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Potential Assessment of Geomorphological Landforms of the Mountainous Highland Region, Haraz Watershed, Mazandaran, Iran, Using the Pralong Method

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ABSTRACT: As the largest service industry in the world, tourism plays a special role in sustainable development. *Geomorphic tourism* is known to be a segment of this industry with lower environmental impact and underlying causes that explain lower demand; therefore, it is essential to study, identify, assess, plan, and manage natural tourist attractions. As such, the present study assesses the ability of geomorphological landforms of Haraz watershed, one of the major tourism areas of Iran. In this regard, the features of geomorphologic landforms, including Mount Damavand, the Damavand Icefall, Shahandasht Waterfall, Larijan Spa, and Deryouk Rock Waterfall in different parts of the Haraz watershed have been compared from the standpoint of geotourism features. To assess these landforms, geological maps, topographic and aerial photos, satellite imagery, Geographic Information Systems (GIS), and data field have been used as research tools. Evaluation results demonstrate that the average of scientific values in these landforms' catchment (with 0.76 points) has been greater than the average of other values. These high ratings show the landforms' potentials to be informative to those examining them for the purpose of education as well as tourist attraction. Through proper planning and understanding of its both merits and demerits, this type of tourism can play an important role in national development and diversify regional economies.

Keywords: Geomorphic Tourism, Geomorphological Landforms, Pralong method, Haraz watershed

INTRODUCTION

Tourism, being a type of development or "rite of passage", is one of the most encouraged and enjoyable worldwide activities. Taking advantage of tourism's potentials and capabilities along with the use of ecotourism can provide a dynamic and energetic foundation (Jalani, 2012 and Mirsanjari et al., 2013), leading to economic growth at both national (Brida & Pulina, 2010; Figini & Vici, 2010; Lee & Chang, 2008; Marrocu; Paci and Zara, 2015) and regional levels (Cortes-Jimenez, 2008; Paci & Marrocu, 2014; Marrocu, Paci and Zara 2015). As a matter of fact, tourism is one of the largest income sources in the world, injecting a great amount of currency (from many different countries) into worldwide circulation. Additionally, tourism creates new job opportunities and provides many valuable socio-cultural interactions (Sariisik, et al., 2011).

Geomorphic tourism is a novel subdivision of tourism that has been developed around the world (Ekinci, 2010). Lately, geomorphic tourism ("geotourism" for short) has been defined as tourism that accounts for or improves the geographical

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character of a place and can include the environment, culture, aesthetics, and heritage. Especially, it focuses on landscape and geology (Newsome and Dowling 2010; Hose 2012; Newsome and Johnson 2013). The term is regularly used to refer to a particular form of nature-based tourism, mainly emphasizing geosystems (Newsome & Dowling, 2010; Gray, 2011 and Newsome et al. 2012).

With respect to international standards, geotourism specifically introduces geological and geomorphological phenomena to tourists, while maintaining their local identity. By preventing destruction of these geological treasures at the hands of humans, geotourism organizes observation of these structures while simultaneously making them meaningful. Additionally, it can provide the basis for development of a region (Ghorbani et al., 2011). A type of especially interesting tourism that emphasizes morphological phenomena and landscapes of geomorphic tourism, is sustainable tourism with a focus on helping tourists experience landform types in ways that promote geomorphological and cultural apprehension, appreciation, and conservation, while being locally advantageous (Dowling, 2008).

The concept of *geomorphological heritage* can refer to a collection of sites, which is then referred to as a set of geomorphological sites, or "geomorphosites" for short (Panizza, 2001). In fact, geomorphosites are geomorphologic systems with a specific value based on how humans understand them (Comanescu and Dobre, 2009). Such places may include one or more geomorphologic phenomena or an extensive landscape that can be altered, damaged, or destroyed by human activities (Mokhtari, 2010). Panizza and Piacente (2003) believe that geomorphosites are important not only because of their "scientific value", which is related to the knowledge of Earth's history, but also due to the fact that their value can be related to other potential fields and to economic, ecological, or cultural values. Today, geomorphosites, geomorphoheritage, and geomorphic tourism are commonplace concepts in many nations. The value of the geomorphosites has been introduced and defined both to communities and to scientists from other fields in an inappropriate manner (Ekinci, 2010), and attention to geotourism is developing worldwide (Dowling & Newsome, 2010; Newsome & Dowling, 2010 and Dowling, 2011). According to the statistics, Iran is among top-five countries of the world in terms of biodiversity and natural attractions (mountains, caves, forests, desert, sea, etc.), yet when it comes to tourist attraction Iran is considered one of the lowest rated countries (Mostofi, 2000).

Several studies have been conducted based on geomorphological landform Pralong. Pereira et al. (2007) assessed the ability of tourist geomorphosites of Montesinho Natural Park in Portugal. In this study, they nominated 154 sites, then to select 26 sites as able to draw more tourists via investment in tourism sector. The highest score was 15/37 and the lowest score, 9/55, out of a maximum of 20 points. The authors classified these sites into specific categories to set the value of each criterion (Pereira et al., 2007). Reynard et al. (2007) presented a new method of geomorphosites assessment. Somehow similar to other techniques in this area of study, this method deals with the scientific value and value-added features of the geomorphosites. Their research differed from that of Pereira's in that the former (Reynald) considered economic, ecological, and aesthetic values as independent criteria, giving two main criteria (scientific and cultural value) their own subindex. Finally, the potential geomorphosites were selected and introduced (ibid.). Yamani et al. performed research on geomorphosites and comparison methods of assessment (Pereira and Pralong) in order to describe and spur tourism development in Hormozgan province. In Perevira's method, the geomorphologic and management criteria were assessed, while the productivity criteria

and tourism were evaluated, using the Pralong method. The results indicated that the grade zone of geomorphosites was attributable to high scientific criterion and educational aspects. As a matter of fact, this value influenced other parameters. Generally, obtaining such a low grade could be attributed to a variety of factors. In this case, the authors attributed it to difficulty in accessing the site, lack of accommodations and facilities, lack of organization (especially in connection with tourism), and so forth (Yamani, Negahban and et al., 2012).

The present study, however, tests a potential assessment method for geomorphic tourism in a mountainous highland region by means of vast geomorphological features and tendencies at each geomorphological landform in two parts—scientific/educational and public tourism.

MATERIALS AND METHODS

Haraz watershed is located in Mazandaran Province, north of Iran (Fig.1) and extends from 51° 56' to 52° 36' longitude and 35° 45' to 36° 22' latitude, giving a total area of about 2000 km^2. The minimum height of Haraz watershed is 200 meters and the maximum height, about 5600 meters. From the climatic point of view, this watershed is located in semi-steppe zone of the Iranian and Turanian region. The ecological characteristics of the pastures inside the study area include high mountainous areas, upper slopes of mountain land, the middle-land mountain ranges, and land predominantly composed of mounds and hills. From the viewpoint of geomorphology, the watershed is based on the hills, which include deposits of Tertiary and Caspian coastal plain, and are delineated by ancient Tethys seaway, the existence of which has been caused by collision of Alborz lithosphere and Turan lithosphere during late Triassic. The various natural attractions, present in this area, has created the potentials for its development into a strong tourist draw. The mountainous highland region of Haraz watershed is one of the most important touristic areas in Iran, being rich in natural resources such as caves, springs, mineral bodies of water, glaciers, lakes and rivers, valleys, waterfalls, and numerous mountain peaks. For this reason, landforms of the watershed are selected to evaluate its geomorphic tourism ability.

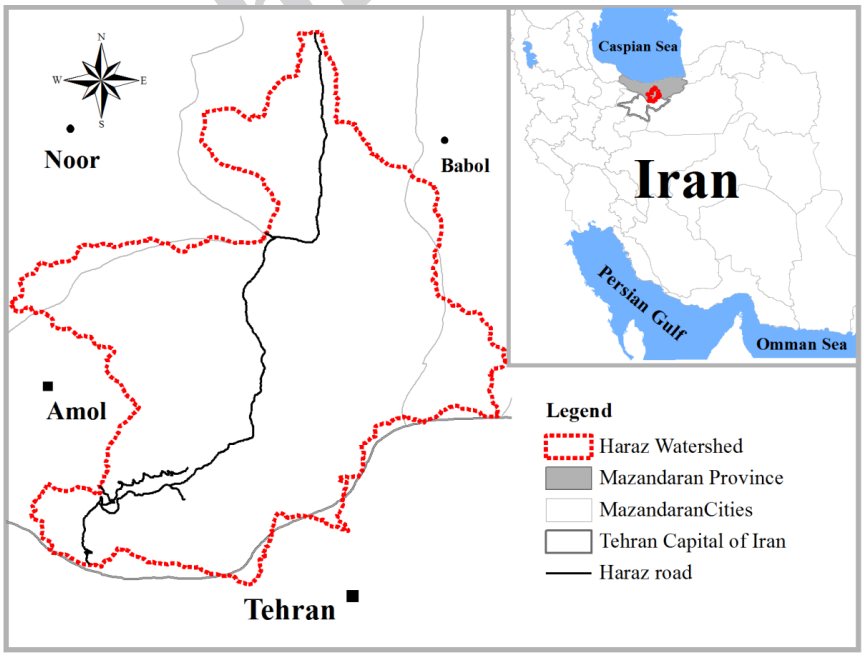

Fig. 1. Location of Haraz watershed in Iran

This research aims at evaluating the history of geomorphological landforms' assessment of Haraz watershed through reference to valid documents and other resources as evidence. In this regard, in order to initially evaluate the case study, the topographic map (National Cartographic Center, 1987) and aerial photographs of the region (National Geography Organization of Iran, 1955), both at a scale of 1/50000, were studied, utilizing geological maps of Amol and Damavand (Geological Survey of Iran, 2012) at a scale of 1/100000, geological maps of Amol and Tehran (Geological Survey of Iran, 2012) at a scale of 1/250000, and Landsat ETM^+ satellite images (2012), pursuant to this study. Finally, identification sheets for the geomorphological landforms of the Haraz watershed were filled out. Once the geomorphologic features were identified, they got enumerated on identification cards.

Pralong Model (2005) was used after completion of the identification sheets to determine the potential of relevant landforms to spur geotourism. According to Pralong Model, potential tourism empowerment of geomorphological landforms can be reviewed, based on four indicators (visual aesthetic, scientific, cultural and historical, and socio-economic). Here, in order to determine the value of each indicator, a specific criterion was considered. In determining the theoretical potential of an identified item to spur geomorphological landform tourism, there is no reason to weight one item more prominently than the other as there is no clear rationale for believing that one index is more telling or important (although the "Cultural Value" parameter does receive some extra weighting, thankss to the potential presence of a literary biography of the geomorphological landmark). Accordingly, tourism-related potentials of a landform can be expressed through the means of the four indexes as follows:

Scientific value of a geomorphological landform is calculated based on criteria such as rarity, educational status, and paleogeographical and biological value. It can be calculated according to the following equation and the rates, presented in Table 1. Scientific value = (V1 + V2 + 0.5*V3 + 0.5*V4 + V5 + V6) /5

Scenic value of a geomorphological landform depends on its inherent scenic aspects and can be calculated according to the following equation as well as the rates in Table. Scenic value = (V1 + V2 + V3 + V4 + V5) /5

When assessing the validity of historical-cultural elements on the depth of artistic ability/expression, the emphasis is on artistic ability and cultural mores, prevalent in geomorphologic places. In this formula, the weight of paragraph 2 is calculated twice, as this paragraph may also include a literary biography, usually associated with the iconography of 1. Points are calculated, in accordance with Table 1. Cultural value = (V1 + 2*V2 + V3 + V4 + V5) / 6

When assessing socio-economic empowerment, the emphasis is on useable features and entrepreneurship of the item in the field of landform tourism. Points are calculated based on Table 1, too. Economic Value = (V1 + V2 + V3 + V4 + V5) / 5

After scoring a given landform, assessment of the degree of exploitation for the geomorphological landforms was examined. This assessment consisted of two components and was homological to tourism capability assessment, with criteria and scoring scales, specified for each of the components. Accordingly, the stated degree of exploitation (coordinate X) and quality (coordinate Y) of exploitation were both given; therefore, the coordinates were developed according to the following equation: Exploitation value = Degree of exploitation value, Modality of exploitation value.

Where, degree of exploitation value represents the spatial and temporal use of geomorphological landform and can be drawn from the following equation with its

rating being calculated according to Table 1. Degree of exploitation value: (V1 + V2 + V3 + V4) / 4

Also, quality of exploitation value is calculated on the basis of using four geomorphologic landform tourism score criteria with its provisions, calculated according to Table 1. Modality of exploitation value = (V1 + V2 + V3 + V4) / 4

Table 1. Points of comparison and scores in assessment of the values of the Haraz mountainous highland region

Values	Points of Comparison / Marks	0	0.25	0.5	0.75	1
Scientific	V1: Palaeogeographical interest	-	Low	Modest	High	Very high
	V2: Representativeness	Zero	Low	Modest	High	Very high
	V3: Area(Plottage) [%]	-	less than 25	25-50	50-90	More than 90
	V4: Rarity(Rareness)	More than 7	5-7	3-4	1-2	Unique
	V5: Integrity	Destroyed	Strongly deteriorated	Moderately deteriorated	Weakly deteriorated	Intact
	V6: Ecological interest	Zero	Low	Modest	High	Very high
Scenic	V1: Number of view points	-	1	2-3	4-6	More than 6
	V2: Average distance to viewpoints [m]	-	less than 50	50-200	200-500	More than 500
	V3: Surface	-	Small	Modest	Large	Very large
	V4: Elevation	Zero	Low	Modest	High	Very high
	V5: Color contrasts with site surroundings	Identical colors	-	Different colors	-	Opposite colors
Cultural	V1: Cultural and historical customs	Without link	Weakly linked	Moderately linked	Strongly linked	Initiatory of custom(s)
	V2: Iconographic representations	Never represented	Represented 1 and 5	Represented 6 and 20	Represented 21 and 50	Represented 50 or more
	V3: Historical and archaeological Relevance	No vestige or building	Weak relevance	Modest relevance	High relevance	Very high relevance
	V4: Religious and metaphysical relevance	No relevance	Weak relevance	Modest relevance	High relevance	Very high relevance
	V5: Art and cultural event	Never	-	Occasionally	-	At least once a year
Economic	V1: Accessibility	more than 1 km of track	less than 1 km of track	by a local road	by a road of regional importance	by a road of national importance
	V2: Natural risks	uncontrollable	not controlled	Partially controlled	Controlled residual	no risk
	V3: Annual number of visitors in the Region	less than 10.000	10- 100.000	0.1- 0.5 million	0.5- 1 million	more than 1 million
	V4: Official level of protection	complete	limiting	-	not limiting	no protection
	V5: Attraction	-	local	regional	national	international
Degree of exploitation	V1: Used surface [ha]	Zero or ex situ	less than 1	1-5	5-10	more than 10
	V2: Number of infrastructure	Zero or ex situ	1	2-5	6-10	more than 10
	V3: Seasonal occupancy [day]	-	1-90 (1 season)	91-180 (2 seasons)	181-270 (3 seasons)	271-360 (4 seasons)
	V4: Daily occupancy [hour]	-	less than 3 hours	3-6	6-9	more than 9 hours
Quality of exploitation	V1: Use of the scenic value	no advertising optimization	1 support & 1 product	1 support & some products	some means of support & 1 product	some means of support & products
	V2: Use of the scientific value	no didactic optimization	1 support & 1 product	1 support & several products	several means of support & 1 product	several means of support & products
	V3: Use of the cultural value	no didactic optimization	1 support & 1 product	1 support & several products	several means of support & 1 product	several means of support & products
	V4: Use of the economic value [person]	no visitor	less than 5.000	5-20.000	20-100.000	more than100.000

RESULTS AND DISCUSSION

The study showed that 5 geomorphological landforms within Haraz watershed were distinguishable (namely, Mount Damavand, Damavand Icefall, Shahandasht Waterfall, Larijan Spa, and Deryouk Rock Waterfall). Tables 2 through 6 represent the identification of these geomorphological landforms.

Fig. 2 illustrates the geological map of Haraz Watershed.

Table 2. Mount Damavand: Geomorphological landform identification table

	Index
Location	
Relative position	Amol city, Larijan region, at the top of Larijan village, in the northeast of Tehran
Mathematical situations	city35°49' to 36°5' north latitude and 51°59' to 52°16' east longitude.
The nearest population center	City of Reeneh
Distance from the center of the city	62 km west of Amol and 69 km northeast of Tehran
Geomorphology	
Landform genesis	Originated from the last pressure movement, which created an impression on the Iranian plateau; namely, wrinkling, tuck, and accumulation of the continental crust of Iran, putting Alborz under pressure and rendering the fissures more active, with an opening (with lava) materializing from the fissures.
Dominant processes	Fumarole activity and hot springs
Age	Orogenic Pasadenian (1.8 million years ago)
Lithology	Sulfur rock, limestone, coal, flint, metamorphic rocks such as marble, alum, and stones, which originate from the lava of Damavand volcano trachyte rocks, then andesite and basalt.
The Main form	P_d, Ja, Qta, Qtu and Qb
Adjacent formations	Qs, $TR3^{JS}$, Q^1, Q^2 and Cm
Tourism	
Importance	Value regionally, nationally and internationally
How to Access	Haraz road
Tourist services	Infrastructure facilities such as paved roads, water, gas, public transport, accommodation, and emergency services
Surrounding land use	Mineral mining and beekeeping
Tourist tendency	
Scientific-educational	Geology, geomorphology, geology and visiting the climatology fault
Public	To introduce people to the environmental changes, caused by volcanic lava, climate changes with increasing altitude, hiking and mountain climbing, ecotourism, and adventure tourism

Table 3. Damavand Icefall: Geomorphological landform identification table

	Index
Location	
Relative position	South slope of mount Damavand
Mathematical situations	35°56'26″north latitude and 52°7'18″east longitude
The nearest population center	City of Reeneh
Distance from the center of the city	62 km from the city of Amol, 69 km from Tehran province
Geomorphology	
Landform genesis	Melt snow from the above pit
Dominant processes	Emission of sulfur gas
Age	Present age
Lithology	Andesite to basaltic volcanics
The Main form	Qta
Adjacent formations	Q1 and Ji
Tourism	
Importance	Regional, national, and international value
How to Access	Haraz Road
Tourist services	No facilities
Surrounding land use	Mineral mining and beekeeping
Tourist tendency	
Scientific-educational	Ecotourism, hydrology, geology, geomorphology
Public	To introduce people to its geomorphologic phenomenon along with adventure tourism

Table 4. Shahandasht Waterfall: Geomorphological landform identification table

	Index
Location	
Relative position	Located in Shahandasht Village, near Gazanak of Amol
Mathematical situations	35°55'26″north latitude and 52°15'60″east longitude
The nearest population center	Shahandasht Village
Distance from the center of the city	100 km northeast of Tehran province; 65 km from the city of Amol
Geomorphology	
Landform genesis	High physical erosion (water erosion) and weathering
Dominant processes	High erosion
Age	Present age
Lithology	Dark gray shale and sandstone
The Main form	Qal
Adjacent formations	$TR3^{JS}$, Q^2, Qtu and Qs
Tourism	Having both regional and national values
Importance	Haraz Road
How to Access	Infrastructure facilities like paved roads, water, accommodation, and emergency services
Tourist services	Gardens plus agricultural and residential areas
Surrounding land use	
Tourist tendency	
Scientific-educational	Geology, biological studies, lithology, hydrology, and archeology
Public	To introduce people to its geomorphologic phenomenon, ecotourism, and rural tourism

Table 5. Larijan Spa: Geomorphological landform identification table

	Index
Location	
Relative position	Southeastern slope of mount Damavand, near Gazanak of Amol
Mathematical situations	35°54'36″north latitude and 52°11'18″east longitude
The nearest population center	Abe Garm Village
Distance from the center of the city	60 km northeast of Tehran Province; 26 km northeast of Damavand City
Geomorphology	
Landform genesis	Tectonic activity and underground water from the gap of basaltic and andesite rocks
Dominant processes	Hydrogeochemical processes
Age	Quaternary
Lithology	Andesite and basaltic volcanics
The Main form	Qta
Adjacent formations	$TR3^{JS}$, JI, Qal, Qtu and Qs
Tourism	
Importance	Having both regional and national values
How to Access	Haraz Road
Tourist services	Infrastructure facilities such as paved roads, water, public transport, hotel, restaurant, and emergency services
Surrounding land use	Garden plus agricultural and residential areas
Tourist tendency	
Scientific-educational	Hydrology, water treatment and hydrogeology, sedimentology, geology, anthropology, and archeology
Public	To introduce people to its geomorphologic phenomenon, the formation of villages around the spa, rural tourism, health rural tourism, and ecotourism

Table 6. Deryouk Rock Waterfall: Geomorphological landform identification table

Index	
Location	
Relative position	South Amol, Namarestagh region
Mathematical situations	36°5'52″ north latitude and 52°4'18″ east longitude
The nearest population center	Deryouk Village
Distance from the center of the city	40 km from Tehran Province, 6 km from west of Panjab Larijan
Geomorphology	
Landform genesis	Physical and chemical weathering
Dominant processes	Water erosion
Age	Present age
Lithology	Thick bedded to massive, white-to-pinkish orbitolina-bearing limestone
The Main form	Ql
Adjacent formations	Qal, J_d, K^{1v}, Ji, Q1, TRe2 and $TR3^{js}$
Tourism	
Importance	Having both regional and national values
How to Access	Haraz Road
Tourist services	Infrastructure facilities such as paved roads, water, and emergency services
Surrounding land use	Agricultural and residential
Tourist tendency	
Scientific-educational	Ecotourism, Geology, Hydrology, and Erosion
Public	To introduce people to its geomorphologic phenomenon and educating them to avoid environmental contamination.

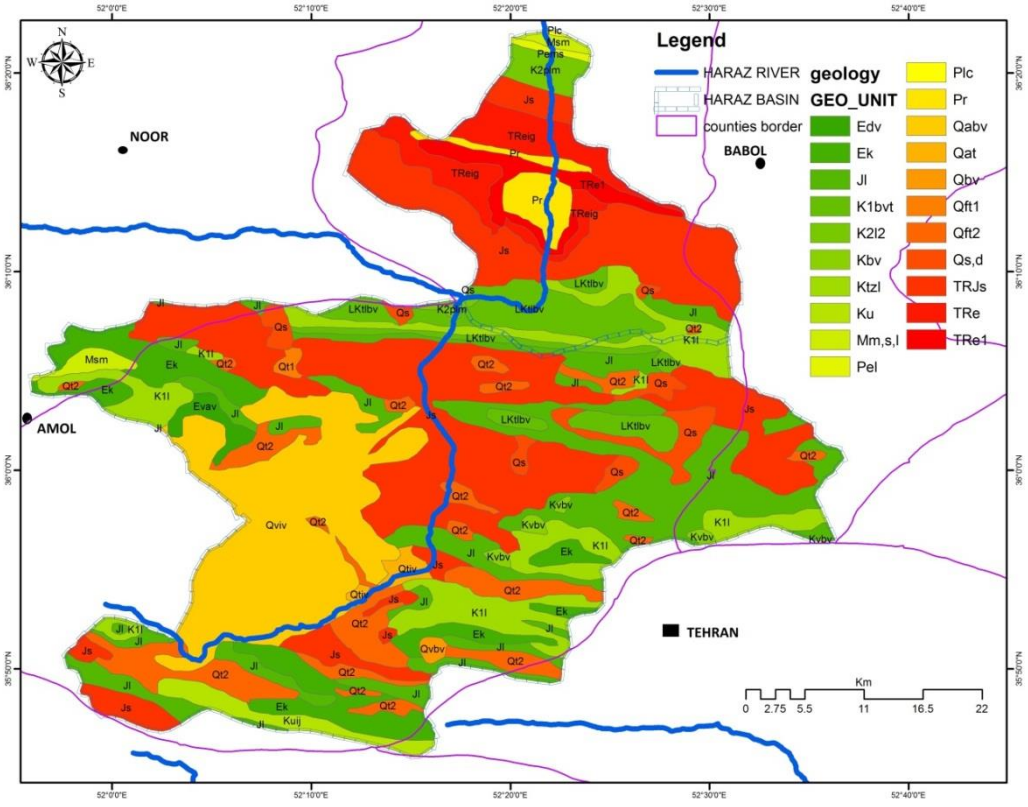

Fig. 2. Geological map of Haraz Watershed (Geological Survey of Iran, 2012)

After the surveys and scoring each indicator, by means of Pralong Method, validity and the efficiency of geomorphological landforms were calculated as the values of tourism and exploitation. Once each of these values were calculated and estimated, a logical comparison was applied among them so that a comprehensive understanding of the landform region's ability to attract geotourism could be obtained. To assess the geotouristic value of a set of potential landmarks, four scientific values, including aesthetic, historical-cultural, and socio-economic backgrounds were scored (Table 7). Mount Damavand attained the highest rating due to certain geological conditions (0.95), while Shahandasht Waterfall got the lowest, obtaining a score of 0.65. Wheen evaluating the aesthetic value, it was shown that Mount Damavand was placed first with 0.9 points and Damavand Icefall was placed last with 0.4 points. The rate of historical-cultural value indicated that Shahandasht Landform achieved the highest score, thanks to its position adjacent to Malek Bahman Castle, while Damavand Icefall got the lowest score.

Table 7. Points of comparison and scores in the assessment of the values of the Haraz mountainous highland region

Scientific Value							
Sites/ Values	**Palaeogeographical interest**	**Representativeness**	**Area[%]**	**Rarity**	**Integrity**	**Ecological interest**	**Total**
The Mount Damavand	1	1	1	1	0.75	1	0.95
The Damavand icefall	0.75	0.75	1	1	1	0.5	0.8
The Shahandasht waterfall	1	0.75	0.75	0.25	0.5	0.5	0.65
The Larijan spa	0.75	0.75	0.75	0.5	0.75	0.5	0.67
The Deryouk rock waterfall	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Scenic Value							
Sites/ Values	**Number of view points**	**Distance to view points(m)**	**Surface**	**Elavation**	**Colour contrast with site surroundings**	**Total**	
The Mount Damavand	1	1	1	1	0.5	0.9	
The Damavand icefall	0.5	0.25	0.25	0.5	0.5	0.4	
The Shahandasht waterfall	0.75	0.5	0.5	0.75	1	0.7	
The Larijan spa	0.5	0.75	0.5	0.5	1	0.65	
The Deryouk rock waterfall	0.5	0.75	0.5	0.75	0.5	0.6	
Cultural Value							
Sites/ Values	**Cultural and historical**	**Iconographic representations**	**Historical and archaecological**	**Religious**	**Art and cultural**	**Total**	
The Mount Damavand	1	0	0.75	0.25	0	0.33	
The Damavand icefall	0	0	0	0	0	0	
The Shahandasht waterfall	0.75	0	1	0.5	0.5	0.45	
The Larijan spa	0.5	0	0.5	0.5	0.5	0.33	
The Deryouk rock waterfall	0.25	0	0.25	0.25	0.25	0.16	
Economic Value							
Sites/ Values	**Accessibility**	**Natural hazards**	**Annual number of Visitors**	**Official level of protection**	**Attraction**	**Total**	
The Mount Damavand	0.75	0	0	0.25	1	0.4	
The Damavand icefall	0	0	0	0.25	1	0.25	
The Shahandasht waterfall	0.5	1	0	0.25	0.75	0.5	
The Larijan spa	0.5	0.75	0	0.25	0.75	0.45	
The Deryouk rock waterfall	0.5	0.75	0	0.25	1	0.5	

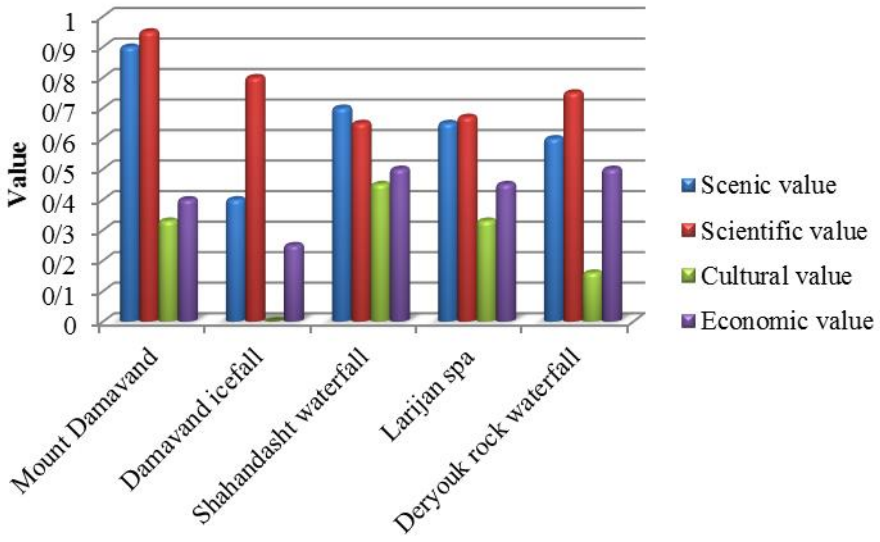

Fig. 3. Comparing tourism values of the geomorphological landforms of the Haraz watershed

Another value, assessed in this study, was the degree of exploitation (Table 8), in which Larijan Spa landform earned 0.87 points, due to its location in Larijan downtown and the short distance of the city of Larijan from Tehran-Amol main road, along which various comforts are accessible to all kinds of vehicles. In addition, there are two ways to travel to the site that, if developed, can be turned into both input and output roads. The village's participation in tourism spa services also contributed to its highest value. One example of an opposite circumstance (a site with somewhat limited access and services) was Damavand Icefall that lacked necessary and standard tourist services and facilities, hence its lowest score (0.18), indicative of the fact that the site lacks appropriate elements and amenities for potential tourists.

Table 8. Points of comparison and scoring in assessment of the degree and modality of exploitation of Haraz mountainous highland region

Degree of exploitation					
Sites/ Values	**Used Surface[ha]**	**Number of infrastructure**	**Seasonal Occupancy**	**Daily Occupancy**	**Total**
Mount Damavand	1	0.75	0.5	0.5	0.68
Damavand icefall	0.25	0	0.5	0	0.18
Shahandasht waterfall	0.25	0	0.75	1	0.5
Larijan spa	0.5	1	1	1	0.87
Deryouk rock waterfall	0.5	0	0.5	0.75	0.43
Modality of exploitation					
Sites/ Values	**Scenic**	**Scientific**	**Cultural**	**Economic**	**Total**
Mount Damavand	1	1	0.75	0.25	0.75
Damavand icefall	0.25	0.75	0.5	0.25	0.43
Shahandasht waterfall	1	0.5	0.5	0.5	0.62
Larijan spa	0.75	0.5	0.25	0.75	0.56
Deryouk rock waterfall	1	0.25	0.25	0.5	0.5

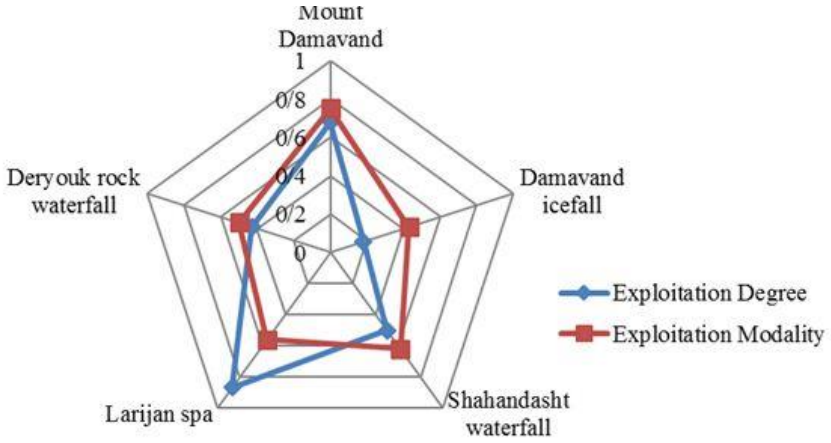

Fig. 4. Comparing the values for Exploitation Degree and Exploitation Quality of Geomorphological Landforms of Haraz Watershed

The final mean tourism values and exploitation values for the evaluation of geomorphological landforms of Haraz Watershed were above average (except for the Damavand icefall) (Table 8) (Fig. 4). Thanks to its importance in the international arena, Mount Damavand attained the highest rating. Other reasons for this landform to attain the highest scores included its location near Tehran metropolitan area, its low distance from Larijan and Reeneh, and its location adjacent to Haraz Road. Mount Damavand encompasses natural resources including the highest peak in Iran, hot springs, a river, the Lar Dam, and the Lar protected area. A broader range of items for exploration, due to the diversity of the described natural resources, include specific geology of the region, cold climate, mountainous region, and mineral springs. The average of scientific values in these landforms' catchment (with 0.76 points) was greater than the average of other values, followerd by aesthetic values, with an average of 0.65 in the second place, and economic values with an average of 0.42 points in the third. Cultural and historical values (with an average of 0.25 points) ranked last. Overall, the mean tourist value of the geomorphological Mount Damavand landform with 0.64 points achieved the highest value and was at an appropriate score level for a worthy geomorphic tourism site. Damavand Icefall, which earned mean values of 0.36 points, gained the lowest value, since it is difficult to access (the route to it is often impassable) and the infrastructure facilities around the landform are lacking. Table 9 shows tourism and exploitation values for Haraz Watershed.

Table 9. Tourism and exploitation values for Haraz Watershed

Values	Average values
Scientific	0/76
Scenic	0/65
Cultural	0/25
Economic	0/42
Tourism value	0/52
Exploitation Degree	0/53
Exploitation Quality	0/57
Exploitation value	0/55

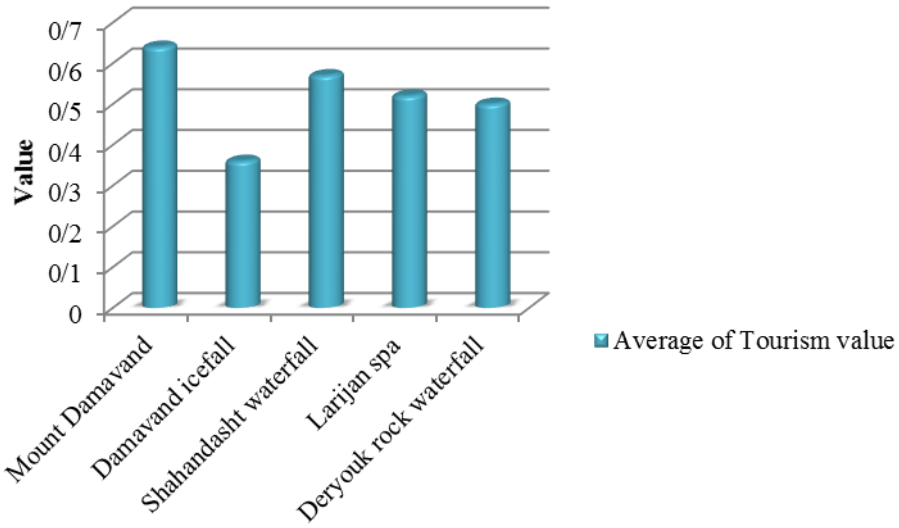

Fig. 5. Average tourism value of geomorphological landforms of Haraz Watershed

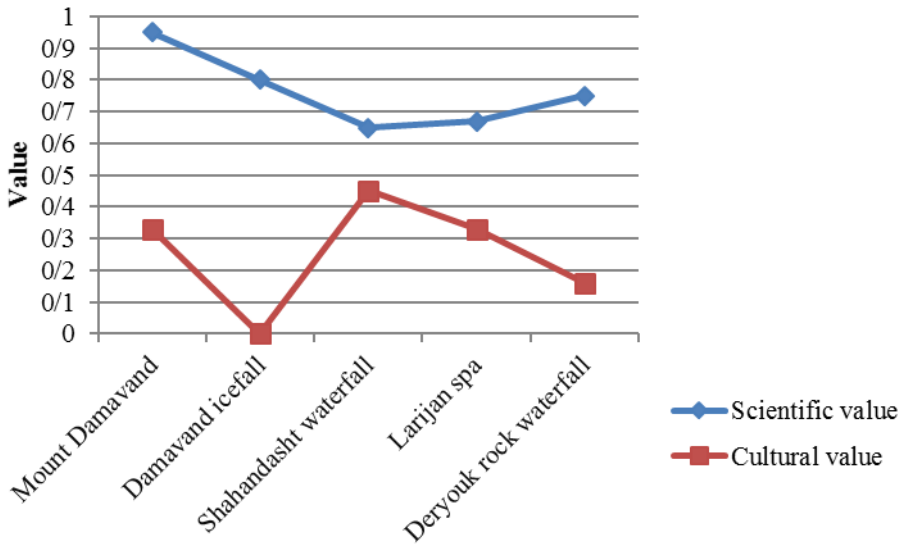

Fig. 6. Comparing cultural and scientific values of the geomorphological landforms of Haraz Watershed

According to the low cultural and historical values of landforms as well as their high scientific values in this assessment (Fig. 6), it can be concluded that this area is tailored to the development of tourism or geotourism, being a less potential candidate for cultural tourism, which requires accurate planning for greater development of geotourism.

CONCLUSIONS

The present study tried to evaluate the ability of geomorphological landforms of Haraz Watershed to spur geotourism, using Pralong Method along with field visits. In this regard, features of geomorphologic landforms, namely Mount Damavand, Damavand Icefall, Shahandasht Waterfall, Larijan Spa, and Deryouk Rock Waterfall, in different parts of Haraz Watershed were compared from the standpoint of geotourism features, then to be evaluated. Results of this assessment showed that selected landforms of this area were in an appropriate category for tourism development. The fact that some are more accessible to tourists and have more

infrastructure in place is simply due to lack of many elements such as coherent planning, regional tourist facilities and equipment, and appropriate signs to guide tourists. Problems are also associated with the traffic in Haraz (in which many vehicle accidents occurs), long winter in the region, and no diversity in having access to the region. It is, therefore, essential to identify potential areas for creation and enhancement of tourist facilities and investment opportunities when improving the infrastructure to achieve sustainable development of tourism in Haraz Watershed, due to its particular geomorphological landforms, geographic location, and its position as a main transportation hub between Tehran metropolitan area and Mazandaran Province. With regard to tourism development in the region, one must take into account the specific characteristics of the climate; the natural, social, and cultural climate of the area; the ecological carrying capacity of the region; and its social tolerance factor. Each of these elements is vital for tourism development, which should be based on sustainability criteria. Over the long term, ecological and economic problems must be confronted and necessary commitments has to be made to social and ethical aspects in order to fully realize the potential of these tourism sites. Sustainable development of tourism in the region is possible only with coherent planning. Such development of tourism, which has entered into a strategic framework for national and local planning as well as environmental impacts with the aim of increasing long-term reliability for tourism industry, is taken into consideration.

REFERENCES

Brida, J. G. and Pulina, M. (2010). A literature review on the tourism-led-growth hypothesis. Centro Ricerche Economiche Nord Sud, Universita Di Cagliari: 1-30.

Comanescu, L. and Dobre, R. (2009). Inventoring Evaluating and Tourism Valuating the Geomorphosite from the Central Sector of Tourism and Geosites. GeoJournal of Tourism and Geosites, 1 (3): 86-96.

Cortes-Jimenez, I. (2008). Which type of tourism matters to the regional economic growth? The cases of Spain and Italy. International Journal of Tourism Research, 10: 127-140.

Dowling R.K. (2008). The Emergence of Geotourism and Geoparks. Journal of Tourism, 9 (2): 227-236.

Dowling, R. K. (2011). Geotourism's global growth. Geoheritage, 3: 1–13.

Dowling, R. K. and Newsome, D. (Eds.). (2010). Global geotourism perspectives. Oxford, UK: Goodfellow Publishers.

Ekinci, D. (2010). The Noticeable Geomorphosites of Turky. International Journal of Art and Science, 3(15): 303-321.

Figini, P. and Vici, L. (2010). Tourism and growth in a cross-section of countries. Tourism Economics, 16(4): 789-805.

Geological Survey of Iran. (2014). *Geological Map*. Cm 1114 and 1116. Iran: TSO (The Stationery Office).

Ghorbani, R., Asteenchideh, M. and Mehri, M. (2011). Geo-tourism, using geomorphological attractions and geology of mountain vally (Sample: SiminVallyin south of Hamedan). Spatial Planning (Modares Human Sciences), 14(4): 1-22.

Gray, M. (2011). Other nature: Geodiversity and geosystem services. Environmental Conservation, 38(3): 271–274.

Hose, T. (2012). 3 G's for modern geotourism. Geoheritage, 4: 7–24.

Jalani, J.O. (2012). Local people's perception on the impacts and importance of ecotourism in Sabang, Palawan, Philippines. Procedia – Social and Behavioral Sciences, 57: 247-254.

Lee, C. C. and Chang, C. P. (2008). Tourism development and economic growth: a closer look at panels. Tourism Management, 29(1): 180-192.

Marrocu, E., Paci, R. and Zara, A. (2015). Micro-economic determinants of tourist expenditure: A quantile regression approach. Tourism Management, 50: 13-30.

Mirsanjari, M M., Naghizadeh, M., Farzamfar. N., Baghi, H., AsliGharabagh, V. and Sultani, A. (2013). Assessment of Scientific and Additional Values of Sustainable Ecotourism for Desert Areas by Using Pralong Method, Case Study: Khor and Biabanak, Iran. Advances in Environmental Biology, 7(2): 269-277.

Mostofi, N. (2000). Sustainable tourism way for development. Tourism and Touring Organization.

National Cartographic Center. (1987). *Topographic Maps*. Iran: TSO (The Stationery Office).

National Geography Organization of Iran. (1955). *Aerial photographs.* Iran: TSO (The Stationery Office).

Newsome, D. and C. P. Johnson. (2013). Potential Geotourism and the Prospect of Raising Awareness About Geoheritage and Environment on Mauritius, Geoheritage, 5: 1–9.

Newsome, D. and Dowling, R. (Eds). (2010).Geotourism: The tourism of geology and landscape. Goodfellow Publishers Limited, Oxford, UK.

Newsome, D., Dowling, R. and Leung, Y. (2012). The nature and management of geotourism: A case study of two established iconic geotourism destinations, Tourism Management Perspectives, 2-3: 19-27.

Paci, R. and Marrocu, E. (2014). Tourism and regional growth in Europe. Papers in Regional Science, 93(Suppl. 1): 25-50.

Panizza, M. (2001). Geomorphosites: Concepts, methods and examples of geomorphological survey. Chinese Science Bulletin, 46: 4-6.

Panizza, M. and S. Piacente. (2003). Geomorfologia culturale. Pitagora Editrice, Bologna, 350 pp.

Pereira, P., Pereira, D., Caetano, M. and Braga, A. (2007). Geomorphosite assessment in Montesinho Natur al Park (Portugal), Geographica Helvetica Jg: 159-168.

Pralong, J. P. (2005). A method for assessing the tourist potential and use of geomorphological sites. Géomorphologie. Relief, processus, environnement. 3: 189-196.

Reynard, E., Fontana, G., Kozlik, L. and Scapozza, C. (2007). A method for assessing scientific and additional values of geomorphosites, Geographica Helvetica Jg, 62-3: 148-158.

Sariisik, M., Turkay, O. and Akova, O. (2011). How to Manage Yacht Tourism in Turkey: A SWOT Analysis and Related Strategies, Procedia Social and Behavioral Sciences, Vol 24: 1014-1025.

Yamani, M., Negahban, S., Harabadi, S. and Alizadeh, M. (2012). Geomorphotourism and Comparison of Methods for the Assessment of Geomorphosites in Tourism Development (Case Study: Hormozgan Province). Journal of Tourism Planning and Development, 1(1): 83-104.