally,land use planning of the Tandoreh National Parkwas then prepared(Fig.3).

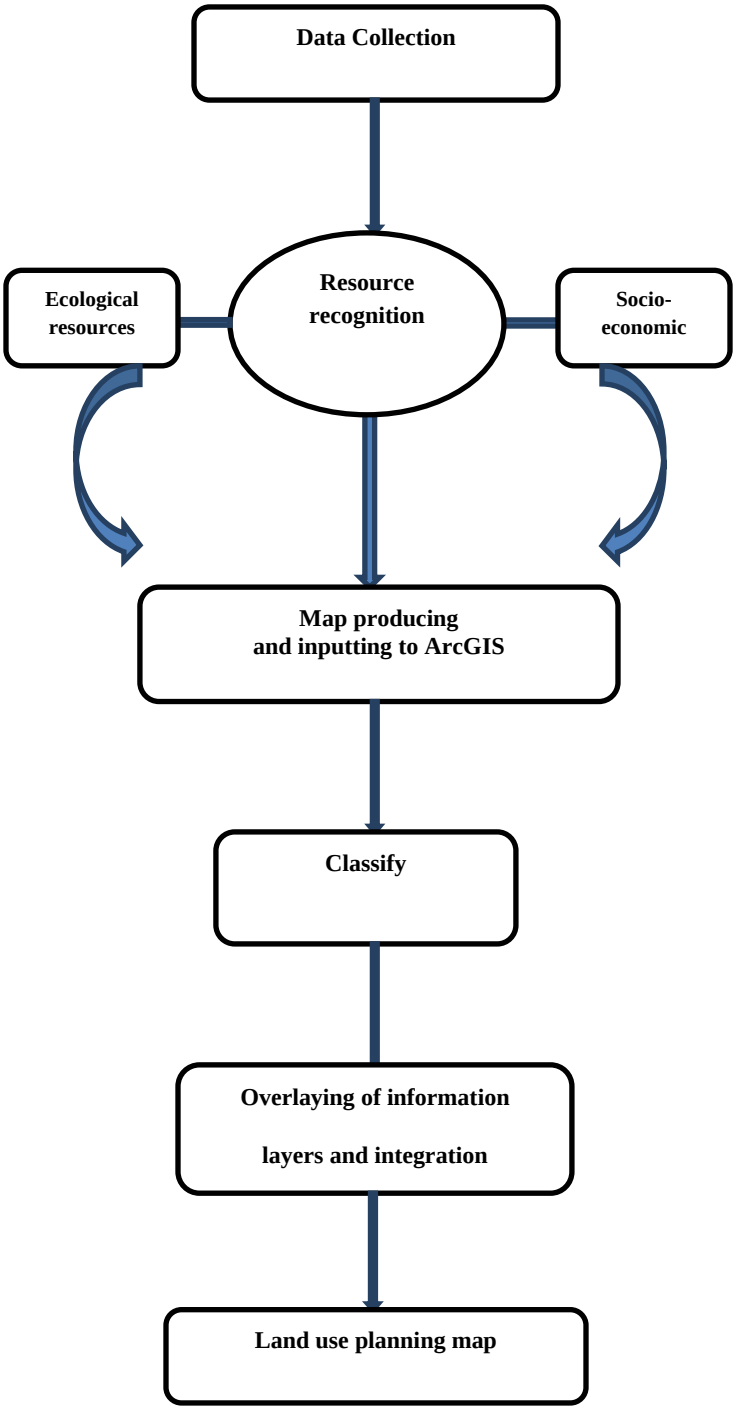

Figure 3: Operational process of the procedures

III. Results

All maps produced to recognize the land use condition in Tandoreh National Park were revealed (From Fig.4 to Fig.9) The available layers representing the ecological resources of the area and overlaying of these maps in ArcGIS environment were based on systematic analytical model [4]. In addition to combining the obtained results while considering the socio-economic condition of the area and its existing potential resulted in developing, an appropriate land use map was produced for the Tandoreh National Park. The results of the evaluation of the area based on maps obtained indicated land suitability and allocation as follows: 30.68 percent (108.68 km2) for Strict Nature Reserve Zone, 58.18 percent (206.77 km2) Protected Area Zone, 6.64 percent (23.62 km2) Extensive Use Zone, 0.2 percent (0.72 km2) for Historical-Culture Zone, 1.69 percent (6.02 km2) for Recovery Zone and 2.68 percent (9.55 km2) for Spatial use Zone. Figure 11 shows land use planning map for Tanadoreh National Park.

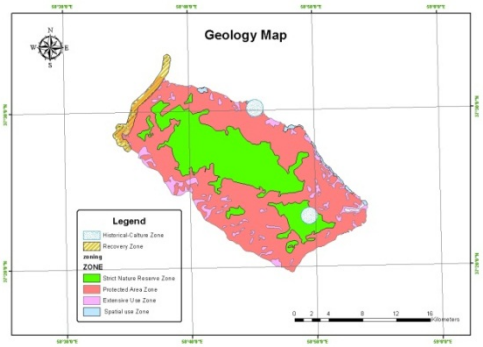

Figure 11: Land use planning map of the study area.

IV.DISCUSSION AND CONCLUSION

The determination of the appropriate land use for the purpose of best utilization of the land in the country and prevention of further destruction of resources due to population increase can be an effective step in strategy for stable expansion [7].The precision of GIS output is considerably higher than that of manual methods, and claims have been made that, from the time point of view,computerized methods take about one third of the time needed for manual methods employed when organizing a land use planning project.Through employing GIS and combining the various raster layers of the area, which in reality represent its ecological resources, one can obtain a map for appropriate land utilization of the area. However, determination of priorities for appropriate land use from obtained maps cannot be adequately precise without considering the socio-economiccondition of the area or the tendency of area residents to utilize the land for specific uses [1].

The examination of land use planning maps has the potentials for determining not just a single purpose use, but also has the determination of multiple uses[4]. Hence, under special circumstances and only through considering the socio-economic conditions of the area and its residents' way of life as well as their tendency and desire to use the land for specific utilization, must the best use for each unit be determined andprioritized. For example the units situated close to villages in an area,where multiple uses are possible, the priority was therefore given to the present use. The units with soil erosion vulnerability, that presently enjoy fairly stable surface vegetation cover. In units where there are no socioeconomic limitations, the priority is with the one demonstrating the highest potential [2]. It can be seen that the Strict Nature Reserve Zone, and Protected Zone in National Park are the largest area whencompared with the others zones, this is as a result of the grazing activity in the area. The paper therefore recommends that a recovery zone which will includes dry farming in the eastern edge of the park should be considered.

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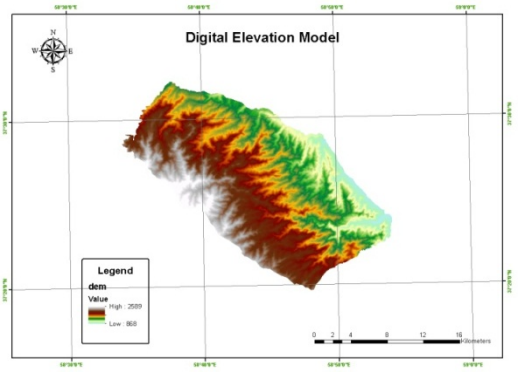

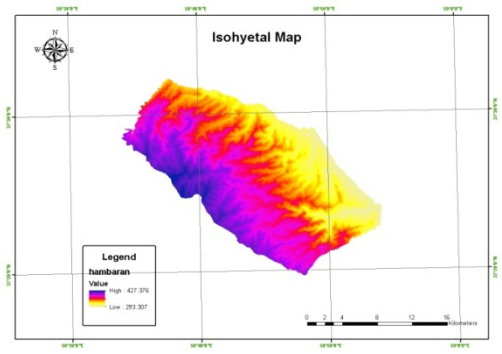

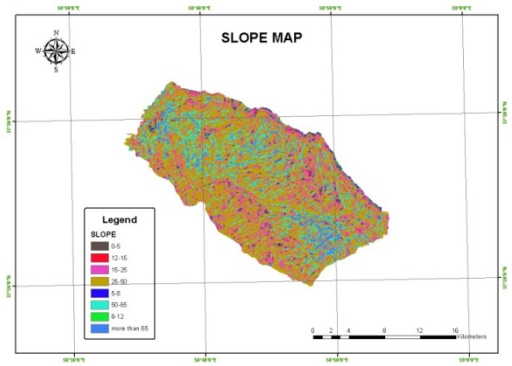

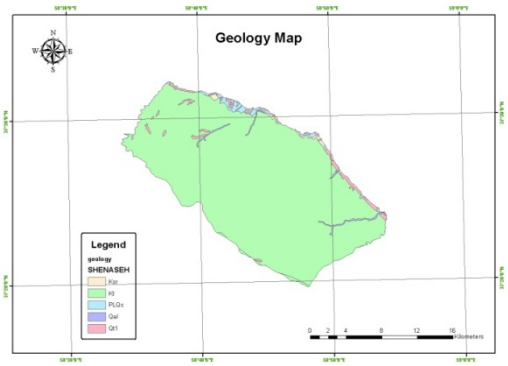

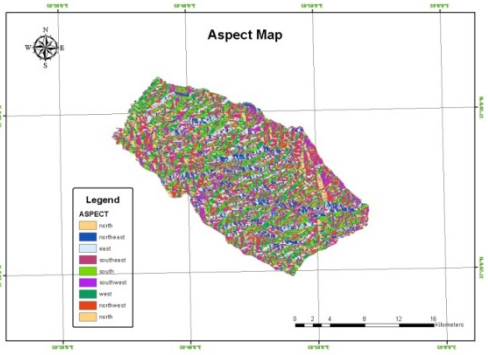

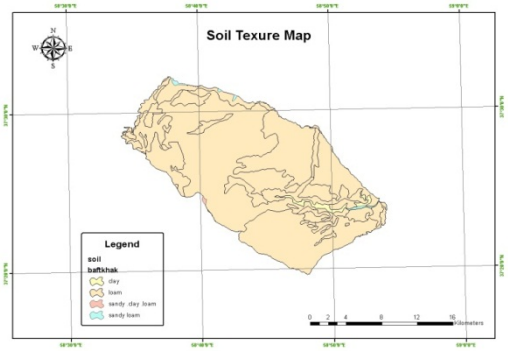

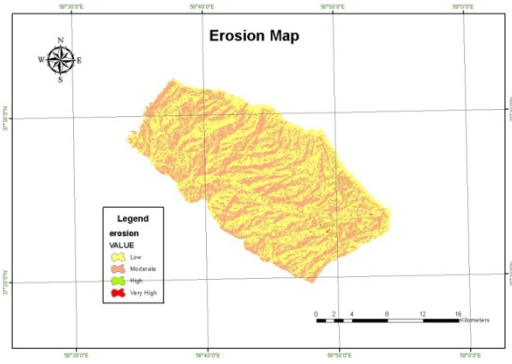

Figure 4 to Figure 10: Dem,Slope,Aspect, Rainfall, Geology, Soil Texture and Erosion of study area