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TOURISM SILENCE IN GEOMORPHOSITES: A CASE STUDY OF ALI-SADR CAVE (HAMADAN, IRAN)

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Abstract Geotourism is one of the branches of tourism which is based on knowledge of geomorphosites and special geomorphic perspectives and by combining the cultural, historical and ecological heritage, it offers potentials in planning sustainable tourism. Geomorphosites of caves is a perfect example of complex systems. The multiple relationships between components and performance of these systems create unique and innovative forms which have great potential in stimulating aesthetic sense of people and attracting visitors. Ali-Sadr cave has a great potential in attracting visitors because of its diversity, uniqueness and convenient access. In this study, the potential geomorphosites of Ali-Sadr cave is under investigation applying Reynard and Pereira's model. The results show that based on Reynard's model, the additional value criterion accounts for 52% of the total mean score and has the utmost importance, which is due to the high rate of economic potential, the geohistorical importance, the variety of monuments and ecological effects. Then, the criterion of scientific value by 35% ranks the second due to the high points of Paleogeographic sub-criterion. The results of the evaluation of potential geomorphosites of cave based on Pereira model shows that the geomorphological value with an average of 6.86 has allocated the highest rank and management value with an average of 6.32 ranks next. In general, the results obtained from Pereira model show that the criterion of usage, with 39 percent of the total points of this model, allocated the highest rank of importance, which is due to the high rating of sub-criteria of accessibility and visibility. Scientific and additional value with a share of 21% of the total points rank the second.

Key words: geomorphosites, geotourism, Ali-Sadr cave, Hamedan

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INTRODUCTION

Geomorphotourism as a segment of tourism developed worldwide is emerging as a new global phenomenon in recent years. It is a special form of tourism and focuses on morphological features and the types of landscapes. Furthermore, the primary focus of geomorphotourism which is sustainable tourism is on experiencing the landform types in a way that fosters geomorphological and cultural understanding, appreciation and

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preservation, and is locally advantageous (Dowling, 2008). Geomorphotourism is one form of tourism based on nature which is formed of two words of geomorphology and tourism and it includes tourist attractions based on the performance of morphogenetic systems on the ground that has an extraordinary ability in attracting visitors through the creation of attractive forms with aesthetic value (Ramesht & Shahzeidi, 2011,). In other words, geomorphotourism is one domain of earth science studies and it studies of tourism that focuses on identifying geomorphosites or especial prospects of geomorphology. By combining cultural, historical and ecological heritage, this area offers a great potential in planning of regional sustainable tourism (Fakhri et al., 2013). Geotourism which Dowling (2011) considers as 'geological tourism' includes two aspects. The geological element focuses on geology and landscape. It consists of 'form', such as landforms, rock outcrops, rock types, sediments, soils and crystals, and also 'process', such as volcanism, erosion, glaciation etc. The other element, that is tourism, includes tourists visiting, learning from, appreciating and engaging in geosites. According to Adryansiah, Ulfa, Amalina and King-King (2016), a better understanding of the Earth can be achieved through geotourism in the way that its geological attractions can be acknowledged. Geotourism preserves the place's identity with the introduction of geomorphological landforms to tourists (Bayati Khatibi et al, 2010). Accordingly, geomorphotourism can be defined as the science of studying geomorphosites or the special geomorphic landscapes which benefit scientific, ecological, cultural, aesthetic and economic value simultaneously (Pereira et al., 2007). Geomorphosites are geomorphological landforms which have gained scientific, historical, cultural, aesthetic or socioeconomic value due to human knowledge and exploitation (Shayan et al. 2011). So, geomorphosites in combination with cultural, historical and ecological heritage would have great potential in the development of sustainable tourism (Coratza et al., 2008, 107). Geomorphosite term was first proposed in 1993 by Panniza. Basically geomorphosites are landforms that gain certain values such as scientific, cultural, historical, aesthetic and social-economic over time (Panniza, 2001). In general, geomorphotourism capabilities are considered as the unique assets of each country and region which are very important to be identified, classified and planned in order to develop scientific tourism (Beladpas, 2011). Basically, tourism attractions are based on a systematic structure that in accordance with the charm rate can attract tourists (Fennell, 2009). The main objective of geomorphotourism is to train tourists and make them familiar with the geomorphic phenomena and to protect the natural environment and its prospects in relation to human interference in changing the appearance of the earth. In this regard, Shayan et al (2012), studying the additional and scientific value of touristic places of Giyan hill in Nahavand plain, report that the calculated value with an average of 0.68 represents the significant potential for tourism development of this geomorphosite. Yamani et al., (2012) studied the tourism potentials of some geomorphosite of Guilan province applying Pralong and Pereira models and suggest that among the studied geomorphosites, raised beaches got the highest score and muds got the lowest score in tourism development. Maghsoudi et al., (2011) studying the geomorphotouristic potentials of Maranjab region geomorphosites using the Reynard's model suggest that based on the two criteria of scientific value and the supplementary value, terraces lake are introduced as the best site in the area.

Sepehr, Safarabadi & Biglarfadafan (2014) in an investigative attempt prioritized areas for solid wastes disposal considering the Geomorphologic factors in Mashhad (Iran) applying ranking MCDM methods including TOPSIS and AHP based on seven geomorphologic criteria involving slope, lithology, fault distance, surface water distance, ground water depth, and land use and geomorphology type. The authors found that region 2 (the new landfill, located in Miami Road) had first rank to waste disposal and the region 1 (located in Nishabour road) which is the old landfill of Mashhad is not a suitable

place for waste disposal. Kubalíková and Kirchner (2016) proposed a method for finding out the sites which are suitable for geotourism development and assessed the selected sites of the Vizovická vrchovina Highland (Czech Republic) cv. Based on this, strengths, weaknesses, opportunities and threats were identified. The assessment and the following analysis of the area can serve as a basis for the future proposals for geotourist use of the sites. González-Amuchastegui et al., (2011), evaluating the geodiversity and geomorphosites in a natural protected area in Spain, introduced a series of tools that the manager can apply to integrate abiotic aspects in the evaluation and protection of areas with outstanding natural diversity and considerable natural heritage.

Artugyan (2016), in another investigation, used the Pralong method for geomorphosites assessment in the Anina karst region, in Romania and he evaluated many geomorphological sites, such as karst springs, caves, gorges and karst plateaus with a high density of karst features. The author found that in this region, it is more important that these geomorphosites are appropriately exploited in order to protect the karst landscape.

Coratza et al., (2011) conducted a study for the identification, selection and enhancement of the rich geomorphological heritage of the area and represented the first step and the necessary basic knowledge for possible enhancement of geomorphosites in Malta and the promotion of tourism activities at the Il-Majjistral Nature and History Park through the auspices of environmental agencies. Gravis et al., (2016) studied the role of cultural and indigenous values in geosite evaluations on a quaternary monogenetic volcanic landscape at Ihumātao, Auckland (New Zealand). The authors also showed that implementing management strategies to add and conserve geosite values in the region could provide positive outcomes; however, reduction of its main geosite values would be inevitable and irreversible should proposed urban development take place on a block of land immediately bordering the OSHR. Geosite evaluations demonstrate that high geoheritage values of regions like the Ihumātao Peninsula are influenced by the strong cultural link between the community (in particular the indigenous population) and the volcanic landscape. These cultural factors could be given more weight in currently used geosite evaluation methods, enabling such geoheritage values to be demonstrated in a more explicit and meaningful way and providing a basis for further community education and protection of specific sites within the geographical context of the Ihumātao Peninsula.

In another study, Pica et al., (2016) enhanced geotourism in the city centre, by describing the palaeogeography of ancient Rome through the landforms that were still visible and identified two geomorphosites. In their investigative attempt, Pica, et al. (2016) developed an evaluation model of the geotouristic value of a Site (VSG index), which consisted of the quantification of five fundamental attributes for a geosite, characterizing its scientific and geotourist interests. The VSG index produces an order of priority for geosites for their enhancement. The major outcome of their study was to supplement a proposal for developing the historical and cultural tourism of the *Aeterna Urbs* combined with its natural environment features. More recently, Badang, et al., (2016) conducted a study in Sarawak Delta, Sarawak, Malaysia and through the geoheritage concept which involves proper identification, characterisation, assessment and rank of significant geoheritage sites based on its scientific, aesthetic, cultural and recreational heritage value, propose the area as partially geoconserved for geotourism purposes. The authors also established further understanding of the relationship between the field of geology and sustainable development through geoheritage development of the proposed Sarawak Delta Geopark.

METHODOLOGY

This study is based on descriptive and analytical method relying on field survey. Spatial distribution of landforms was determined through an extensive literature survey and

documents using topographic maps, digital elevation models and field survey. Then, in order to assess the geomorphosites tourism potentials of Ali-Sadr cave, Reynard and Pereira model was used. In Reynard's method, a geomorphosite is evaluated based on scientific value, additional value and the synthesis value. In scientific value, the index of rareness, representativeness, integrity and palaeogeographic value indices are considered and in the additional value, the indices of ecological, aesthetic, economic and cultural (with an emphasis on geohistorical importance) are taken into account. The additional value can make a connection between geomorphology and tourism by highlighting the considered indices. In this value, due to the development of particular ecosystem or the presence of certain plant species, the ecological sub-criteria is of particular importance. In the aesthetic sub-criterion, the number of landscapes and perspectives and in the cultural sub-criterion, the mystical and religious aspects are important. Also in this sub-criterion, historical and archeological heritage is also important. In the economic sub-criterion, the gained revenue and profit from the number of tourists is considered. In the synthesis value, the global, educational, threats and management indices are taken into account. The sub-criterion of synthesis value, the emphasis is on officials' management practices and planning for tourism development, creating tourism infrastructures, and publicity measures (Table 1). Questionnaires were designed based on Reynard's model and filled out by 30 experts (tourism, natural resources and watershed management, teachers and students). In this method, scoring was conducted by averaging individual scores and integration of experts' opinions.

Table 1. Criteria, sub-criteria and ranking based on Reynard's model (Source: Reynard et al. 2007)

Criteria	Sub-criteria	Content	Ranking			
			Weak	Average	Good	Excellent
			0-0.25	0.25-0.5	0.5-0.75	0.75-1
Scientific	Integrity	State of conservation of the site. Bad conservation may be due to natural factors (e.g. erosion) or human factors.				
	Rareness	Concerns the rarity of the site with respect to a reference space				
	Representati -veness	Concerns the site's exemplarity. Used with respect to a reference space (e.g. region, commune, country).				
	Paleogeogra -phical	Importance of the site for palegeo - morphology and paleoclimatology				
Additional	Ecological value	Ecological impact				
		Protected sites				
	Aesthetic value	View points				
		Contrasts, vertical development and space structuration				
	Cultural	Religious importance				
		Historical importance				
		Artistic and literature importance				
		Geohistorical importance				
	Economic	Economic products				
Synthesis	Global value	The importance of site at global level				
	Educational value	Importance of the site for education (school, universities).				
	Threats	Natural and human existing and potential threats.				
	Management measures	Proposed measures in order to protect and/or promote the site				

Table 2. Geomorphological value of geomorphosites (Source: Pereira et al. 2007)

Scientific value of geomorphosites (Maximum 5.5)		Additive value of geomorphosites (Maximum 4.5)	
Rareness in relation to the area	score	Cultural value	score
It is not one of the most important 5	0	Without cultural features or with cultural features damaging the site	0
It is not one of the most important 3	0.25	Cultural features with no connection to landforms	0.25
One of the most important 3	0.50	Relevant cultural features with no connection to landforms	0.50
The most important	0.75	Immaterial cultural features related to landforms	0.75
The only occurrence	1	Material cultural features related to landforms	1
Integrity/Intactness	rank	Relevant material cultural features related to landforms	1.25
Highly damaged as a result of human activities	0	Anthropic landform with high cultural relevance	1.5
Damaged as a result of natural processes	0.25	Ecological value	rank
Damaged but preserving essential geomorphological features	0.50	Without relation to biological features	0
Slightly damaged but still maintaining the essential geomorphological features	0.75	Occurrence of interesting fauna and/or flora	0.38
No visible damage	1	One of the best places to observe interesting fauna and/or flora	0.75
Representativeness of geomorphological processes and pedagogical interest	rank	Geomorphological features are important for ecosystem(s)	1.12
Low representativeness and without pedagogical interest	0	Geomorphological features are crucial for the ecosystem(s)	1.5
With some representativeness but with low pedagogical interest	0.38	Aesthetic value	rank
Good example of processes but hard to explain to non-experts	0.67	Low	0-.05
Good example of processes and/or good pedagogical resource	1	Medium	0.5-1
Other geological features with heritage value	rank	High	1-1.5
Absence of other geological features	0		
Other geological features but without relation to geomorphology	0.17		
Other geological features with relation to geomorphology	0.33		
Occurrence of other geosite(s)	0.5		
Number of interesting geomorphological features (diversity)	rank		
1	0		
2	0.33		
3	0.67		
More than 3	1		
Rareness at national level	Rank		
More than 5 occurrences	0		
Between 3 to 5 occurrences	0.17		
3 cases at national level	0.33		
Being unique at national level	0.5		
Scientific knowledge on geomorphological issues	Rank		
None	0		
Medium: presentations, national papers	0.25		
High: international papers, thesis	0.5		

In Pereira's model, the geomorphological and management values of geomorphosites to develop tourism is assessed. The geomorphological value is obtained from scientific and additional values. The scientific value is calculated based on the sub-criteria of rareness, intactness, pedagogical potentials of geomorphological processes, diversity of geomorphological features, geological features with heritage value, rareness at national level, scientific knowledge on geomorphological issues and additional value is assessed based on cultural, ecological and aesthetic values.

Table 3. The management value of geomorphosites (Source: Pereira et al. 2007)

USE VALUE (maximum 7.0)		PROTECTION VALUE (maximum 3.0)	
Accessibility	Rank	Vulnerability of use as geomorphosites	rank
Very difficult, only with special equipment	0	Very vulnerable, with possibility of total loss	0
Only by 4 wheel-drive vehicle and more than 500 meters by footpath	0.21	Geomorphological features may be damaged	0.5
By car and more than 500 meters by footpath	0.43	Other, non-geomorphological features may be damaged	1
By car and less than 500 meters by footpath	0.64	Damage can occur only in/along the access structures	1.5
By 4 wheel-drive vehicle and less than 100 meters by footpath	0.86	Not vulnerable	2
By car and less than 50 meters by footpath	1.07	Integrity/Intactness	rank
By bus on local roads and less than 50 meters by footpath	1.29	Highly damaged as a result of human activities	0
By bus on national roads and less than 50 meters by footpath	1.5	Damaged as a result of natural processes	0.25
Visibility	Rank	Damaged but preserving essential geomorphological features	0.5
Very difficult or not visible at all	0	Slightly damaged but still maintaining the essential geomorphological features	0.75
Can only be viewed using special equipment (e.g. artificial light, ropes)	0.3	No visible damage	1.00
Limited by trees or lower vegetation	0.6		
Good but need to move around for a complete observation	0.90		
Good for all relevant geomorphological features	1.2		
Excellent for all relevant geomorphological features	1.5		
Present use of other natural and cultural interests	Rank		
Without other interests, promotion and use	0		
With other interests but without promotion and use	0.33		
With other interests and their promotion, but without other use	0.67		
With other interests, with promotion and use	1		
Equipment and support services	Rank		
Hostelry and support services are more than 25 km away	0		
Hostelry and support services are between 10 and 25 km away	0.25		
Hostelry and support services are between 5 and 10 km away	0.5		
Hostelry or support services are less than 5 km away	0.75		
Hostelry and support services are less than 5 km away	1		
Legal protection and use limitations	Rank		
With total protection and prohibitive use	0		
With protection, with use restriction	0.33		
Without protection and without use restriction	0.67		
With protection but without use restriction or with very low use restriction	1		
Present use of the geomorphological interest	Rank		
Without promotion and not being used	0		
Without promotion but being used	0.33		
Promoted/used as landscape site	0.67		
Promoted/used as geomorphosite or geosite	1		

The total obtained rank would be 10 at this stage. On the other hand, the management value is obtained from the sum of use and protection value of geomorphosites. The use value consists of accessibility, visibility, use of other natural and cultural interests, equipment and support services, legal protection and use limitations, use of the geomorphological interest and protection criteria consists of vulnerability of use as geomorphosites and intactness. In general, the sum of these two values shows the potential of a geomorphosites in developing tourism. The more the obtained amount is near to 20, the higher the potential of the site in tourism planning. Tables 2 and 3 represent the scoring method to various criteria and sub-criteria in Pereira's model.

THE LOCATION OF THE STUDIED AREA

Ali-Sadr cave is one of the most unique scenic and natural caves in the world and it is located 75 kilometers to the northwest of Hamedan in a village by the same name which is one of the districts of Kabudarahang Township. The region has a semi-arid climate and the average annual rainfall is 300 ml. Geologists believe that the rocks of this mountain pertain to the second geological period i.e. Jurassic (190-130 million years ago). Ali-Sadr field itself is a fold of a large anticline that its main axis is in north-south direction. The angle of the layers in the cave and its surrounding area is about 40 to 45 degrees. The length of the cave is about two kilometers. The maximum height of the field is 2180 meters and the height in the entrance of the cave is 1980 meters.

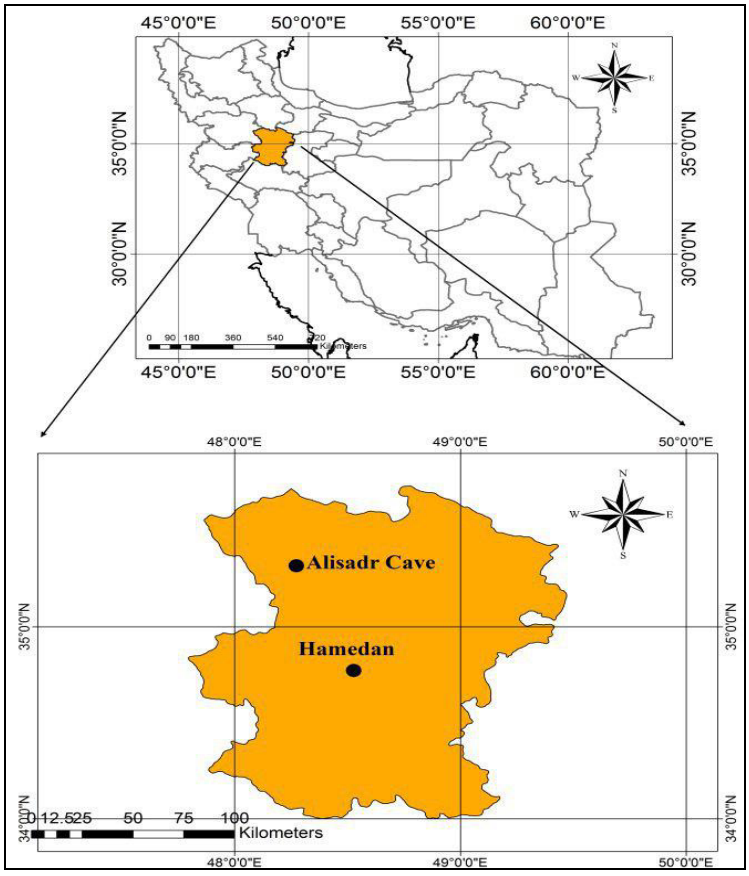

Figure 1. The location of the studied area

After entering the cave, the carbonate sediments hanging from the ceiling attract a lot of attention. The water in the cave is formed by several winding halls which are connected through the grid corridors. The cave has a river flowing through it and most travel through the cave system is done by boat. The cave water is cool of about 12 degrees and it is light blue and it is so clear that in some parts of the lake with a depth of 5 meters, the floor water is clearly visible. In Ali-Sadr cave resort, facilities include a hotel, a wooden villa, suite accommodations, pavilion, restaurant, food and crafts shopping mall, toilets, car parking, children's play equipment, landscaping and the possibility of climbing.

DATA ANALYSIS

Geomorphosites characteristics of Ali-Sadr cave

Ali-Sadr cave in Hamadan Province is one of the most important water caves of Iran which is made by the impact and progress of karst phenomena. Geologically, the cave is developed in crystallized limestones and Jurassic schists in the region. In terms of karstology, this cave is among karst caves of anastomotic type. No advanced surface karst phenomena or an obvious case can be seen in the region, but numerous sub-surface phenomena can be seen in the cave. The origins of the cave is not accurately identified but probably the phenomenon of differential solubility between the hard schists and layers of soluble limestone has a special role. The creation and development of karst phenomena and Ali-Sadr cave can be divided into six distinct periods. In terms of hydrology, it turned out that the values of PH, dissolved oxygen and water temperature did not show much change up to 10 meters, while the EC value exponentially increases with the increasing depth (Rahnamaee & Afrasiabian, 1994).

Figure 2. Images of Ali-Sadr cave geomorphosites

ASSESSING THE ALI-SADR GEOMORPHOSITES APPLYING THE REYNARDS MODEL

Table 4 presents the average score given by experts for value and sub-criteria based on Reynard's model. Results show that the scientific value has allocated 2.6 ranked. According to the table, paleogeographical sub-criterion got the highest rank scoring 1 and Integrity with 0.21 got the lowest among all sub-criteria. Also, additional value gained 3.82. In this value, economic with the grade of 1 and religious importance with the grade of 0.08, gained the highest and the lowest rank, respectively. In addition, synthesis value scored 0.99. In this value, threats gained 0.2 and education gained 0.58, ranking the lowest and the highest, respectively. Figures 3 and 4 show the score of each value and its sub-criteria.

Table 4. The average score of values based on Reynard's model considering results obtained from the survey (Source: Current study's calculations)

Value	Sub-criteria	Content	Score
Scientific	Integrity	State of conservation of the site	0.21
	Rareness	The rarity of the site with respect to a reference space	0.72
	Representativeness	The site's exemplarity with respect to a reference space (e.g. region, commune, country)	0.67
	Paleogeographical	Importance of the site for palegeomorphology and paleoclimatology	1
Additional	Ecological value	Ecological effects	0.64
		Protected site	0.18
	Aesthetic	View points	0.58
		Contrasts, vertical development and space structuration	0.42
	Cultural	Religious importance	0.08
		Historical importance	0.11
		Artistic and literature importance	0.13
		Geohistorical importance	0.68
	Economic	Economic products	1
Synthesis	Global	The importance of ste at global level	0.21
	Educational	Importance of the site for education (school, universities).	0.58
	Threats	Natural and human existing and potential threats.	0.2
	Management method	Proposed measurn order to protect and/or promote the site	0.01

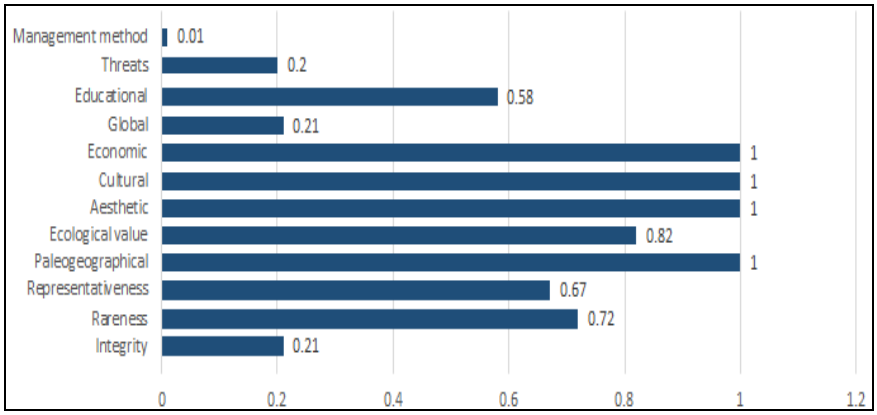

Figure 3. The plot of rating the sub-criteria based on Reynard's approach by respondents

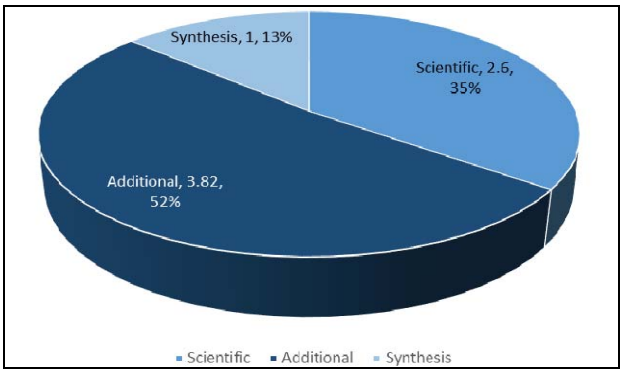

Figure 4. Diagram of the importance of the values according to the scores earned

ASSESSING ALI-SADR CAVE GEOMORPHOSITES APPLYING PEREIRAS MODEL

Table 5 shows the scores obtained by each value in Pereira's model. Results show that from 6.86 points gained by geomorphological value, 4.04 goes for scientific value and 2.82 goes for additional value of geomorphosites. According to the results, rareness at national level in the scientific value of geomorphosites with the score of 0.07 is the lowest and aesthetic value in additional value of geomorphosites criterion with the score of 1.4 got the highest rank. In addition, results point that management value scored 6.32, 5.19 of which goes to use value of geomorphosites and 1.13 goes to protection value of geomorphosites. In use value, the highest score is for accessibility which is 1.37 and the lowest one is for present use of the geomorphological interest, with the score of 0.35. In addition, in protection value of geomorphosites, the lowest point is for vulnerability of use as geomorphosites with the score of 0.68 and the lowest one goes for intactness scoring 0.45. Figures 5 and 6 represent the average points scored by each of the criteria and sub-criteria and also the importance of values and criteria.

Table 5. Scoring values based on Pereira's model considering the results obtained from survey, (Source: Current study's calculations)

Value	Criteria	Sub-criteria	S
Geomorphological value	Scientific value of geomorphosites	Rareness in relation to the area	0.73
		Integrity/Intactness	0.46
		Representativeness of geomorphological processes and pedagogical interest	1
		Number of interesting geomorphological features (diversity)	1
		Other geological features with heritage value	0.31
		Rareness at national level	0.07
		Scientific knowledge on geomorphological issues	0.47
	Additive value of geomorphosites	Cultural	0.36
		Ecological	1.06
		Aesthetic value	1.4
Management value	Use value of geomorphosites	Accessibility	1.37
		Visibility	1.5
		Present use of other natural and cultural interests	0.43
		Equipment and support services	0.68
		Legal protection and use limitations	0.86
		Present use of the geomorphological interest	0.35
	Protection value of geomorphosites	Vulnerability of use as geomorphosite	0.68
		Intactness	0.45

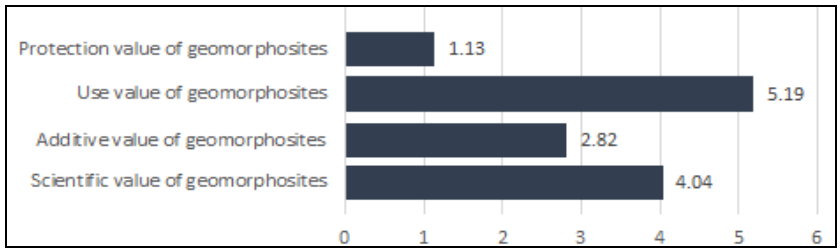

Figure 5- The average score obtained by each sub-criteria based on Pereira's model

CONCLUSION

Caves are defined as geomorphological processes and forms for understanding the evolution of the earth and one of the most influential geosites and worthy of geotourism industry boom of each country. Ali-Sadr cave geomorphosite is one of the rare tourist attractions in Iran and the world and it is a combination of scientific, rareness and aesthetics values which is of great importance in terms of Paleogeography.

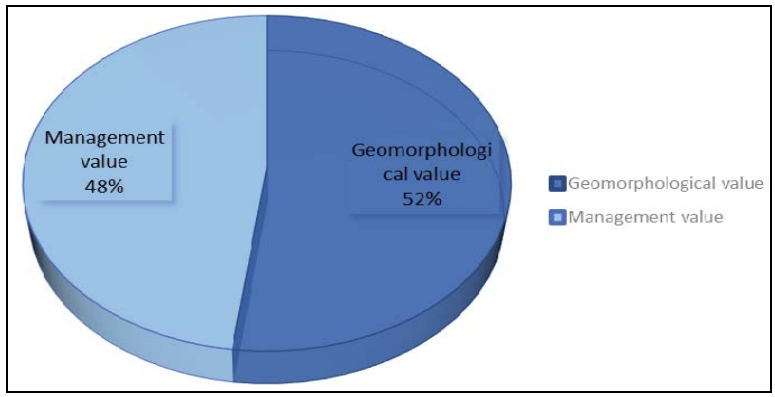

Figure 6- The importance percentage of each criterion and value based on Pereira's model

This study intended to find the geomorphotouristic potentials of Ali-Sadr cave applying Reynard and Pereira model. Results of the study point that based on Reynard's model, additional value has been accounted for 52% of the total mean score and it is of utmost importance, which is due to the high rate of economic potential, the geohistorical importance, the variety of monuments and ecological effects. Then the criteria of scientific value by 35% ranks second due to the high points of Paleogeographic and Representativeness sub-criteria. The low point obtained by integrity, ranked the scientific value lower than the additional value. Results obtained show that synthesis value with the percentage of 13%, due to the weak rank of management method and natural and human threats of the geomorphosites sub-criteria got the lowest importance in assessing the geomorphotouristic potentials of Ali-Sadr cave. Based on this finding, the management sub-criterion with the score of 0.01 has the lowest importance. This reflects the weakness of the administration in protection and promotion of the geomorphosites.

The results of this model point that the additional value with the average of 3.82 got the highest score, and the scientific value with the average of 2.6 and synthesis value with the average of 0.99 come second and third, respectively. On the other hand, the results of the evaluation of geomorphosites potentials of cave based on Pereira model

shows that the geomorphological value with an average of 6.86 has allocated the highest rank and management value with an average of 6.32 ranks next. Based on this model, the sub-criterion of visibility with the score of 1.5 and aesthetic value with the score of 1.4 got the highest scores. In general, the results obtained from Pereira model show that the criteria of usage with 39 percent of the total points of this model allocated the highest rank of importance which is due to the high rating of the sub-criteria of accessibility (1.37) and visibility (1.5). Scientific and additional value with a share of 21% of the total points rank the second. In addition, the protection value with the score of 9 shows the weakness in managing this geomorphosites.

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