



# Assigning ID to Geomorphic Landforms as the Initial Stage of Geoconservation by Scientific Research Approach, Iran

Vajihe Gholizade<sup>1</sup>, Ali Eshraghi<sup>2</sup>

1- MSc. in geomorphology, University of Applied Sciences Iranian heritage, Mashhad, IRAN

2- MSc. in geomorphology, Payamnoor University of Mashhad, Mashhad, IRAN

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## Abstract

The initial stage of geo-conservation is assignment of ID to geomorphic landforms by scientific approach. There is a variety of important landforms in Iran. As national capital, they are used for economic purposes and also research and education aims. Some of the specific landforms are in danger of destruction due to excessive and inappropriate exploitations. If this type of operation continued ecological imbalance in the region will follow. Thus, protection of the geologic heritage for better protection of the environment and for scientific and educational applications seems necessary. Geo-conservation attempts to protect these features of the earth to avoid their decay. The purpose of this research is to conduct a hypothetical coding pattern for landforms of Iran. Identification, listing, programming, design of coding system, registration and definition of standards are performed to define buffer zones for the landforms. This ID assignment is to be suggested to the ministry of Science, Research, and Technology of Iran for implementation and further studies. With implementation of this coding system and access to a comprehensive database, execution of many plans can be performed with proper recognition of the area. It can be concluded that these results can be effective in conservation of geomorphic land features as natural invaluable resources.

**Keywords:** Geo-conservation, Geo-diversity, landform, ID assignment, landscape, Iran

## 1 Introduction

Conservation of environment is considered as one of the 8 Millennium Development Goals and one of the three fundamentals of sustainable development in the 21st century. As many kinds of animal and plant species are identified and conserved in all countries of the world, land surface features and landforms as an important part of the environment require such identification and conservation. But this acknowledgment is realized just in a few cases. The main reason may be poor understanding of these land surface features and their importance in natural evolution process of the earth. Pollutants, land degradation, and destruction of earth and texture are the issues can frequently be observed in many regions in Iran [1]. Land use change and urbanization towards surrounding mountainous areas increase the risk of flooding due to increase in peak flow and volume of discharge and decrease in time of concentration [2]. For average people, all the features and earth surface topography are called mountains and hills regardless of their importance, divisions, and function. As a result, these landforms are disregarded for their conservation and are also subject to destruction, erosion, and anthropogenic threats. Thus geomorphologic

processes and the consequent landforms must comprehensively be identified in all the country of Iran. They should be archived as a comprehensive collection in related organizations (Geography group of Ministry of Science, Research, and Technology). The importance of these resources can better be understood as one see that degradation and excessive exploitation of these landform resources have caused extinction of these invaluable features in some cases. Conduction of this research is essential in that many scarce and unique landforms are devastating due to unplanned manipulations. Thus, a landform shaped during millions of years can be disappeared from the earth surface. It is necessary to conserve geological and geomorphologic landforms to maintain them for future scientific and educational purposes. As the first step, the entire landforms should be identified and registered to assign a national identity to each. As there is still no comprehensive list of the geomorphologic landforms as a basis for conservation of the features and buffer areas, this research suggests a completely novel pattern to make the list of the landforms. The study area of the research can be all the country of Iran. Identification and registration can be executed first by main landforms of those in vulnerable conditions.

## 2 Material and methods

It seems necessary to use two historical and empirical methods of geomorphology to achieve the goal of identification. Hence, this research has been conducted by field observations of some threatened and vulnerable

**Corresponding author:** Vajihe Gholizade, MSc. in geomorphology, University of Applied Sciences Iranian heritage, Mashhad, IRAN. E-mail: [vajihe\\_gholizade@yahoo.com](mailto:vajihe_gholizade@yahoo.com) Tell: +989155257401 and Fax: +985136059535.

landforms. Then, it has been continued by library studies. This study has designed a process pattern for the registration and defining buffer for these landforms. It will be suggested to Ministry of Science, Research, and Technology for implementation.

### 3 Results and Discussion

Geomorphic information have not been employed, as it may seems essential, in many studies to meet the requirements related to environmental and sustainable development projects. Nevertheless, geomorphologists and many politicians are increasingly noticed that geomorphology play an important role in many development projects along other fields of study [3]. Geomorphologic landforms as natural resources and national capital can be considered in many economic activities including tourism. These landforms can be recommended for tourism visits, though some of them due to scarcity and vulnerability are advised to be used with more caution for tourism or mining activities. Scientific tourism can be suggested for them because it takes shorter time of visiting and has less adverse impacts on the geomorphic forms and the environment.

Tourism income of Iran is annually 150-180 million USD. This is very low compared with other countries including Canada, Tunisia, and Jordan. Even this amount makes huge environmental changes in natural landscapes of Iran. The tourism traffic in destination areas has influenced water bodies, forests, urban environments, and particularly mountainous areas throughout the world [4].

There are some principles in constitution of Islamic Republic of Iran about the importance of conservation of natural resources.

*Principle 45:* public wealth including barren lands, mines, seas, lakes, rivers and other water bodies, mountains, valleys, forests, flaggy ponds, rangelands, pastures, legacies without descendent, and the estates with unknown owners are entirely owned by Islamic government and under its jurisdiction to apply them for advantage of the public with details of uses according to the law[5].

*Principle 50:* in Islamic Republic it is incumbent upon the public to conserve the environment for the current and future generations in order to develop a growing social life. Hence, any economic activity or others which cause pollution or irreversible devastation in the environment are strictly prohibited[5].The conservation of environment was so important for the legitimate law makers authority that article 22 in chapter 4 stated explicitly to form an armed guard as an organization to protect natural resources and the environment[6].

#### 3.1 Importance of conservation of geomorphic landforms

There are very much Natural Protected Areas where their abiotic elements have a high value and they are protected by geological, geomorphological, hydrological or landscape values. The current concept of Geodiversity was born like a applied tool to the management of Natural Protected Areas [7].Geodiversity refers to diversity of earth surface features in geologic and geomorphologic phenomena, soil types, process and systems. In one hand, it is related to current active processes and the forms shaped

by them and, on the other hand, to the landforms left from the past as "heritage" landforms. The concept of geo-conservation is broader than that just to contain heritage of earth sciences and conservation of natural and geological signatures. The concept emphasize mainly upon geologic features and landforms for their scientific, educational, research, and aesthetic, and spiritual values for human. It also maintains that the survival and presence of the geologic formations, landforms, and soils, and their formative processes are necessary for human survival over the planet. The primary concepts in geo-conservation are geologic sites and geomorphic forms and systems [8].

Geoconservation aims to preserve the natural diversity - or 'geodiversity' - of significant geological (bedrock), geomorphological (landform) and soil features and processes, and to maintain natural rates and magnitudes of change in those features and processes [9].

This is to conserve two groups of phenomena: one group is related to landforms and processes which were active and formative in the past and not so effective now (heritage forms). The further is related to currently active processes and landforms (active forms). There are different management approaches for these. In active formative systems, landforms are dependent on the current active processes for their conservation and integration. In addition, all active and inactive landforms are related to active surface processes and constitute the essence of ecologic systems. Since the heritage forms were created in the conditions different from those of the present, any anthropogenic changes can cause irreversible impacts devastations that lead to permanent extinction of the landforms. Therefore, some economic activities including extraction from mines must be controlled.

Eberhard believes that geo-conservation is identification and protection of geologic, geomorphic, soil, processes and systems for their aesthetic and ecologic values and their assignment in list of earth science heritage [9].

Geo-conservation approach emphasize on management of lands for their application in human life. To protect natural and aesthetic values of rocks, landforms, and soil a sensitive and separate part of geo-conservation is seeking to find some approaches to impede devastation of the land features and also to decrease the degradation [8].

Geomorphologic diversity is a function of the sensitivity of the landscape, the divergence in response to changes in non-linear and dynamic processes at different spatial and temporal scales [10]. Many geomorphologists have attempted to explain the landform evolution in a predicable trend. Some systems are very sensitive against slight changes in their dependent variables. Thus, a negligible change in their primary condition may lead to huge changes in whole the system. As it is said that there is equilibrium between forms and processes, this is not to say that there is no change, but a tendency can be observed towards sustainability and directions of the landforms. Although there may be some fluctuations, these are around a certain axis [11].Nevertheless, concept equilibrium is accompanied with that of sustainability in geomorphic landscape so that sustainability in landscape is indicative of a kind of equilibrium in form and process [12].

### 3.2 the purpose of assigning ID to geomorphologic landforms

Many of geo-diversity elements are fossil landforms or heritage forms that cannot be rehabilitated in case of destroy. As many changes on the earth are resulted from anthropogenic sources, the critical problem of earth sciences is conservation of geological heritage. Some of the examples are important fossil sites, mineral resources due to unmanaged manipulations, making geological collections by individuals and organizations, unsuitable waste management, and etc. many of the sites are very sensitive and access to these areas should be prohibited.

The main purposes of geo-conservation are to preserve natural rates and magnitude of changes. This purpose emphasizes on traditional approach of earth science heritage. It says that the landforms must be conserved for their research and educational values. As a result, it is important to conserve their heritage of earth sciences in that the geo-diversity considers the integrity of ecologic processes as a whole and attempts to know the inherent value of geo-phenomena for themselves. This conserves the special elements of geo-diversity and their natural values by making a listing of them. There are many plausible effective actions for this aim in China, New Zealand, Australia, and European countries. Geo-conservation phenomena and processes are divided into eight classes by Grey (2005) and each is investigated in normal and exceptional conditions [8]. (Table 1)

Table 1: Geoconservation goals for the eight elements of biodiversity-[8]

| No. | Class                 | Condition | Goe-conservation management objectives   |
|-----|-----------------------|-----------|--|
| 1   | Rock                  | Scarce    | Maintaining the integrity of facies and transfer of samples for conservation                     |
|     |                       | Normal    | Maintaining the facies and encouragement of authorities in collection and conserving the facies  |
| 2   | Mineral               | Scarce    | Maintaining the integrity of minerals and transfer of samples for conservation                   |
|     |                       | Normal    | Maintaining the minerals and encouragement of authorities for collection and conserving them     |
| 3   | Fossils               | Scarce    | If possible, conserve fossils in their own place and if not, transfer them for conservation      |
|     |                       | Normal    | Encouragement of authorities for collection and conservation of fossils                          |
| 4   | Landforms             | -         | Conserving the landforms and rehabilitation based on their importance                            |
| 5   | Landscape             | -         | Conserving topography of rock facies and active processes of landscape based on their importance |
| 6   | Processes             | -         | Conservation and restoration of process integrity  |
| 7   | Soil                  | -         | Conserving quality, quantity and performance of soil   |
| 8   | Other earth resources | -         | Encouragement of valuable and sustainable use in historical and modern fields                    |

Although in many issues there is no consensus among many countries of the world, the subject of conserving the environment and natural resources seems to be the only case that many countries agree about that [13]. According to the legislation and historical precedence, the main goals of the authorities established environmental institutes were conservation of the resources as the principal tasks. There was a need to establish a new particular military force for conservation. It was due to the many variant task fields of the existing military force, new crimes and criminals, and lots of administrative problems. This resulted in suggestion and approval of article 179 of 3<sup>rd</sup> development plan. According to this article, the administrative organizations providing that they adhere to the rules can constitute their own organs to serve the conservational purposes [6].

Other than aesthetic values of conservation of natural resources, there are lots of other powerful scientific reasons for conserving global genetic resources. When a species is distinct, the world has to suffer from lose of an invaluable collection of genetic information that took hundred millions of years to evolve [14].

### 3.3 Examples of unsustainable exploitation and landscape degradation

Some of the landforms and geomorphic processes in Iran are affected by manipulation and unsustainable exploitations. If this situation continues, it will be resulted in enormous devastation and complete disappearance of a form and disequilibrium in a region. Examples of these landuse changes and manipulations of geomorphic landforms are as following:

1: global increase of cave tourism has caused problems due to irreversible degradation of cave ecotourism by changes in entrance shape and number of visitors [15]. Members of international union of caving along with the caving groups of Iran have visited some caves and declared these caves in Iran are in unsuitable environmental condition. This was believed to be by caving members rather than other people [16]. Excessive exploitation of the caves leads to increase in degradation and irreversible devastation in these areas. One of the uses is visiting these caves and changes in some forms such as stalactites and stalagmites. Furthermore, human spaces inside the caves and lighting facilities made also damages to the environment. It has led to the growth of some algae. An example of this is Katleh Khor Cave in Zanjan Province (Figure 1). Because of sensitivity of the environments, the caves should be protected particularly.

2: Semi-Cuesta in Mashhad-Baghcheh Road is used for installation of telecommunication pole due to its high altitude. This is not only related to aesthetic and landscape degradation, but it can also result in intensified erosion by the roads and transportation around the facilities. (Figure 2)

3: mountains have inherently very fragile systems that their location in arid areas of the world like Iran makes them even more vulnerable and sensitive. The mountains are affected by anthropogenic and natural forces. Damage to the mountains in Iran is more than that in other countries [17]. One of the exploitation of the geomorphic landforms is mining exploration in mountains with sometimes complete extermination of the earth features. For example, in Rostamkola, a region on coastal area in north of Iran, mining operations in an old headlands destroyed this coastal landforms and in addition made an unkempt landscape (Figure3). However, subterranean mining activities are better than in open spaces on marked geomorphic landforms.

4: The Lake Urmia is the largest hypersaline lake in the world that is rapidly drying. The drying leaves salt layers in a belt around the shore of the lake [18]. Tourism activities and building infrastructure such as a transportation bridge, eliminated circular water flows and decay of rare aquatic ecosystems, accelerated decay of this water body. In addition, manipulation in drainage basin of the lake with dam building activities upstream has disrupted equilibrium of the lake and drying of this water body. This is not possible for the lake to restore its condition and back to

previous equilibrium conditions. Figure 4 shows terrible acceleration rate of the drying in the recent years.

5: Addition to mining operations, installation of building stone works industries in the vicinity of landforms have led to unsuitable landscapes in a region between Mashhad and Nishaboor cities (Figure 5). Human activities by making obstacles in climatic processes accelerate erosion of the landforms.

6: A project was recently suggested to build a bridge between Behshahr City and Miankaleh Peninsula. This can destroy the aquatic and land ecosystem of Gorgan Bay and the peninsula just in a short time, regardless of better access to this tourism site and easy transportation.



Figure 1: artificial lighting and growth of algae inside the Katlehkhor Cave, Zanjan (2010)



Figure 2: installation of telecommunication pole on a semi-cuesta and destruction of landscape in road of Mashhad-Bagheh (2010)

### 3.4 Landform codification pattern

The first step geo-conservation is identification and listing of landforms as well as assigning formal ID for these land features. This involves participation of a research-execution group of geomorphologists and thorough planning based on scientific standards. The initial steps can be as following:

1: Identification and listing of all recognized landforms in Iran. This should be performed according to different subject areas including fluvial, coastal, aeolian, mountain, and glacial landforms. A variety of data can be used

including researches and literature, aerial photos, satellite images, and other resources.



Figure 3: mining operations in headland of old coastal areas in Behshahr, Rostamkola (2013)



Figure 4: rapid drying of Lake Urmia in the recent years (2013)



Figure 5: industries in the vicinity of landforms and landscape change in Mashhad-Nishaboor (2010)

2: Identification and listing of scarce and unique landforms of global importance. Some of these are sand pyramids. The maximum height of the highest pyramids is about 300 meters, in Libia. In Iran, there are some of the pyramids with about 475 meters and it would be the highest of the world [19].

3: Identification and listing of the landforms in rangeland of destruction due to human activities and manipulations in their vicinity.

4: Programming for coding system to define ID for each recognized phenomena.

5: defining required standards to determine suitable buffer zones for the features. This is based on the landform dimensions, active or inactive landforms, dynamic or static landforms, and sensitivity and scarcity of landforms.

6: presenting the list of features and landforms to Ministry of Science, Research, and Technology to formulate an agenda and instruction for conservation of the phenomena by cooperation with related organizations.

7: introducing the phenomena and the areas after confirmed by the ministry to the universities and research institutes as laboratory of geography. Their ownership can be assigned to some scientific centers like Iranian Association of Geomorphology (IRAG).

This can initially be implemented in Iran for geomorphic landforms which have global importance in terms of extent, archaism, elevation, and other geomorphologic factors. Then, it can be continued for other landforms based on their importance and scientific values.

**3.5 Automatic coding system**

Coding system of landforms must automatically assign a unique identity code to each landform by giving the characteristics of that landform to the application. For this, the landforms can be categorized into main groups of fluvial, mountain, coastal, and aeolian based on their formative process. This can specify the first digit of number, e.g., a ten digit code number, as the subject area of that landform (Table 2). In the second step, numbers of 1 and 2 can specify erosional or depositional nature of the landform. The type of landform can be specified by two digit code number, e.g., from 00 to 99. Finally, location of the phenomena in administrative divisions can also be specified by two digit number from 01 to 32, each for each province. Therefore, a ten digit code number can represent identity (ID) of a unique landform (Table 3). Other characteristics of landform and supplementary information can be entered in field of attribute table information. The information can be age, extent, elevation, latitude and longitude, buffer zone for prohibition, images of that feature. The date of registration can also be recorded in the same table. (Table 4)

All information must be recorded in a comprehensive system. The related organizations and institutes, including environment organization, industry, mining and trade organization, and natural resource organization should have access to the database. In case of allocation of these landforms to different land uses, they can be determined as prohibited areas to prevent manipulation.

Table 2: the principal and subsidiary divisions of geomorphic processes and landforms\*

|                    |          |              |                                   |
|--------------------|----------|--------------|-----------------------------------|
|                    | Fluvial  |              |                                   |
|                    | Coastal  |              |                                   |
| Types of processes | Aeolian  | Erosional    | Yardang<br>Kalute<br>Micro-Kalute |
|                    |          | Depositional |                                   |
|                    | Mountain |              |                                   |
|                    | Glacial  |              |                                   |

Table 3: coding of landforms\*

| Identity Code | Serial number of features | Province       | Types of landforms | Erosional/depositional | Process |
|---------------|---------------------------|----------------|--------------------|------------------------|---------|
|               |                           | South Khorasan | Micro-Kalute       | Erosional              | Aeolian |
| 0137-093013   | 0137                      | 09             | 03                 | 1                      | 3       |

Table 4: field of attribute table for each landform\*

| ID code     | Geographical situation |             |                  |   |   |                 |                 |           |      |                  |                   |                   |                   |              |
|-------------|------------------------|-------------|------------------|---|---|-----------------|-----------------|-----------|------|------------------|-------------------|-------------------|-------------------|--------------|
|             | Province               | Rural/urban | Physical setting | X | Y | Active/inactive | Approximate age | Elevation | Area | Threat situation | Conservation type | Buffer definition | Registration date | Descriptions |
| 0137-093013 | South Khorasan         | Birjand     | Terminal basin   |   |   |                 |                 |           |      |                  |                   |                   |                   |              |

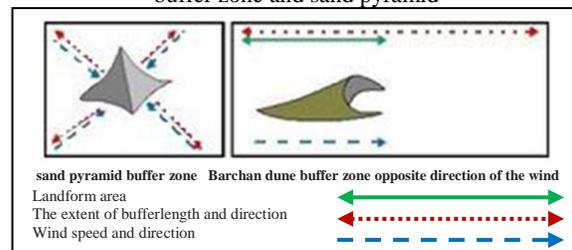
\*All these digits and divisions are just suggested as hypothetical

**3.6 Suggested buffers for conservation**

For optimized conservation of geomorphic landforms it is required to determine an appropriate buffer for each. This buffer is defined based on type of the feature, strategic position, importance and uniqueness, the rate to which they are threatened, age and scientific value, and dynamism. In fact, the type and the radius of the buffer should be according to the type and possibility of destruction. (Figure 6)

For example, there are many barchans dunes in deserts of Iran on the areas where detached sands and strong winds are available. In Lut, Dasht-e-Kavir, and Jazmorian deserts crescent shape landforms can be observed along with other depositional sand masses [20]. In case of barchans dunes because of their dynamic characteristics the buffer zone should be considered along their movement path and approximate speed rate. In some other cases, the radius of buffers must be changed according to type of landforms and over time, e.g., some coastal landforms formed in tidal zone. Finally, in order to conserve the features properly, it is suggested to introduce the extent of the buffers to related equipments for better decision making in the future.

Figure 6: Schematic figure of the extent of barchan dunes buffer zone and sand pyramid



## 4 Conclusion

Destruction of landforms as a main part of natural resources, addition to serious economic damages, leads to lose of invaluable scientific heritage with irrecoverable detriments in the future. Conservation of these landforms requires a competent management of accurate planning consistent with scientific international standards. It is expected that after the geomorphic landforms are given ID, the conservation trend extend to the forms and processes with the best way. There are some suggestions and following:

- Examination and modification of the legal rules related to exploitation of natural resources to conserve the landforms
- Legislation of codes for protection of the landforms
- Enhanced coordination between execution, research, and academic organizations related to natural resources
- Formation and strengthening the groups for rehabilitation of landforms by experts
- Assigning conservation responsibilities to related experts
- Comprehensive supervision and punishment of violent people to protected areas
- Allocation of enough budgets for conservation of landforms to the Ministry of Science, Research, and Technology
- Making the public familiar with the natural features and landforms by education in media
- Continuous effective cultural programs to change the public attitude to the landforms by introducing geo-sites and geo-parks
- Independence of landforms from other natural resources in conservation for specification in scientific and executive activities
- Forbidding the assignment of natural areas of valuable landforms to human activities
- Reforms in the plans of exploitations in natural resources such as Miankaleh Peninsula, Anzali Wetland, and Lake Urmia

In conclusion it can be said that all the landforms should be under the supervision of the Ministry of Science, Research, and Technology as the laboratory of geography, geomorphology. Legal rights must be applied for the areas as a university. It must be attempted to maintain the scientific history of the features for use of all students and researchers. It is expected that by assigning ID to the landforms as documents representative of their values and identity and also defining a buffer zone for each landforms prepare the requirements for better conservation of these invaluable resources in the near future.

## References

- 1- Habibizad, Z. (2010). Eco-museum (human and biome), Iranshenasi Press
- 2- Nirupama N., and Simonovic S.P. (2007). Increase of flood risk due to urbanization: A Canadian example, *Natural Hazards* 40:25-41.
- 3- Hook, J.M. (1993). *Geomorphology in environmental planning*, translated by Zomorodian. Samt Press
- 4- Ghanbarzadeh, H., Behniafar, A. (2007). *Fundamentals of environmental change*, Sokhangostar Press
- 5- Mansour, J. (2010). *Rules of constitution of Islamic Republic of Iran with modifications in 1980*; Doran Press
- 6- Politics of Day Press, (2008). *Conservation Organ and its sensitive role in conservation of natural resources and the environment*
- 7- Serrano Cañadas, E. Ruiz Flaño, P. (2007). *Geodiversity: Concept, Assessment and territorial application. The case of tiermes-Caracena (Soria)*. Department of Geography University of Valladolid *Boletín de la A.G.E. N.º 45* -389-393
- 8- Khoshraftar, R. (2009). Diversity of geo-features and their conservation. *Geographical Education Growth* 89
- 9- Sharples, C. (2002). *Concept and Principles of Geoconservation*. Published electronically on the Tasmanian Parks & Wildlife Service website. Version 3
- 10- Sepehr, A. (2013). *Geomorphologic Inheritance: Environmental Hazards and Geodiversity*, the first National Conference of Iranian association of Geomorphology, geomorphology and human habitat
- 11- Howard, A.D. (1982). Equilibrium and time scales in geomorphology: application to sand-bed alluvial streams. *Earth Surf. Proc. Landforms*. 7
- 12- Ramesht, M. H. (2003). Chaos theory in geomorphology. *Journal of Geography and Development*. 1
- 13- Jafari, M. (2003). Importance of natural resource conservation. *Moddad Magazine*, 40, 1-6
- 14- Hematti, Z. (2007). *Sparse pieces of our home land (conservation of natural resources)*. Hamshahri Press
- 15- Gilson, D. (2007). *Speleology (process, development, and management)*, translated by Velayati, S., Behniafar, A., Sokhangostar Press [16] Soltanzadeh, H. (2008). *Caves in Iran are in bad situations*, Hamshahri Press
- 17- Bakhtyari, S. (2008). *Mountains, the most vulnerable ecosystems of the world*, Iskanews Press, 20080303
- 18- Alavipanah, S.K., Nezammahalleh, M.A. (2013). The Relationship of Salt Classification with Distance to Shoreline and Elevation, Case Study Lake Urmia, Iran. *Journal of Environmental Treatment Techniques*, Volume 1, Issue 1, Pages: 35-37
- 19- Mahmoudi, F. (2001). *Dynamic geomorphology*, Payamnoor University Press
- 20- Zomorodian, M. J. (2006). *Geomorphology of Iran, climatic processes and external dynamics*. Ferdowsi University Press.