



Ecological capability of rangelands based on environmental factors in Iranshahr, Iran

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Abstract

Rangelands are profoundly affected by climatic conditions, especially the ambient temperature. These ecosystems have a significant role in the rural communities' economy and sustaining. In this research, we aimed to analyze the ecological capabilities of the rangeland in southern Iran, Iranshahr, to find out the best strategies for land use planning. Makhdum Iranian model was the basic model which we used to classify the ecological capability of the target rangelands. The main factors which we used in the modeling process were altitude, terrain slope, precipitation, soil properties, and the area's lithological peculiarities. All necessary input spatial data have been prepared using ArcGIS 10.2, and after weighting, they were classified again. The resulted ecological model constituted from three distinct areas where the northwestern part of the area covered the largest one where showed the highest ecological capacity. Meanwhile, some small parts located in the center, southeast, and southern parts also showed high capability. In contrast, most of the western, central, and southwestern parts were classified with low ecological capacity. The northern, east north to southeastern parts have been organized in moderate class.

Keywords: Climatic factors, ecological production capability, Iranshahr, Makhdum ecological model

Introduction

Natural resource consumption needs precise planning based on the target resource environmental capabilities. One major part of the ecological capabilities is an ecological capability which mainly influence and controlled by ecological and environmental factors. Based on Makhdum (2002), land's ecological capability assessment is an investigation on land's capacity, limitations, capabilities in the framework of environmental resources like topography, soil, vegetation cover, and nonstable resources like wildlife. The rangeland ecosystem's equilibrium is commonly influenced by climate and on-ground variables (Mahdavi et al. 2006). These ecosystems have a very fragile ecologic state, especially to climatic oscillations (Jafarpour 2002) as the vegetation reflects the ambient climate conditions (Woodward 1995), and there is a highly significant relationship between climate and vegetation type in each geographic area (Negareh 2001). Therefore, it is necessary to evaluate the rangelands and pastures' ecological capabilities to make better vegetation protection (Hosseieni 2001, Akbarzadeh 2015). During past 25 years ago, some studies have been carried out on the rangelands and pastures to achieve to different kind of land uses in the fragile areas which almost all of them were based on Makhdum modeling approach (Babaei et al. 2006, Meybodi Daghestani 2007, Mirdavoodi 2008, Javdani 2010, Karkaj et al. 2012). Yaghmaei et al. (2017) studied the relationship between vegetation cover oscillation and mean precipitation and aridity situations using NDVI index. They found that growth form can be affected severely from environment aridity, specifically annual forbs. One of the significant factors which impact the rangelands sustainability is intensive grazing, which already has been pointed out by different

authors like Mahdavi *et al.* (2006). Other than human-induced factors, the other habitat variable which has been introduced as one of the most critical variables in rangeland conservation status is rainfall (Humphery and Rang 1962, Martin *et al.* 1995, Alexander *et al.* 2007). Some authors also used satellite images processing indices like NDVI and SAVI using Landsat data and tried to find correlation among LI and LFA indices (Jafari *et al.* 2015). In this research, we aimed to evaluate rangelands' ecological capabilities, which can be used in better future protection and conservation programs in Sistan and Baluchistan province where suffer from extensive desertification.

Material and Methods

Study area

Iranshahr has been located in the west of Sistan and Baluchistan province with the field of around 30200 sq km. This area receives annual precipitation of approximately 120 mm, which classifies it as a desert area (IRMO 2017). In this research, a systematic method known as the Makhdoom model has been used, which is mainly based on the Boolean algebra concept (Makhdom 1381). In this model, the ecological spatial data like altitude, slope, rainfall (for 26 years from 1990-2012) and area's lithology has been applied to make ecological models. Concerning the ecological and socio-economic resources of the study area. Boolean (binary) model is an overlay methodology intersected parameters based on AND (intersection) and OR (union). The annual rainfall data has been acquired from meteorology stations distributed in Iranshahr and was modified compared to other neighborhood stations (Table 1).

Table 1. Stations used to get meteorological data

Station	Elevation (m)	Mean temperature (celsius)	Mean precipitation (mm)
Iranshahr	591	27	113
Gelmorti	370	27	34
Bampour	397	25	59
Damen	720	26	89
Delgan	410	25	37
Mirabad	1500	25	135

All the variable maps have been merged in ArcGIS 10.2, and layers to be considered based

on Makhdom model's criteria have been prepared. At elevation, slope and azimuth maps have been classified into eight classes. All of these maps were equalized from scale and borders and overlaid. After this process, the output map has been reclassified based on Makhdom model criteria, including:

Suitable slope of 8-15 percent, Suitable altitude of 1400-1800 m above sea level, appropriate rainfall of more than 100 mm, and finally soil texture of silt, loam, loam-silt (Kardavani 1985). As some authors advised, the lithological map also was prepared to use in the modeling process. The whole flowchart of the modeling process has been shown in figure 1.

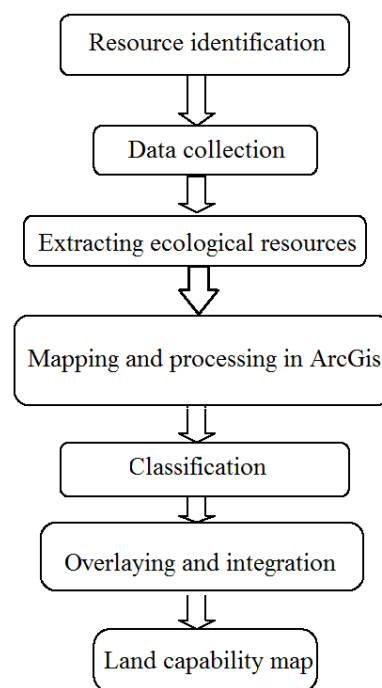


Figure 1. The entire process of land capability modeling based on the Makhdom model.

Results and Discussion

The spatial input data has been shown in figure 1. As the output shows, the ecological model is corresponding with rainfall and temperature distribution map in the study area. As can be seen from the lithology map, the southern parts of the study area is comprised of metamorphic rocks with the sedimental origin, while the northern part is covered by igneous rocks (both fine and coarse textures). The slope classification map also indicated that the high

altitude areas with higher steepness has been located at the central parts of the study area. As

ecological capabilities. The most abundant area, wich colored in very

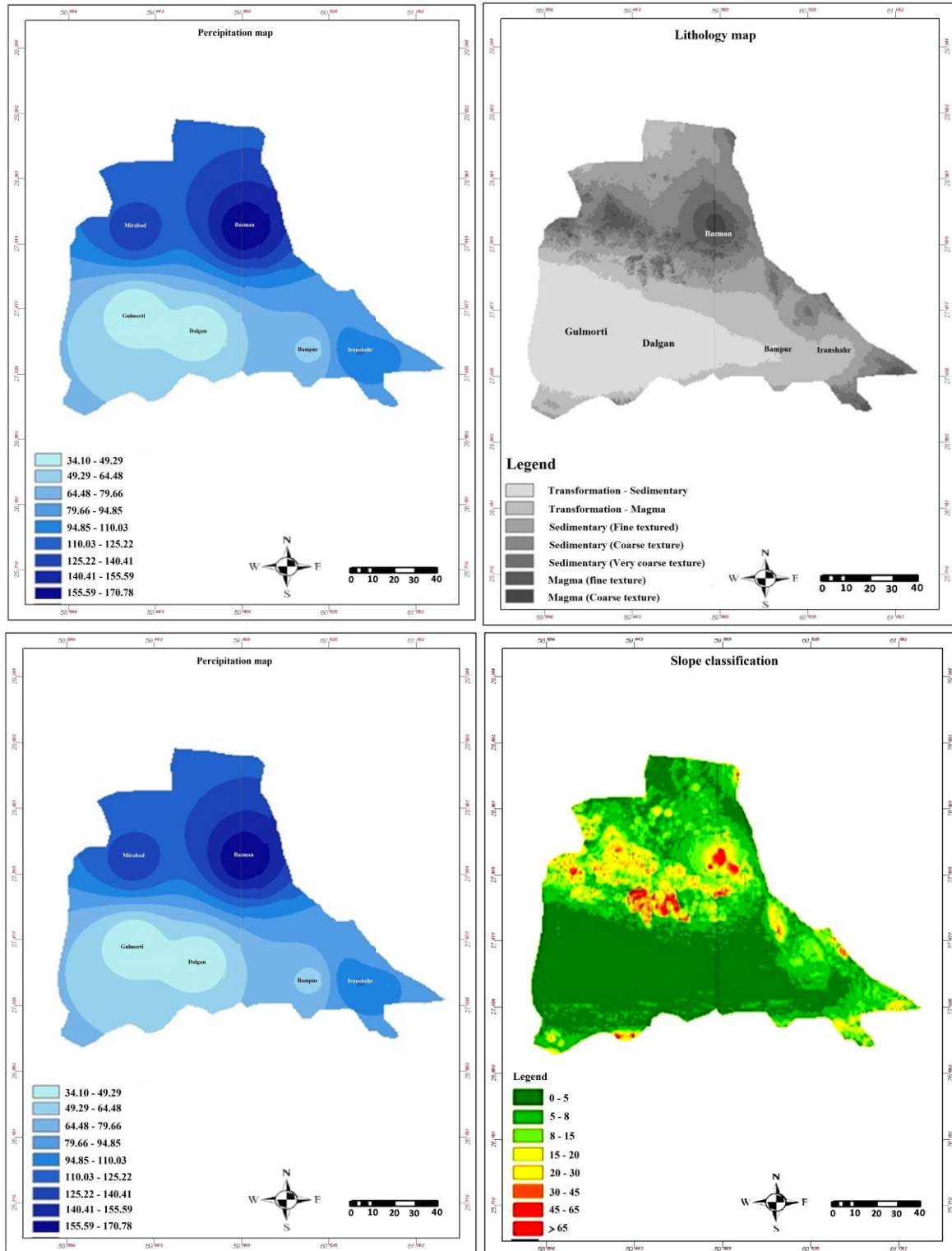


Figure 1. Slope, lithology, mean annual temperature and precipitation maps used in the modeling process

can be seen from the ecological model (Fig. 3), the study area can be classified into three distinct regions based on its

light green, has been mainly distributed at the west, center, and southwestern parts of the study area, including Gelmorti, Delgan,

Bampur, and Bazman. This area showed to be one of the weakest regions concerning the ecological capabilities and low productive rangelands and pastures. These areas compromised from two extremes of slop categories, very low (more moderate that three percent) to very steep regions (more than 30 percent). The lithological properties of the area also constituted from metamorphic rocks with sedimental origins, which replaced with igneous rocks at the higher regions. The ambient mean temperature also varies from 26-27 celsius, which is higher than in other parts of the study area. The annual mean precipitation was also lower than 60 mm.

The second area has been located in the northwestern parts of the county as well as a small part in the center and south, including Iranshahr, Damen, and Mirabad (Zarinkafsh 1989). This area has high ecological capability with a slope of 8-15 percent and elevation of 1400-1800 m above sea level. The lithology of the domain is composed of sedimental rocks as well as igneous ones with fine to coarse texture. The ambient temperature ranges from 24-25 celsius, which is milder in comparison with other parts of the study area. Mean annual precipitations are equal or a little bit more than 100 mm (Farajolahi *et al.* 2012). The third

Conclusion

Rangeland located in the desert belt is very fragile and entirely dependent on climatic factors like mean annual precipitation and temperature. In this regard, they need crucial planning to protect them against overgrazing and other human-induced pressures. Finding ecological capabilities of the rangelands based on its unique ecological resources is an ideal way to plan human activities like the grazing cycle and animal husbandry management. Most parts of Iran have been located on the global desert belt, and the southern parts of the country like Sistan and Baluchistan experience sever aridity conditions and suffer from low rainfall and needs special consideration toward the natural resources management and conservation. This study can be used to plan human-induced activities and resource exploitation in Iranshahr rangelands. The slope varies between 15-30 or 5-8 percent in high

ecological region has been located in the north, northeast, and southeastern part of the study area, which shows moderate capabilities. This area has been highlighted in green (Fig. 3).

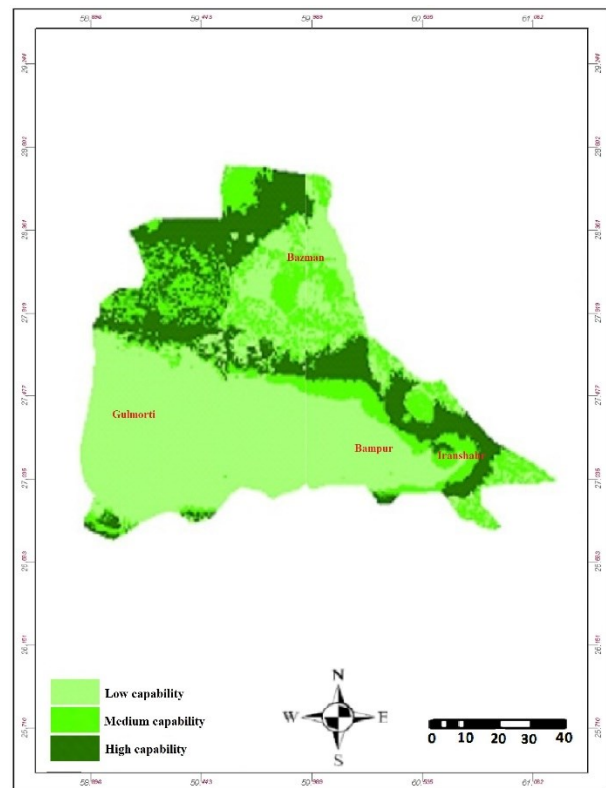


Figure 3. Ecological capability model

elevation areas or plains, respectively (Dehdar Dargahi and Makhdum 2000). Rock belongs to the metamorphic with sedimental and igneous origin. The annual mean temperature varies from 25 to 26 celsius, and mean annual precipitations also range from 60-100 mm (Kardvani 1985)

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