ECOTOURISM ZONING IN SISTAN&BALOUCHESTAN BY USING GIS

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Abstract: *Sistan&Balouchestan Province is located on the arid areas. Geographical position of Sistan&Balouchestan and its various lands (in view of topographic, hydrologic and climatic conditions) have created a beautiful area in the east of Iran. There are 117 tourist attractions that it indicates this province can be developed in the field of ecotourism. In this paper, Makhdoum Ecological Model has been used for Ecotourism Zoning of this province. This model is the sole ecological model to develop ecotourism activities in Iran. It is on the basis of systemic analysis and multi-criteria evaluating. Combination and overlay of the layer has been performed by ARCGIS 10.2. Than Fuzzy and Boolean logic Models and Query have been used to search for ecotourism. According to outputs of different models and evaluating Makhdoum Ecological Model, it is found that east of Sistan&Balouchestan Province has better conditions to develop ecotourism on the basis of various high densities, climates and natural views. All maps illustrate that focus of ecotourism zonings is located on the east. Map No.6-1 provided by using Zonal Statistics in GIS illustrates that 55147 pixels have been analyzed in the model that 23000 suitable pixels for ecotourism are located on the east of the province alone.*

Key words: Ecotourism, Sistan&Balouchestan, Geographic Information System, Makhdoum Model.

INTRODUCTION

Ecotourism is the most pervasive tourisms of all and it plays important role in various countries differently. It is clear that it is a factor to attract tourists. The areas that considered by this tourism include national parks, jungles and wildlife (Bowker and Cordell 1999: 350).Tourism industry, especially Ecotourism has played important role to develop interaction and relation between human and community, economical activities and development (DehCheshmeh and ZangiAbadi, 2008). In all relevant literature,

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Lascurain who was the first person provided the term and was kept on working. According to Lascurain, the tourism boom is to study, admire, appreciate and enjoy the natural landscape and observe the flora, fauna, cultural features and find local communities in the past and present times (Niyazmand 2003). Generally, Ecotourism is responsible to travel to natural areas that its aim is to protect the environment and improve the quality of life for local people. Ecotourism creates minimal damage to nature and culture of the region (SaremiNaein, Mohammad Hossein 2003).Ecotourism is a kind of tourism that tourists visit the Wilderness and undisturbed natural areas and travel the world to watch the plants, birds, fishes and other animals. The kind of tourists who visit the ecosystems and natural allies alive, is called Eco-tourist or ecological tourist. Their activities are to search mineral springs, climbing, etc. Many countries have a large part of their income from foreign tourists. The developing countries use this industry to business and pay their debts. The natives should develop ecotourism in small scale (Kitter, Erlet 1994) . Ecotourism makes a social relation between people of various communities. It can increase social interactions among nations and present different cultures and religions and cause to world peace (Babapor 2001). There is a near relation between tourism and nature. There are many natural views and landscapes in the environment that are attractive for tourists, and then they can help to protect and conserve the environment. Developing tourism can be affected on the environment .if there is a good planning for ecotourism to develop and manage; it will lead to positive effects (Homayoun, Anahita, 2001). Ecotourism Potentials Treasure of SistanBalouchestan can change this province to one of ecotourism poles. It should be consider as a short term plan in development plans of the province. Therefore, it is necessary to find the suitable and favorable zonings in the field of ecotourism. In this paper, suitable areas of ecotourism will be presented to plan the tourism in this province. It has been studied in this field:

Farajzadeh and Karimpanah (2008) studied on the suitable zonings for ecotourism in Kordestan Province. DehCheshmeh and Zangiabad (2008) considered ecotourism potentials in ChaharmahalBakhtiari. Azimi and Hojaji pour (2008) took actions to plan development of tourism and ecotourism industry in Iran. Shayan and Parsayi (2007) studied on feasibility of suitable zonings for ecotourism in Kohgiluyeh and Boyer-Ahmad Province. Davling and Wayler (1998) studied on ecotourism in the south of Asia. Ringinga (2008) considered suitable ties of ecotourism in India. Boukina (2008) applied Geographic Information System to make decision to develop ecotourism in the south of Africa. Teripasi and Ghoosh (2007) studied on sources of ecotourism and beaches and their effects on economic development and entrepreneurship in Asia. Akbari and Bemanian (2008). Akbari and Bemanian (2008) have taken actions to study rural ecotourism and its role on stable development of Kandovan village. In measurement of forests, Arasbaran in special ecological position have allocated 30.09 %, 28.47% and 0.01% of the area to protect, wide ecotourism and intensive ecotourism, respectively. Pirmohammadi (2007) evaluated ecologic potential of Kaka Reza jungle in Lorestan Province and concluded that altitude from sea, application of play and using of lands have played important role to evaluate ecotourism zonings. Abdolsalam et al (2000) have used Geographic Information System (GIS), Thematic Mapper (TM) and Information Technology (IT) to plan ecotourism in Mangrove forests in Sundarbans and believed that ecotourism is

a good thing to help to stability in jungle sources and conserve World Heritages Sites. MajidMakhdoum (1993) have considered the meaning of ecotourism in an Iran seminar and believed that it is necessary for various natural areas of Iran to plan in the field of ecotourism. RakhshaniNasab and Zarabi (2009) write a paper named Challenges and Occasions to develop Ecotourism in Iran and suggested that there are many challenges in ecotourism industry and it hasn't played important role in global markets. Some features of areas such as finding tourist attractions, substructures and available facilities are necessary to plan around tourism. Also, it is necessary to use different data of places and areas. Tourism planners should use GIS to manage and analysis various information. This information is very benefit for both tourists and managers (Frajzadeh 2008). In this paper, Ecotourism Zoning has been considered in Sistan&Balouchestan by GIS.

Geographical position of the researched

Sistan&Balouchestan Province, with an area of 187,502km², has covered 11.4% of total areas in Iran. It is the largest province in Iran, which is located between 25 ° 3′to 31° 27′of north latitude from the equator and 58° 50′to 63° 21′of east longitude from the meridian of Greenwich.
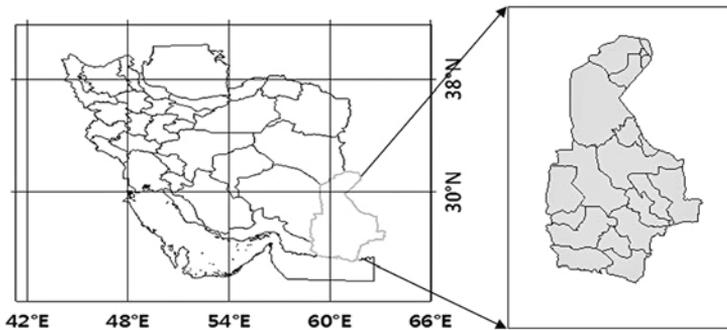

Fig. 1. Location of Sistan and Baluchestan

MATERIAL AND METHOD

It is necessary for ecotourism and stability to be planed the tourism spaces by using the available sources and be utilized optimally by finding the suitable tourism zonings. In this paper, therefore, the natural potentials and abilities of Sistan&Balouchestan Province have been studied and the suitable ecotourism zones and methods of their developments have been considered. This methodology is descriptive and analytical studies. Two methods have been applied in this research: Gather Information and Documents, Field Survey and processing Data. Analyzing place and time of tourism cases are performed by GIS and application of tourism can be evaluated. After gathering necessary data from transportation system, GIS can show tourism progresses.

Information of contour line of 100m of topographic map has been used to draw map of slope. Digital Elevation Model (DEM) has been formed by administrating functions of Triangulation Irregular Network (TIN) and map of slope has been drawn for each pixel in dimension of 100* 100 by transforming Raster Data. In this map, the slope has been categorized in 7 categories (in percent) that the most percent of slope is belonged to a category less than 10% that include plains and plateaus such as west of the province. The second frequency (20-30%) is belonged to the mountains of the west of the province. Slope in 30-40% has been located as a band in south-western of the province around Khash City. This map illustrates that 7.5 % of all have a slope less than 20%, 25.8 have a slope between 20 and 50% and only 30% have a slope more than 50%. Regarding the effective factors to evaluate land suitability is not important similarly, and then there are various methods to evaluate weight such as ranking, paired comparison and Boolean Logic Models (table 1) (Malczewski, 1999).

After drawing necessary Digital Maps and stratifying the layers by using Makhdoum Ecotourism Model, potential of area to applying concentrated and wide promenades recreation is evaluated. As it is a sole and suitable ecotourism model in Iran, then it is used to study on ecotourism. In Makhdoum Ecologic Model, slope, geographic direction of slope, altitude from the sea and type of land unite have been studied. In concentrated promenade (it needs to develop), slope of 0-5% is suitable and more than 15% isn't suitable for tourism. But in wide promenade (it doesn't need to develop), slope of 0-25% is suitable and more than 50% isn't suitable for tourism (Makhdoum 2005). In the field of geographic direction, eastern (summery) and southern (wintry) directions are suitable for tourism in the concentrated promenade and southern-western (summery and spring) and eastern-northern (wintry) directions aren't suitable for tourism (Makhdoum 2005). It is important that different slopes can create different attractions in tourism. The early studies suggested that the least and most height have been 8 and 3830m, respectively. And the difference between the highest and lowest point has been 2822m. ArcGIS, Logic Function, Query and Map Calculator have been used to combine the maps. The map of suitable ecotourism zones has been created on the basis of the data and by using software Browser Language. Digital Elevation Models (DEM) and ARC-GIS have been used to draw a map of slope. According to layers of DEM, slope of eastern mountains is more than 30% but slopes of central, western and southern zones are maximum 15%. Features of Counter Curve have been used to draw the map of geographic direction. After that, four geographic directions of each mountain slope have been drawn by marking Top Chords, valleys and method of relation between top chord and peak and rivers. It found that northern direction has involved the most area of all (EbrahimiFini 2006). After drawing maps of slops, height and direction, it is also necessary to combine other components. One of the most important components is data layers of land units and abilities of sources. This layer not only illustrates mountain, hill, terrace, etc, but it also provides benefit information about their abilities. Therefore, land units and abilities if sources are considered to combine as the other components.

Table 1. Criteria of Locating and Specifications for ecotourism

Unite	Criteria of Locating	Specifications
1	Slope	Slope less than 40%. Regarding rainfalls and producing leachate to bury, it is necessary to be a 20.4% surface slope with 30%side slope in the covered soil.
2	Underground water	It should be low. The depths more than 7m are suitable.
3	Surface water	It should be at distance of 600m from surface waters.
4	Wind Direction	It shouldn't be located at a direction of prevailing winds
5	Rainfall	It shouldn't be located on the rainiest areas.
6	Fault	It should be at a distance of 80-100m from faults.
7	Soil materials	It shouldn't be permeable and it should be Silty Clay.
8	Bedrock	The beds with Integrated quartz and impermeable sedimentary rocks and metamorphic rocks are suitable to bury.
9	Flood	It shouldn't absorb floods.
10	Topography	It should located on flat lands
11	Depth of Soil horizon	Subsoil should be 10m in thickness from clay (or similar materials)
12	Distance from Cities	It should be at a distance of minimum 2-3 km and maximum 20km from Cities.
13	Direction of Development of Dwellings	It should be in direction with developing cities.
14	Ecological sensitivity	It shouldn't be dangerous for Vegetarian, wildlife, rare species and conserved areas.
15	Present and Future Land Application	It shouldn't be opposite of the available users.
16	Present and Future Land Development	It should be minimum 15-20 years old and can receive the wastes for the future times.
17	Across roads	It should be trafficable in all seasons. The short ways are better. It shouldn't be passed through traffic ways. Width of way shouldn't be less than 6-7m.
18	Cover	It shouldn't be exposed and it should have natural obstacles.
19	Infrastructure possibilities	Water, power, etc
20	Cultural, historical and ancient values	It shouldn't be dangerous for Cultural, historical and ancient monuments.

Source: Shayan 2007 and Author: 2014

DISCUSSION

Scientist knowledge of geographic zonings is necessary to utilize all environmental possibilities and it helps to be successful ecotourism of the province. In comparison with Asian (north and east) and European countries, the suitable areas of Iran are desert where located in Sistan&Balouchestan Province. It can attract many tourists. It is necessary to study on potentials of the province to plan well. Knowing human and natural potentials and their limits can play important role to plan and develop stably (Bazi and Salari 2010). At present, this method is based on the changes that can be in evaluation pattern of ecologic potential.
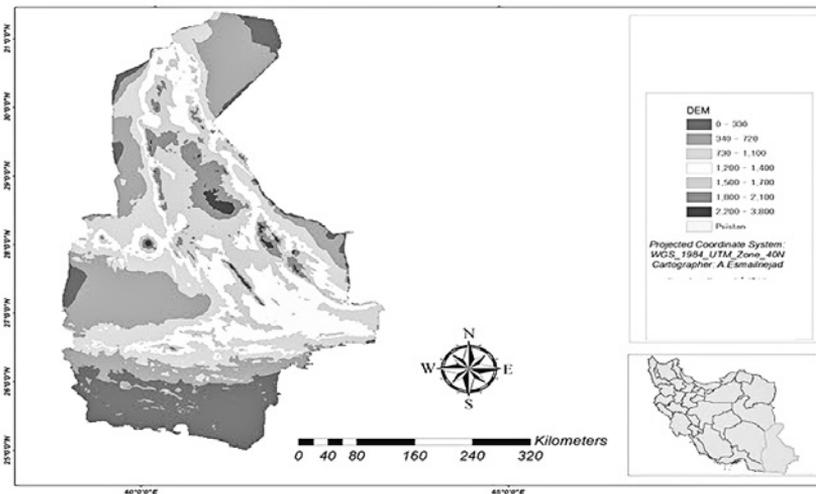

Fig. 2. Digital Elevation Models map of Sistan and Baluchestan province

Regarding effective factors are not important to determine land suitability similarly then there are various methods to determine weight such as Ranking, Paired comparison and Boolean Logic Model(Malczewki :1999). In the Boolean Logic, weighted to the units in each data layer is on the basis of logic of zero and one. It manes right and wrong pixels are defined in final maps. It has two operators OR, NOT-AND. On the basis of Set Theory, union and intersection operators extract the sets. Two number of zero and one play role in this logic. That is, inappropriate options are zero and appropriate options are one. In this paper, Boolean Logic has been used to rank. The effective ecotourism layers have been defined to draw a map of appropriate zones. Operator AND, Query, Computation Places have been used to combine the maps. Finally, map of Ecotourism Appropriate Zones has been drawn.
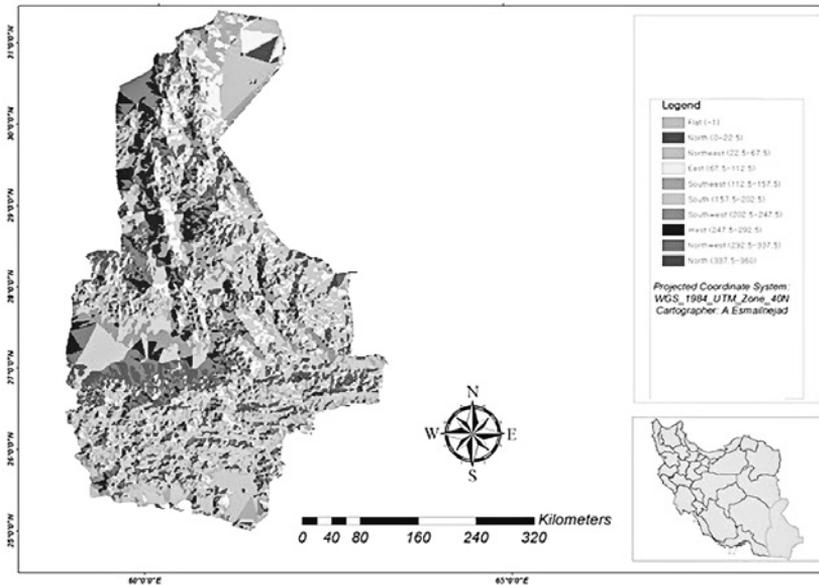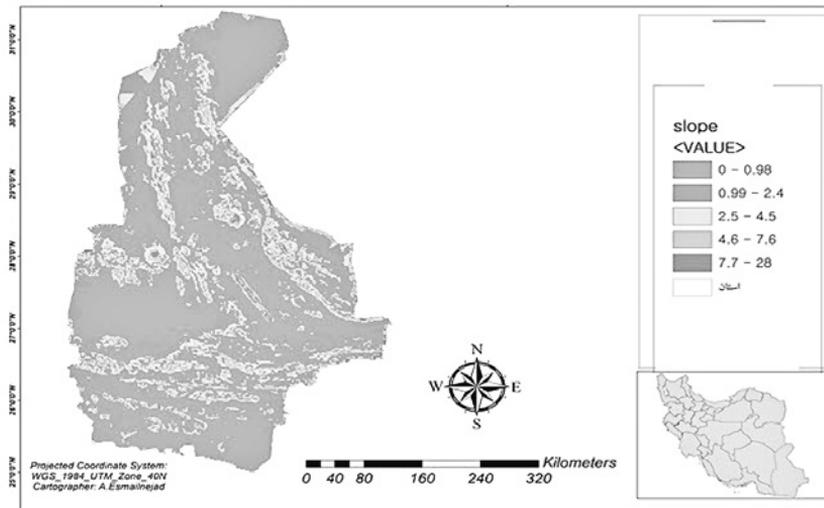
Fig. 3. Dispersing slope Direction in the Province

Fig. 4. Dispersing slope the Province

Table 2. Necessary environs to zone Province Ecotourism

Raw	Kind of Tourism Action	Appropriate Environs
1	Climbing	The places where have the height more than 1800m and their slops are more than 20%.
2	Hiking and Natural Views	The areas in height of 800- 2050m and slope of 20-70%. Also, Jungles in different classes are in this group
3	Water Sports and Fishing	The area located at a distance of 1km from the lake and water places such as dams and at a distance of 1500m from rivers.
4	Ecotourism	Jungles and Riversides

Source: Farajzadeh, 2008

Appropriate Ecotourism Zoning by Makhdoum Model

In this paper, the last current methods of Iran, Systemic Analysis Method has been used to evaluate. Generally, at first it is necessary to find ecologic and socio-economic sources and then to explain and gather data and create mapping unites. After this stage, special model of the area is created according to general ecotourism model of Iran (Makhdoum et al, 2004) and finally ecologic potential is evaluated on the basis of this model for the applications. Equal ecotourism unites and special model of ecologic potential of ecotourism are compared and they are grouped in three groups of concentrated ecotourism potential and two groups of wide ecotourism potential. Totaling equal unites and holder's potential have provided zoning map.

In the present paper, the following process has been done stage by stage to map environmental unites in ArcGIS, 2:

1. Totaling maps of categories of slope and altitude from the sea (the first map of the earth)
2. Coding the common zonings by Makhdoum Formula and adding the new column to descriptive table of the first layers of the earth
3. Totaling the first map of the earth and geographic directions map and making map of earth unites
4. adding the new column to descriptive table of the made layers in the third stage and coding resultant unites
5. Integrating unites less than 5Hecars with slope of 15% and unites less the 25Hecars with slop of more than 15% and making map of final unites of earth (after completing this stage, these unites located in slope of 15% have the areas more than 5Hectars and the unites located in slope of more than 15% have the areas more than 25Hectars.)
6. Totaling map of final earth units (after integrating) and processed soil map and repeating the operation
7. Totaling map environmental units grade 1 and processed map of type and form of vegetarian and performing operation similar to stages 2 & 5 and finding map of environmental unites grade 2.

8. Totaling map environmental units grade 2 and vegetarian density map and repeating stages 2 & 5 and finding final map of environmental unites.
9. After drawing required digital maps and ranking layers, potential of the area to wide and concentrated promenades by Makhdoum Ecotourism Model. As it is a sole map to sty ecotourism in Iran, then it is used to study on ecotourism of the area.

Table 3. Ecologic Model of the present ecotourism

	Concentrated Ecotourism of category 1	Concentrated Ecotourism of category 2	Wide Ecotourism of category 1	Wide Ecotourism of category 2
Percent of Slope	0-5	0-15	0-25	0-65
Direction of Slope	Eastern	Eastern		
Soil tissue	Loam, loamy-Sandy	Sandy, sandy-Loamy, Sandy-Loamy- Clayey, Clayey-Sandy, Loamy-Clayey-Sandy		
Vegetarian	Forest Canopy Density, Forest Canopy middle Dens, Forest Canopy Semi -Dens,	Pasture with Forest Canopy middle Dens, wood and shrubbery, farms		
Parent Rock	Ophiolite (Proprotite, Serpatniste, Gabbro, Basalt, Mix Color), Alluvial river	Limestone and Dolomite lime, Floodplain, Alluvial River, Ophiolite, Mix Color, Loess Quartzite,		
Soil Erosion	Little	Middle		
Temperature	20-24	18-20	18-24	18-24
Relative Humidity	Less than 60%	Less than 80%	Less than 80%	Less than 80%
Days of Sunny Days in a month	Minimum 15	8-15	Minimum 15	8-15

(Source: Makhdoum et al, 2001, Feizi, 2007, Shayan and Parsayi 2007)

Makhdoum Model is special to make decision for concentrated ecotourism category 1 CE_{i1}, category 2 CE_{i2} and category 3 CE_{i3}. Also, wide ecotourism category 1 Cew_1 and category 2 Cew_2 are made decision and evaluated according to these models. Signs of used ecologic specifications in different categories of model evaluating ecologic potential consist of :Ts (Soil Tissue), Sp (Slope in percent), V(Vane), La (Lands), El(Elevations), Hu (Humidity), Te (Temperature), Wi(Wind Speed), Su (Sunny Days. They are also evaluated according to Makhdoum Model.

$$CE_{i1}= S. (1, 2, 3) + El (1, 2, 3) + la (2, 3, 4)$$
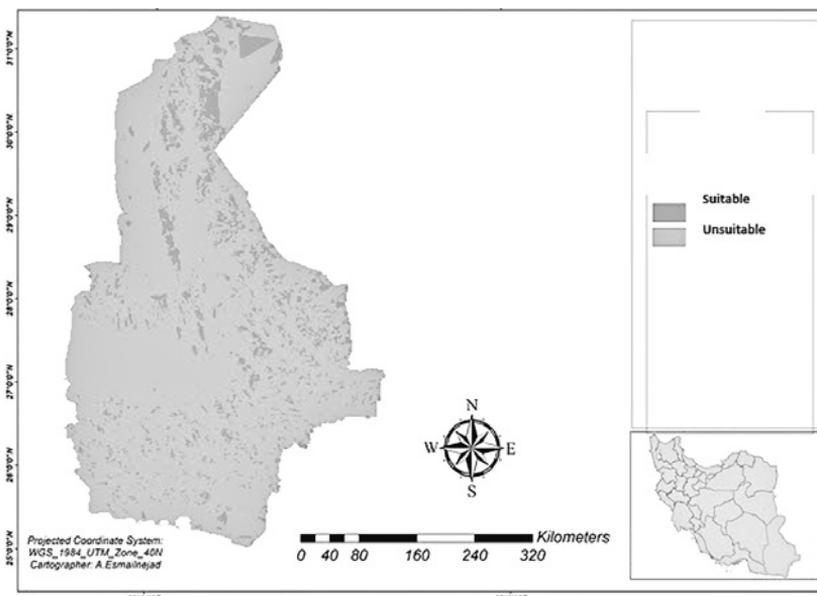$$Cew_1= ts (1, 2, 3, 4) + sp (1, 2, 3) + te (2, 3, 4)$$

Fig. 5. Appropriate concentrated ecotourism zones, Category 1,
Sistan&Balouchestan Province

About 149050Hectars of the area is appropriate for concentrated promenade, category 1. The area of appropriate zone for concentrated promenade, category 2 is about 448075Hectares. Studding on Mode Outputs in various maps illustrates that central and western areas of the province are more favorable to develop tourism in the wide group. In the southern area special in Taftan mountainsides and Makran mountains are more appropriate to develop concentrated tourism. Some areas where have the more slope are well to develop ecotourism because the slop is very important in promenade model. The most important ecotourism unites of the province are located on the Khash and Taftan that are very attractive places for climbing and hiking. This area has been selected as a concentrated ecotourism type 1. Khash includes local mountains where there are many holes and plains in them.

Fig. 5 Illustrates dispersion of appropriate concentrated ecotourism areas, category 1. As it can be seen, they are like some small spots all over the province that there are in high density in the north and center of the province. This zone includes natural views such as rivers and mountains with vegetarian that they are appropriate to invest.

Appropriate concentrated ecotourism zones, Category 2, have been shown in fig 5 Western, central and north-eastern areas of the province have the best conditions to develop ecotourism. Density of developing concentrated ecotourism, Category 2 has been focused in south-eastern and east of the province (fig6).
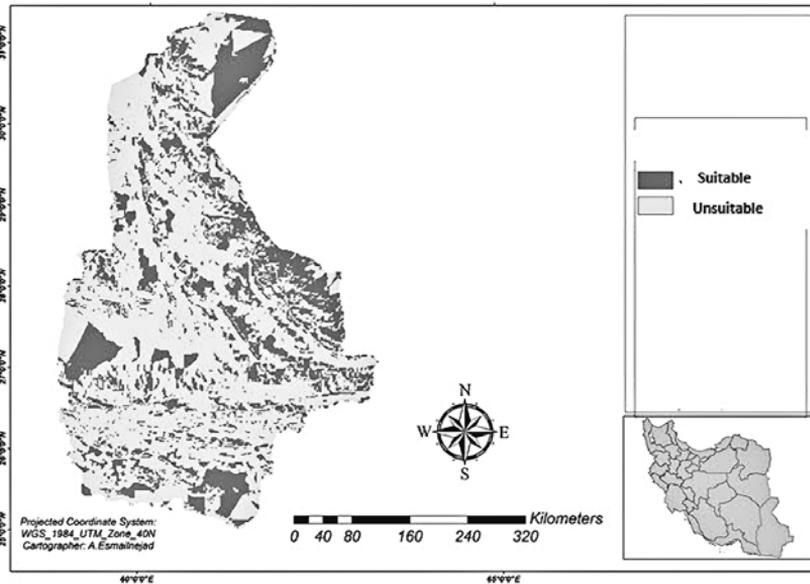
Fig. 6. Appropriate concentrated ecotourism zones, Category 2, Sistan&Balouchestan Province

CONCLUSION

One of the spatial tourism patterns that formed in this modern age is based on the nature or ecotourism. It indicates tourist's approaches on environment in different views. Modeling of ecologic potential evaluation is based on the Makhdoum Model in Iran that led to draw ecologic zoning map in this area. There are many geological and geographic factors, different climates, arid lands in the west and high humidity in the south, entering different flows from different directions and various slopes in Sistan and Balouchestan that led to unique Desert and Mountain View. According to above-mentioned notes, it is concluded that this province has necessity potential for tourism. According to the natural conditions, 65.1% of the areas have two applications. According to topography and slope, the riversides and forests are proper places to climb and hike. 18.1 % of the areas (east, center and south-eastern) are dispersed all aver the province that have 4 ecotourism applications. They are located in east, center and south-eastern of the province where are appropriate to climb, hike and hunt. The most important unite of the province is located on Khash and Taftan where are very well to climb and geo-tourism. In the Model, It is selected as the concentrated ecotourism development, category 1. After evaluating ecologic potential of the area for ecotourism, it is necessary to select the most appropriate zone to plan physical development to concentrated and wide ecotourism. Then, some factors such as application of tourism and applied lands, finding water reservoir and sub-structures can help to develop ecotourism in the next stages. After studding on the maps, it is found that the mountains are not appropriate to develop ecotourism, because there is high slope in the areas and this parameter (slope) is very important in ecotourism model.

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