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

Amiri, M. J.*, Nohegar, A. and Bouzari, S.

Graduate Faculty of Environment, University of Tehran, Tehran, Iran

Received: 18.08.2017 Accepted: 31.01.2018

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; Marrocuc Paci and Zara, 2015) and regional levels (Cortes-Jimenez, 2008; Paci & Marrocuc 2014; Marrocuc 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
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 km². 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](image)
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, thanks 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: \((V_1 + V_2 + V_3 + V_4) / 4\).

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 \((V_1 + V_2 + V_3 + V_4) / 4\).

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

<table>
<thead>
<tr>
<th>Values</th>
<th>Points of Comparison / Marks</th>
<th>0</th>
<th>0.25</th>
<th>0.5</th>
<th>0.75</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1: Palaeo geographical interest</td>
<td>Zero</td>
<td>Low</td>
<td>Modest</td>
<td>High</td>
<td>Very high</td>
<td></td>
</tr>
<tr>
<td>V2: Representativeness</td>
<td>-</td>
<td>less than 25</td>
<td>25-50</td>
<td>50-90</td>
<td>More than 90</td>
<td></td>
</tr>
<tr>
<td>V3: Area (elevation) [%]</td>
<td>-</td>
<td>5-7</td>
<td>3-4</td>
<td>1-2</td>
<td>Unique</td>
<td></td>
</tr>
<tr>
<td>V4: Integrity</td>
<td>Destroyed</td>
<td>Strongly deteriorated</td>
<td>Moderately deteriorated</td>
<td>Weakly deteriorated</td>
<td>Intact</td>
<td></td>
</tr>
<tr>
<td>V5: Ecological interest</td>
<td>Zero</td>
<td>Low</td>
<td>Modest</td>
<td>High</td>
<td>Very high</td>
<td></td>
</tr>
<tr>
<td>V6: Number of view points</td>
<td>-</td>
<td>1</td>
<td>2-3</td>
<td>4-6</td>
<td>More than 6</td>
<td></td>
</tr>
</tbody>
</table>

Scenic

<table>
<thead>
<tr>
<th>Points of Comparison / Marks</th>
<th>0</th>
<th>0.25</th>
<th>0.5</th>
<th>0.75</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>V3: Surface</td>
<td>-</td>
<td>Small</td>
<td>Modest</td>
<td>Large</td>
<td>Very large</td>
</tr>
<tr>
<td>V5: Color contrasts with site surroundings</td>
<td>Zero</td>
<td>Identical colors</td>
<td>Low</td>
<td>Different colors</td>
<td>Opposite colors</td>
</tr>
<tr>
<td>V1: Cultural and historical customs</td>
<td>Without link</td>
<td>Weakly linked</td>
<td>Moderately linked</td>
<td>Strongly linked</td>
<td>Initiatory of custom(s)</td>
</tr>
<tr>
<td>V2: Iconographic representations</td>
<td>Never represented</td>
<td>Represented 1 and 5</td>
<td>Represented 6 and 20</td>
<td>Represented 21 and 50</td>
<td>Represented 50 or more</td>
</tr>
<tr>
<td>V3: Historical and archaeological relevance</td>
<td>No vestige or building</td>
<td>Weak relevance</td>
<td>Modest relevance</td>
<td>High relevance</td>
<td>Very high relevance</td>
</tr>
<tr>
<td>V4: Religious and metaphorical relevance</td>
<td>No relevance</td>
<td>Weak relevance</td>
<td>Modest relevance</td>
<td>High relevance</td>
<td>Very high relevance</td>
</tr>
<tr>
<td>V5: Art and cultural event</td>
<td>Never</td>
<td>-</td>
<td>Occasionally</td>
<td>-</td>
<td>At least once a year</td>
</tr>
<tr>
<td>V1: Accessibility</td>
<td>more than 1 km of track</td>
<td>less than 1 km of track</td>
<td>by a local road</td>
<td>by a road</td>
<td>By a road</td>
</tr>
</tbody>
</table>

Economic

<table>
<thead>
<tr>
<th>Points of Comparison / Marks</th>
<th>0</th>
<th>0.25</th>
<th>0.5</th>
<th>0.75</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>V2: Natural risks</td>
<td>uncontrolled</td>
<td>not controlled</td>
<td>Partially controlled</td>
<td>Controlled</td>
<td>No risk</td>
</tr>
<tr>
<td>V3: Annual number of visitors in the Region</td>
<td>less than 10,000</td>
<td>10,000</td>
<td>0.1-0.5 million</td>
<td>0.5-1 million</td>
<td>More than 1 million</td>
</tr>
<tr>
<td>V4: Official level of protection</td>
<td>complete</td>
<td>limiting</td>
<td>-</td>
<td>not limiting</td>
<td>No protection</td>
</tr>
<tr>
<td>V5: Attraction</td>
<td>-</td>
<td>local</td>
<td>regional</td>
<td>national</td>
<td>International</td>
</tr>
<tr>
<td>V1: Used surface [ha]</td>
<td>Zero or ex situ</td>
<td>less than 1</td>
<td>1-5</td>
<td>5-10</td>
<td>More than 10</td>
</tr>
<tr>
<td>V2: Number of infrastructure</td>
<td>Zero or ex situ</td>
<td>1</td>
<td>2-5</td>
<td>6-10</td>
<td>More than 10</td>
</tr>
<tr>
<td>V3: Seasonal occupancy [day]</td>
<td>-</td>
<td>1-90 (season)</td>
<td>91-180 (seasons)</td>
<td>181-270 (seasons)</td>
<td>271-360 (seasons)</td>
</tr>
<tr>
<td>V4: Daily occupancy [hours]</td>
<td>less than 3 hours</td>
<td>3-6</td>
<td>6-9</td>
<td>More than 9 hours</td>
<td>-</td>
</tr>
</tbody>
</table>

Degree of exploitation

<table>
<thead>
<tr>
<th>Points of Comparison / Marks</th>
<th>0</th>
<th>0.25</th>
<th>0.5</th>
<th>0.75</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1: Use of the scenic value</td>
<td>no advertising optimization</td>
<td>1 support &amp; 1 product</td>
<td>1 support &amp; some products</td>
<td>some means of support &amp; 1 product</td>
<td>some means of support &amp; products</td>
</tr>
<tr>
<td>V2: Use of the scientific value</td>
<td>no didactic optimization</td>
<td>1 support &amp; 1 product</td>
<td>1 support &amp; several products</td>
<td>several means of support &amp; 1 product</td>
<td>several means of support &amp; products</td>
</tr>
<tr>
<td>V3: Use of the cultural value</td>
<td>no didactic optimization</td>
<td>1 support &amp; 1 product</td>
<td>1 support &amp; several products</td>
<td>several means of support &amp; 1 product</td>
<td>several means of support &amp; products</td>
</tr>
<tr>
<td>V4: Use of the economic value [person]</td>
<td>no visitor</td>
<td>less than 5,000</td>
<td>5-20,000</td>
<td>20-100,000</td>
<td>More than 100,000</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Location</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative position</td>
<td>Location: Amol city, Larijan region, at the top of Larijan village, in the northeast of Tehran city, 35°49′ to 36°5′ north latitude and 51°59′ to 52°16′ east longitude.</td>
</tr>
<tr>
<td>Mathematical situations</td>
<td>The nearest population center: City of Reeneh</td>
</tr>
<tr>
<td>Distance from the center of the city</td>
<td>62 km west of Amol and 69 km northeast of Tehran</td>
</tr>
<tr>
<td>Geomorphology</td>
<td>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.</td>
</tr>
<tr>
<td>Dominant processes</td>
<td>Fumarole activity and hot springs</td>
</tr>
<tr>
<td>Age</td>
<td>Orogenic Pasadenian (1.8 million years ago)</td>
</tr>
<tr>
<td>Lithology</td>
<td>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.</td>
</tr>
<tr>
<td>The Main form</td>
<td>P, Ja, Qta, Qtu and Qb</td>
</tr>
<tr>
<td>Adjacent formations</td>
<td>Qs, TR3, Q1, Q2 and Cm</td>
</tr>
<tr>
<td>Tourism</td>
<td>Value regionally, nationally and internationally</td>
</tr>
<tr>
<td>Importance</td>
<td>Haraz road</td>
</tr>
<tr>
<td>How to Access</td>
<td>Infrastructure facilities such as paved roads, water, gas, public transport, accommodation, and emergency services</td>
</tr>
<tr>
<td>Tourist services</td>
<td>Mineral mining and beekeeping</td>
</tr>
<tr>
<td>Surrounding land use</td>
<td>Geology, geomorphology, geology and visiting the climatology fault</td>
</tr>
<tr>
<td>Tourist tendency</td>
<td>To introduce people to the environmental changes, caused by volcanic lava, climate changes with increasing altitude, hiking and mountain climbing, ecotourism, and adventure tourism</td>
</tr>
<tr>
<td>Scientific-educational</td>
<td>Public</td>
</tr>
</tbody>
</table>

Table 3. Damavand Icefall: Geomorphological landform identification table

<table>
<thead>
<tr>
<th>Location</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative position</td>
<td>Location: South slope of mount Damavand</td>
</tr>
<tr>
<td>Mathematical situations</td>
<td>35°56′26″ north latitude and 52°7′18″ east longitude</td>
</tr>
<tr>
<td>The nearest population center</td>
<td>City of Reeneh</td>
</tr>
<tr>
<td>Distance from the center of the city</td>
<td>62 km from the city of Amol, 69 km from Tehran province</td>
</tr>
<tr>
<td>Geomorphology</td>
<td>Melt snow from the above pit</td>
</tr>
<tr>
<td>Dominant processes</td>
<td>Emission of sulfur gas</td>
</tr>
<tr>
<td>Age</td>
<td>Present age</td>
</tr>
<tr>
<td>Lithology</td>
<td>Andesite to basaltic volcanics</td>
</tr>
<tr>
<td>The Main form</td>
<td>Qta</td>
</tr>
<tr>
<td>Adjacent formations</td>
<td>Q1 and Ji</td>
</tr>
<tr>
<td>Tourism</td>
<td>Regional, national, and international value</td>
</tr>
<tr>
<td>Importance</td>
<td>Haraz Road</td>
</tr>
<tr>
<td>How to Access</td>
<td>No facilities</td>
</tr>
<tr>
<td>Tourist services</td>
<td>Mineral mining and beekeeping</td>
</tr>
<tr>
<td>Surrounding land use</td>
<td>Ecotourism, hydrology, geology, geomorphology</td>
</tr>
<tr>
<td>Tourist tendency</td>
<td>To introduce people to its geomorphologic phenomenon along with adventure tourism</td>
</tr>
</tbody>
</table>
### Table 4. Shahandasht Waterfall: Geomorphological landform identification table

<table>
<thead>
<tr>
<th>Location</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative position</td>
<td>Located in Shahandasht Village, near Gazanak of Amol</td>
</tr>
<tr>
<td>Mathematical situations</td>
<td>35°55’26” north latitude and 52°15’60” east longitude</td>
</tr>
<tr>
<td>The nearest population center</td>
<td>Shahandasht Village</td>
</tr>
<tr>
<td>Distance from the center of the city</td>
<td>100 km northeast of Tehran province; 65 km from the city of Amol</td>
</tr>
<tr>
<td><strong>Geomorphology</strong></td>
<td>High physical erosion (water erosion) and weathering</td>
</tr>
<tr>
<td>Landform genesis</td>
<td>High erosion</td>
</tr>
<tr>
<td>Dominant processes</td>
<td>Present age</td>
</tr>
<tr>
<td>Age</td>
<td>Dark gray shale and sandstone</td>
</tr>
<tr>
<td>Lithology</td>
<td>Qal</td>
</tr>
<tr>
<td>The Main form</td>
<td>TR3&lt;sup&gt;IS&lt;/sup&gt;, Q&lt;sup&gt;2&lt;/sup&gt;, Qtu and Qs</td>
</tr>
<tr>
<td>Adjacent formations</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5. Larijan Spa: Geomorphological landform identification table

<table>
<thead>
<tr>
<th>Location</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative position</td>
<td>Southeastern slope of mount Damavand, near Gazanak of Amol</td>
</tr>
<tr>
<td>Mathematical situations</td>
<td>35°54’36” north latitude and 52°11’18” east longitude</td>
</tr>
<tr>
<td>The nearest population center</td>
<td>Abe Garm Village</td>
</tr>
<tr>
<td>Distance from the center of the city</td>
<td>60 km northeast of Tehran Province; 26 km northeast of Damavand City</td>
</tr>
<tr>
<td><strong>Geomorphology</strong></td>
<td>Tectonic activity and underground water from the gap of basaltic and</td>
</tr>
<tr>
<td>Landform genesis</td>
<td>andesite rocks</td>
</tr>
<tr>
<td>Dominant processes</td>
<td>Hydrogeochemical processes</td>
</tr>
<tr>
<td>Age</td>
<td>Quaternary</td>
</tr>
<tr>
<td>Lithology</td>
<td>Andesite and basaltic volcanics</td>
</tr>
<tr>
<td>The Main form</td>
<td>TR3&lt;sup&gt;IS&lt;/sup&gt;, JI, Qal, Qtu and Qs</td>
</tr>
<tr>
<td>Adjacent formations</td>
<td></td>
</tr>
</tbody>
</table>

### Tourism

| Importance                                   | Having both regional and national values                              |
| How to Access                                | Haraz Road                                                           |
| Tourist services                             | Infrastructure facilities like paved roads, water, accommodation, and |
| Surrounding land use                         | Gardens plus agricultural and residential areas                     |

### Tourist tendency

| Scientific-educational                       | Geology, biological studies, lithology, hydrology, and archeology   |
| Public                                      | To introduce people to its geomorphologic phenomenon, ecotourism, and |
|                                             | rural tourism                                                        |

| Tourism                                      |                                                                       |
| Importance                                   |                                                                       |
| How to Access                                |                                                                       |
| Tourist services                             |                                                                       |
| Surrounding land use                         |                                                                       |

| Scientific-educational                       |                                                                       |
| Public                                      |                                                                       |

387
Table 6. Deryouk Rock Waterfall: Geomorphological landform identification table

| Location | 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 | Q1 |
| Adjacent formations | Qal, Jk, K1v, Ji, Q1, TRe2 and TR3b |

**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. When 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

<table>
<thead>
<tr>
<th>Scientific Value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sites/ Values</strong></td>
<td></td>
</tr>
<tr>
<td>The Mount Damavand</td>
<td>1</td>
</tr>
<tr>
<td>The Damavand icefall</td>
<td>1</td>
</tr>
<tr>
<td>The Shahandasht waterfall</td>
<td>1</td>
</tr>
<tr>
<td>The Larijan spa</td>
<td>0.75</td>
</tr>
<tr>
<td>The Deryouk rock waterfall</td>
<td>0.75</td>
</tr>
<tr>
<td><strong>Ecological interest</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Integrity</strong></td>
<td>0.75</td>
</tr>
<tr>
<td><strong>Rarity</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Area[ %]</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Ecological interest</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenic Value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sites/ Values</strong></td>
<td></td>
</tr>
<tr>
<td>The Mount Damavand</td>
<td>1</td>
</tr>
<tr>
<td>The Damavand icefall</td>
<td>0.5</td>
</tr>
<tr>
<td>The Shahandasht waterfall</td>
<td>0.75</td>
</tr>
<tr>
<td>The Larijan spa</td>
<td>0.5</td>
</tr>
<tr>
<td>The Deryouk rock waterfall</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Number of view points</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Distance to view points</strong></td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Surface</strong></td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Elevation</strong></td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Colour contrast with site surroundings</strong></td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cultural Value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sites/ Values</strong></td>
<td></td>
</tr>
<tr>
<td>The Mount Damavand</td>
<td>1</td>
</tr>
<tr>
<td>The Damavand icefall</td>
<td>0</td>
</tr>
<tr>
<td>The Shahandasht waterfall</td>
<td>0.75</td>
</tr>
<tr>
<td>The Larijan spa</td>
<td>0.5</td>
</tr>
<tr>
<td>The Deryouk rock waterfall</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Cultural and historical</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Iconographic representations</strong></td>
<td>0.75</td>
</tr>
<tr>
<td><strong>Historical and archaecological</strong></td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Religious</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Art and cultural</strong></td>
<td>0.33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economic Value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sites/ Values</strong></td>
<td></td>
</tr>
<tr>
<td>The Mount Damavand</td>
<td>0.75</td>
</tr>
<tr>
<td>The Damavand icefall</td>
<td>0</td>
</tr>
<tr>
<td>The Shahandasht waterfall</td>
<td>0.5</td>
</tr>
<tr>
<td>The Larijan spa</td>
<td>0.5</td>
</tr>
<tr>
<td>The Deryouk rock waterfall</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>0.75</td>
</tr>
<tr>
<td><strong>Natural hazards</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Annual number of Visitors</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Official level of protection</strong></td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Attraction</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.4</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Degree of exploitation</th>
<th>Total</th>
<th>Daily Occupancy</th>
<th>Seasonal Occupancy</th>
<th>Number of infrastructure</th>
<th>Used Surface[ha]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount Damavand</td>
<td>0.68</td>
<td>0.5</td>
<td>0.5</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>Damavand Icefall</td>
<td>0.18</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>0.25</td>
</tr>
<tr>
<td>Shahandasht waterfall</td>
<td>0.5</td>
<td>1</td>
<td>1</td>
<td>0.75</td>
<td>0.25</td>
</tr>
<tr>
<td>Larijan spa</td>
<td>0.43</td>
<td>0.75</td>
<td>0.5</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Deryouk rock waterfall</td>
<td>0.43</td>
<td>0.75</td>
<td>0.5</td>
<td>0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modality of exploitation</th>
<th>Total</th>
<th>Economic</th>
<th>Cultural</th>
<th>Scientific</th>
<th>Scenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount Damavand</td>
<td>0.75</td>
<td>0.25</td>
<td>0.75</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Damavand Icefall</td>
<td>0.43</td>
<td>0.25</td>
<td>0.5</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Shahandasht waterfall</td>
<td>0.62</td>
<td>0.25</td>
<td>0.5</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Larijan spa</td>
<td>0.56</td>
<td>0.75</td>
<td>0.25</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Deryouk rock waterfall</td>
<td>0.5</td>
<td>0.5</td>
<td>0.25</td>
<td>0.75</td>
<td>0.75</td>
</tr>
</tbody>
</table>
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, followed 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

<table>
<thead>
<tr>
<th>Values</th>
<th>Average values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific</td>
<td>0/76</td>
</tr>
<tr>
<td>Scenic</td>
<td>0/65</td>
</tr>
<tr>
<td>Cultural</td>
<td>0/25</td>
</tr>
<tr>
<td>Economic</td>
<td>0/42</td>
</tr>
<tr>
<td>Tourism value</td>
<td>0/52</td>
</tr>
<tr>
<td>Exploitation Degree</td>
<td>0/53</td>
</tr>
<tr>
<td>Exploitation Quality</td>
<td>0/57</td>
</tr>
<tr>
<td>Exploitation value</td>
<td>0/55</td>
</tr>
</tbody>
</table>
Amiri, M. J et al.

**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 occur), 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


Amiri, M. J et al.


