

# Investigating the geotouristic risks of spa springs with emphasis on natural and human dangers in the study area between Sarein and Ardebil in the northwest of Iran

Mehdi Feyzolahpour\*, Jamshid Einali, Hassan Gasemlu

Department of Geography, University of Zanjan, Iran

\* Corresponding author: feyzolahpour@znu.ac.ir

## ABSTRACT

Geotourism and geoparks provide good opportunities for rural development and reduce unemployment and migration. It attracts local communities for employment in geoparks and tourism marketing in the form of investments in ecotourism, rural tourism and health geotourism. Geotourism is closely related to the geology of treatment. One of these is the spa spring that has the therapeutic potential and plays a significant role in attracting domestic and foreign tourists. For this purpose the status of 11 hot springs in the geographical range between Ardabil city and Sarein city has been investigated in terms of parameters such as discharge, temperature, pH and anions and cations. However, this geographical area also has a number of natural and human hazards the most important of which is the occurrence of killing earthquakes. The earthquake of February 28, 1997 killed nearly 1000 people and destroyed many villages. The presence of spa springs on or near the faults and the establishment of recreational facilities in the area have threatened investment in the area. In this regard the status of clay, silt and sand percentage, Liquefaction Limit and Plasticity PI index in the study area were studied. It was observed that if in clay formations the amount of dough is about 40 to 50 percent and soil moisture reaches 25 to 35 percent there is a possibility of demolition of buildings and asphalt. According to the results of soil physics analysis, Sarein city is susceptible to soil infiltration and liquefaction during earthquake. In the final section the sanitary condition of the pools was investigated in terms of the possibility of dermatophyte fungi and 284 samples were examined. It was observed that due to the complete disinfection of pools with chlorine no dermatophytes were observed.

## KEYWORDS

spa springs; earthquake; dermatophytes; geotourism; Sarein tourist area

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### 1. Introduction

The growing population of the world especially in developing countries, economic poverty and the low level of national income of the countries has caused the population of these countries to be in a state of economic strain. In examining the causes of these countries' retardation it was found out that despite the availability of natural resources and the of potential income sources they have accepted poverty and deprivation and in fact low levels of knowledge and technology and lack of awareness of how to exploit existing potential has increased the problems. One of the sources that can greatly increase revenues in the current era and by increasing GDP increase income on the international scene is the tourism industry, especially ecotourism which is a good source of revenue for most of the countries in the world. So now the income from tourism and ecotourism in countries like France, Spain, China and Germany is more than the national income in some of the underdeveloped countries. On the other hand the tourism industry will have problems for each region without careful planning and attention to ecological, local, cultural and social capabilities. In fact, the planned and perfect tourism system will advance to the proper use of the environment and various environmental, cultural, historical and similar resources in the region (Edgell et al. 2008). And this shows the position of strategic planning for the sustainable use of tourism resources especially ecotourism. Among many studies that

have been done to develop ecotourism development strategies Johansen and Williams have been studying ecotourism development in a national South African wetland park (Johansen and Williams 2008).

In recent years researchers have dealt with many different aspects of ecotourism including Weaver and Lawton's article on ecological, economic, cultural and social effects of ecotourism and methods of quality control as well as ethics in it (Weaver and Lawton 2007). Jaafar and Maideen also study ecotourism products and services provided in four islands in Malaysia and issues related to the economic sustainability of small and medium-sized huts in these areas (Jaafar and Maideen 2012). Ecotourism encompasses a wide range of nature-based tourism activities. Examples include visiting national parks and protected areas, pristine natural areas, watching birds, circulating in natural environments, hiking, mountain climbing, visiting natural caves, studying plants and animals and ecological exploitation. This part of ecotourism is the interface between ecotourism and geotourism. In 1992 at the United Nations Conference on Environment and Development in Rio de Janeiro in command 21 geotourism was referred to and today is recognized as an appropriate tool for sustainable development. Undoubtedly the importance of geotourism is to emphasize a kind of holistic management perspective in areas such as the history of geological phenomena, ecosystems, land use, natural tourism and environmental education and sustainability (Kim et al. 2008). As a new option geotourism emphasizes

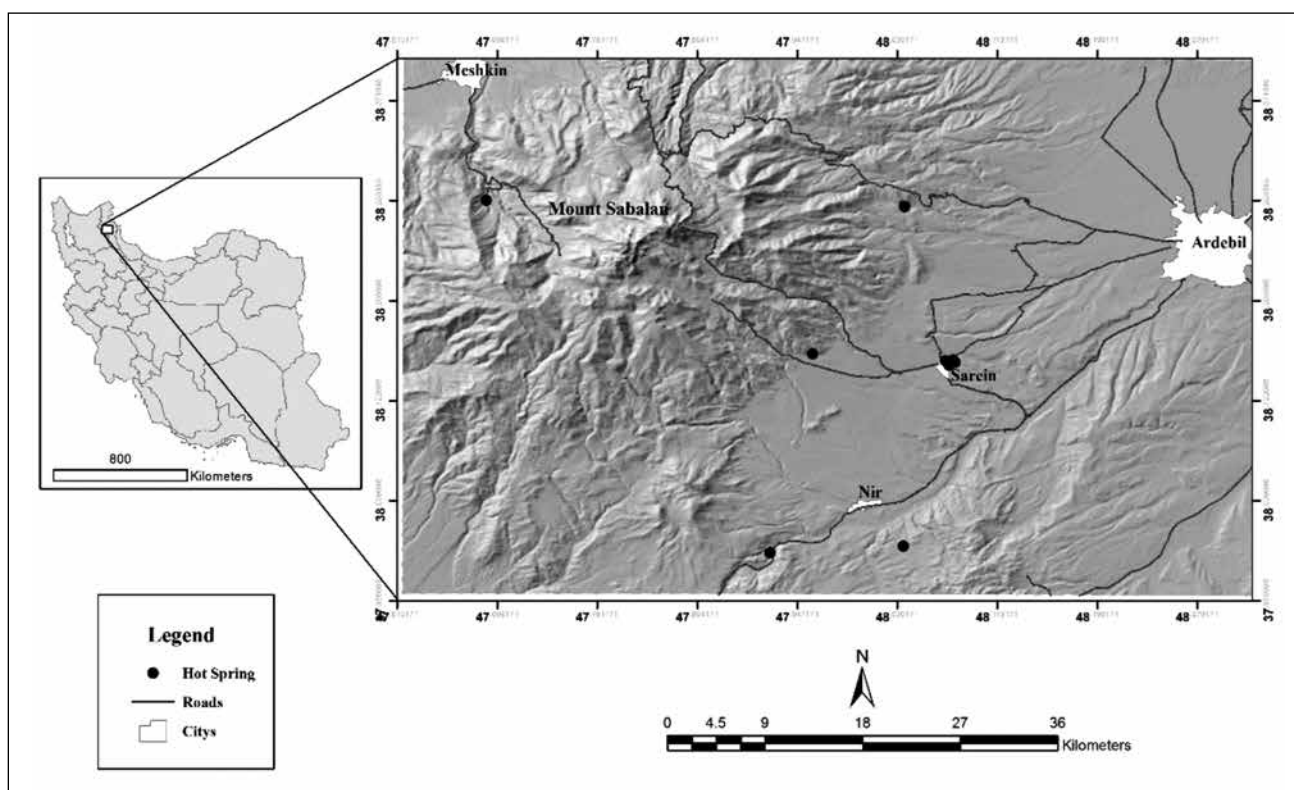


Fig. 1 Location of the study area in terms of location of hot springs.

not only all human and natural characteristics but also the function of each location. This form of tourism can play an important role in national development and diversification of the regional economy through planning based on the recognition of opportunities and limitations of geotourism. Geotourism is a form of cultural and environmental tourism that can be developed in the region with important geological works and is based on the preservation and expansion of the geological heritage that has enjoyed great growth in the world. It is expected that by the next decades the number of nature travellers which now accounts for 7 percent of the total number of travellers in the world will reach more than 20 percent. In 1977 in the UNESCO Earth Sciences Department the geopark program was officially launched (Zouros 2004). Panizza and Piacente (1993) refer to geomorphology as geomorphic assets in their research. Carton (1994) has studied geomorphology and geomorphologic processes that refer to geomorphologic locations as geomorphologic commodities. Hooke (1994) developed strategies to maintain and sustain the dynamics of geomorphologic sites. Grandgirard (1997) worked on the site conservation and geomorphology in his Ph.D. thesis and referred to the geosites as geosciences in his research.

As a region located in the desert and mountainous belt, Iran has special geological and geomorphological conditions. On the other hand, in different geological

periods much of Iran was influenced by Paleozoic orogenic movements such as Caledonian and Hercynian before the Mesozoic era such as Laramide and the Cenozoic period such Pyrenean, Savian and Pasadenian which resulted in the rise of Iran. These geological movements have caused volcanic activity in the third period especially during the Eocene period and during the Quaternary period. This has led to the formation and activation of volcanoes in Iran. In some parts of the country karst and calcareous structures were established which resulted in the distribution of various caves in Iran. Glacial forms formed during the Pleistocene can be found in the northern, northwestern and western parts of Iran.

One of the issues that is encountered in the tourist attractions especially geotourism is the topic of hot springs which have been scattered in different parts of Iran and have been considered for its therapeutic efficacy. With more than 113 mineral water springs of good quality Iran can be one of the hotspots for tourist with natural landscapes and therapeutic applications but practically did not succeed in doing so. Investigation and recognition of mineral waters in Iran began in the second half of the 19th century by foreign tourists and foreign scientific delegations and tested on a number of mineral springs and their properties. In 1928 the first mineral spring was used in the north east of Tehran. In 1949 according to a plan by the Plan and Budget Organization the study of

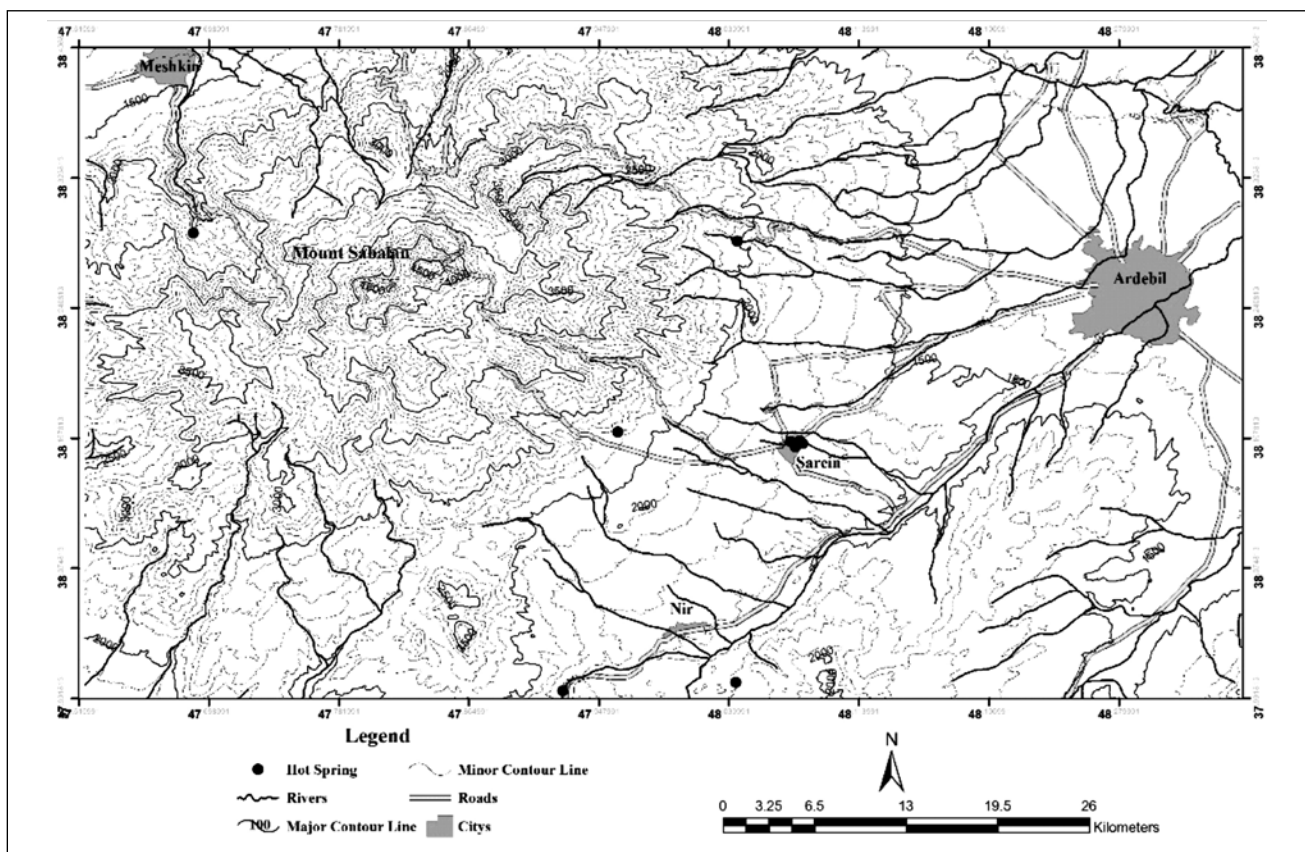


Fig. 2 Topography of the studied area.

the mineral waters of Mahallat and Ardebil was carried out. Determination of the mineral properties of Iran's mineral waters was initiated in 1961 by a team of hydrology from the Faculty of Pharmacy at the University of Tehran and continued until 1969 in which the physical, chemical and microbiological properties of many mineral springs were identified. It is worth noting that these studies have been ongoing and have resulted in the identification and investigation of about 350 mineral water springs in 40 regions of Iran.

Considering the scientific evidence of the therapeutic uses of springs on the one hand and the existence of hundreds of hot mineral springs in the geographical range of Iran on the other hand it is possible to plan and manage efficiently within the tourism industry in addition to the goals of spending leisure time using health applications.

The city of Sarein has become a geotouristic attraction due to the presence of hot springs. The presence of these conditions has attracted a lot of investment in the city and has produced significant positive and negative effects. Therefore, in this research the upcoming risks in the development of the city and tourist centers were examined. Due to the earthquake in the city of Sarein, the dispersion of faults in the area and their relationship with recreational units was discussed. In the biological survey the health status and pathogenicity of the hot springs pools are addressed. The probable germs in these pools were examined.

## 2. The study region

Sarein Tourist City is located in the south-east of the famous volcanic heights of Sabalan (4811 m) (Fig. 1). The western part of the city is located at higher altitudes than other areas due to its exposure to the Sabalan slopes. The eastern part of the city is located in a deeper region and hot springs are located especially in this area. The formation of Sarein city is completely in line with the natural environmental phenomenon.

The presence of highlands in the northwest and the alluvial valley in the east and faults in the city limits and its edges as well as the passage of the river from the city center completely affected the city's geomorphology. The peripheral lands of Sarein city are devoted to agricultural lands surrounded by pastures. Wasteland of about 84.5 hectares in the city of Sarein until 2005 accounting for 34.7% of the continuous urban texture has recently reached about 60.8 hectares. Considering the rapid development of the city it is expected that in the not-so-distant future of Sarein there will be plenty of uneven topographic levels at the surface of the Sabalan range. The general slope of the city of Sarein is in accordance with the state of the northwestern and southwest land.

The city is located at variable topographic levels between the 1640 m high and 1740 m elevation with an area of 430.36 hectares in the eastern slopes of the

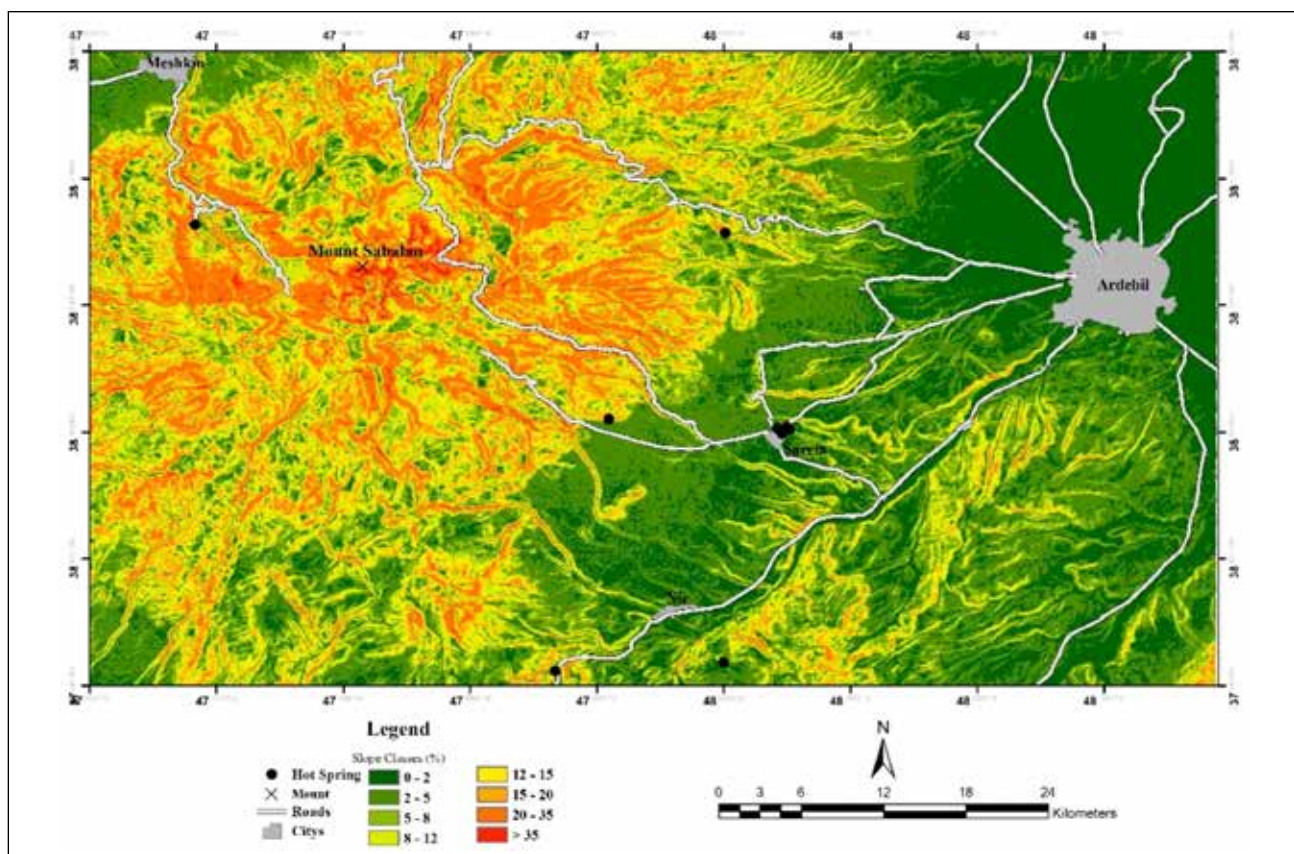


Fig. 3 Slope values of the study area.

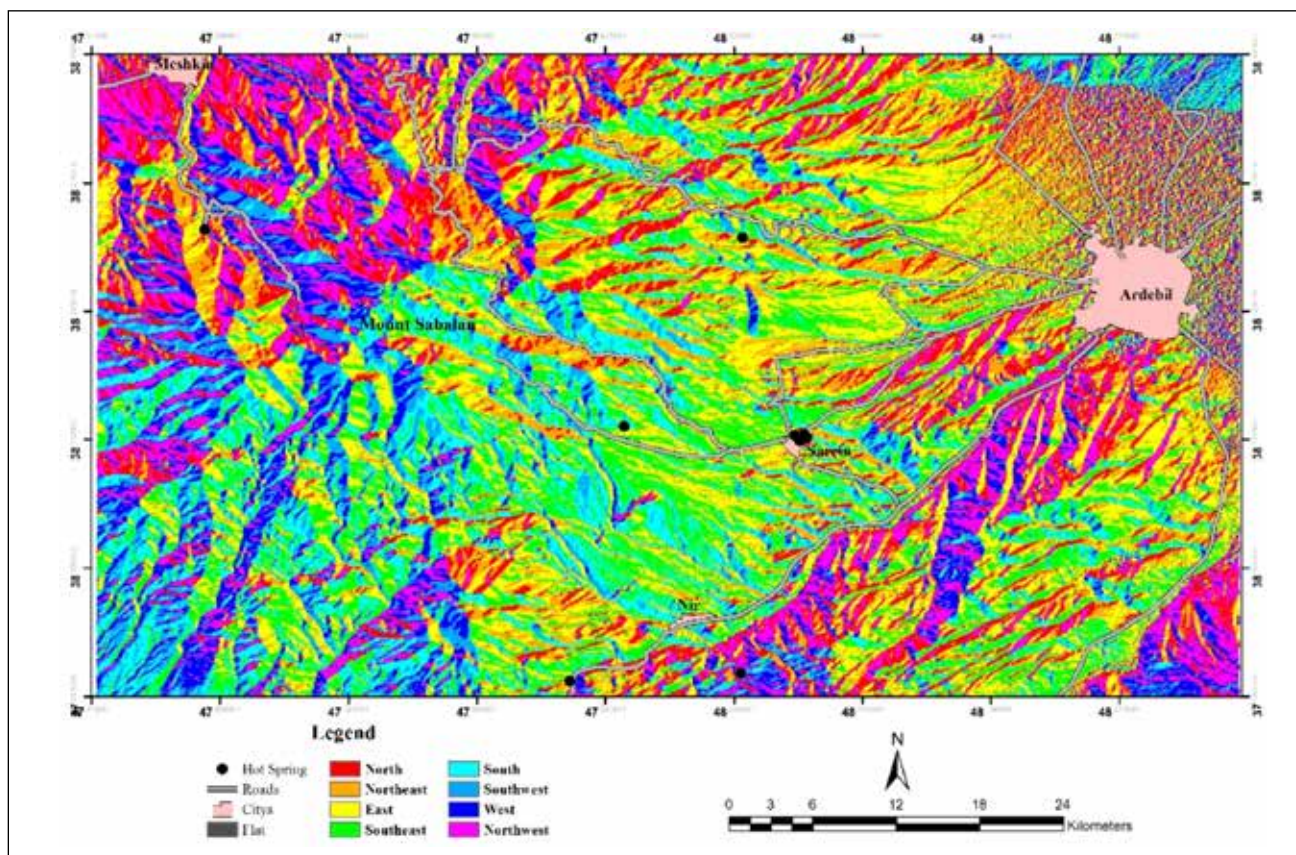


Fig. 4 Slope direction of the study area.

Sabalan Highlands. Therefore, the future expansion of the city to the east and north will be associated with many hydro-geomorphological problems because in the northern part the topographic condition is intensified in terms of the gradient and intensity of the earth's roughness. Parts of the north, northeastern and southwest of the city are developing at steep slopes which are not suitable for physical development of the city.

The tourist attractions of the studied area are important in comparison with tourist attractions in the world from a number of points. This study area is located in the southwest of the world's largest lake

(the Caspian Sea). In the very short distances there are two types of seaside and mountainous climates which has caused 3 outlooks of the sea, forests and mountains. In terms of natural landscape and natural morphology it is comparable to that of Switzerland. The importance of tourism in this area compared to the tourist areas of the world can be better understood when we consider that in one day it is possible to visit and use the tourist attractions and ecotourism features such as mineral water springs, ski resort, volcanic views, forest and mountain views (Estelaji et al. 2011).

Tab. 1 Physical and chemical status of the springs.

Title of springs	Discharge (m/s)	Water Temperature in °C	PH	Anion	Cation
Eyes-Water Spa Spring	0.2	21	5.2	HCO <sub>3</sub>	Ca
Hot springs of Hemmat Ardebil Coffee House	2	40.5	9	HCO <sub>3</sub> , Cl	Na, Ca
Artemis Momtaz Coffee House hot springe	2	47	6.1	HCO <sub>3</sub> , Cl	Na
Five Sisters Springe (Besh Bajjilar) Ardebil	3	35	5.9	HCO <sub>3</sub> , Cl	Na, Ca
Seven Blocks Spring	2	20	5.3	SO	Ca
Boshli Spring	2	49	6.9	HCO <sub>3</sub> , Cl	Na, Ca
Ghinarech spring	4	65	6.1	HCO <sub>3</sub> , Cl	Na, Ca
Isti Su Spring	1.5	42	5.7	HCO <sub>3</sub> , Cl	Na, Ca
Ilanjigh Spring	1	49	6.2	HCO <sub>3</sub>	K, Na, Ca
Springe Dip Siz Gol	2	30	6.3	HCO <sub>3</sub>	Na, Ca
Saghezchi Spring	1	39	5.8	HCO <sub>3</sub> , Cl	Na, Ca

One of the existing capacities in the Sarein geotouristic zone is the existence of many hot and mineral water springs in this area, described by Rashidi et al. (2012). (Table 1) Due to the therapeutic capability and geotouristic attractions some of these hot springs can be considered as an international pole.

### 3. Methodology

The two issues of natural hazards such as earthquakes, and the health and biological hazards were examined in the analysis of the hazards in this region. The geology of Sarein should be considered to analyze natural hazards by emphasizing on the earthquake. The surface formations of the region were first examined in terms of soil thickness and the capillary ascent of water. The soil liquefaction limit was determined in soil formations to explore the vulnerability to earthquake. Results of the study conducted by Abedini (2013) were used to meet this objective. The fluidity limit in formations was determined by sampling three areas of Sarein. Thus, the percentage of clay, sand, silt, liquefaction limit and plasticity PI index were measured using the granulometric results (Abedini 2013).

Also, the status of formations of the area in terms of proximity to the Sabalan volcano was studied to determine the resistance or instability of the area in earthquakes. In addition to the above cases, it was necessary to identify the faults and their positions in the region. Therefore, the position of the faults from Sarein was determined. The conditions of the town before and after the severe earthquake on February 28, 1997 were considered. In all these stages, the conditions of the hot springs were examined according to these parameters. The risks related to the biological agents in the hot springs of Sarein were identified in the second stage. Therefore, the fungal infections were emphasized. The results of Seyedmousavi et al. (2007) were used in relation to fungal infections. 284 samples were collected from 11 hot spring springs to find the type of microbes. Samples of fungi and bacteria were identified in them. It was tried to create

a relationship between the dispersion of fungi and bacteria in spas. In this regard, the dermatophyte was highly considered.

## 4. Results

### 4.1 Natural hazards in the geotouristic region of Sarein city

The current range of the Sarein city considering the slope is composed of rocks, clay, marl and igneous projectiles. The depth of the soils in the city's boundaries and its margins extend from the semi-deep erosion of coarse grains in the northwestern part of the city to relatively deep gravel in its low-slope lands in the south and south-east of the valley. In the current headquarters of the city not only two faults are distinguishable from the east to the west and from the north to the south but the Sabalan semi-volcanic volcanoes (in the tectonic active hydrothermal stage) are located in the east. Surface formation in the area showed that the soils of low-gradient areas (range 3–5%) were of heavy texture (51.45% clay texture). In terms of thickness the soils of the eastern and southeastern part of the city are semi-deep and deep. Water climbing especially freezing climb upward damages roads and pavements in Sarein city as well as the foundation of structures. Soils that are capable of expansion are swollen or as a result of freezing and increasing volume the floor of the building and the surfaces of the asphalt are swelling. Nevertheless, the city boundaries are located on the path to the fault valley and on relatively deep-sea alluvial deposits. Therefore, in this fine-grained form with surface and permeating waters design issues and robust materials will arised. Deepening of the ground and the use of robust anti-earthquake materials for large structures and maintaining the water level with the principles of drainage is necessary. Due to the high ductility pattern in fine-grained urban formations the potential for swelling of structures in the region is mostly moderate to higher-moderate (Table 2). The successive rise of moisture levels in the wet seasons of the year will lead to inflation and fluidization in the surface

**Tab. 2** Location of harvesting samples, granulometric results for determination of tissue texture and ductile tolerance (Abedini 2013).

Plasticity PI index	Liquefaction Limit	Percent of Silt	Percent of Sand	Percent of Clay	Sample collection site
33.32	35.30	26.4	30.3	43	South entrance
42.23	38.22	25.32	22.25	51.45	Eastern regions along the valley of the city limits
34.6	31.22	23.5	43.42	34.35	North slopes

**Tab. 3** Ductility Symbol and Potential of Inflation (Abedini 2013).

Liquefaction Limit	0–10	10–20	20–35	More than 35
Plasticity PI index	Little	Average	A lot	Too much



**Fig. 5** A view of a lake located on the Kaldera Mountain of the volcano Sabalan.

formations of fine-grained clay and in the long run will destroy the base of the buildings. In places where discontinuous materials can saturate with water they can create fluidity. In gradient and hilling area of Sarein, high rainfall, high relative humidity and the number of freezing days (145 days per year) the presence of deep and fairly deep surface formations makes it very probable that soil leakage occurs during earthquake. An earthquake with a magnitude of 5 is a limiting threshold for soil leakage and lateral expansion of soil formations and in an earthquake with a magnitude 6.5 causes mass movement, avalanches and severe earth avalanches. Abedini (2013) declares the fluid level of the texture of the formations in the three sample areas in Sarein as follows:

In clay formations if the amount of dough is about 40 to 50 percent and the soil moisture content reaches 25 to 35 percent it is possible to destroy the building and the asphalt. According to the results of soil physics analysis Sarein city is susceptible to soil swelling and fluidization during earthquake. In the meantime, the lithological and tectonic conditions of the area should also be investigated. The lithological resistance of geological and surface formations depends on the type, shape, color, manner of mineralization, moisture percentage, weathering and tectonization. A wide area of the region consists of periodic layers of green tuff, marl and freshwater lime cobblestone and lava stone. In the northern and northeastern parts of villages and volcanic villages this formation consists of Andesi stone, basalt and trachy basalt. Lithologically these formations are mostly semi-resistant formations. The major geological phenomenon in this area is the Mount Sabalan volcano. It is the result of volcanic activity of the central type and its eruption mechanism is similar to the Italian Stromboli volcano. Volcanic activity of the upper Sabalan is based on volcanic and sedimentary bases of Eocene with an average altitude of 2700 m. The length of this volcanic mass is about 60 km and its width are about 45 km. The main crankcase of this volcanic mountain

is a funnel-shaped hollow. In the summertime as a result of melting of the snow a lake is formed inside this slope.

Sabalan lava flows out in several stages and covers a total surface of 1200 square kilometers. Sabalan's early activities were related to Eocene. But its current cones are due to the subsequent steps in the Pliocene and Quaternary respectively. Sabalan caldera appears to have been created in the second phase of activity in Pliocene. One of the most noticeable side effects associated with magmatic activity is the large spread of mudflows in Sabalan's northern pine forests. These drains result from the combination of volcanic ash with melting water in the cold period. Apparently in Würm glaciation and during the formation of glacial masses in Sabalan its explosive activity was also started. Volcanic activity has melt the glaciers and the water from the melting ice is also smeared with volcanic ash and brought them into mudflows. These masses eventually moved along mud floods along the valleys and pushed to the surface of the plains leading to Meshkinshahr and Ardabil. Conglomerates, lahar, tuffs and volcanic gray formations located in the north and east of Sarein city are also related to the early Quaternary. Lithologically these formations are mostly resistant to semi-resistant. Part of the Sarein area is formed by the material of the alluvial terraces that extends almost in the margins of the western and southwest streams of Sarein and the villages of this area.

The residential areas of the study area are often located on these formations. The thickness of this unit is more than 400 meters and spread from Sarein to the south and south-east of the region. Lithologically these formations are insufficient and semi-resistant. Therefore these structures are risky when earthquakes occur. The most significant potential hazard of these steep slopes will be the occurrence of slip and creep on soft and loose tuffs in the Sarin area. The slip on steep slopes causes a heterogeneous alignment or movement of the pillars and separation of the building from the ground. Liquefaction in saturated sandy soils leads to tilting and collapsing of buildings.

In total the margin area of Sabalan volcanoes and Ardabil area in northwest of Iran have been reported with high potential of seismicity. Situated in the southern volcanic slopes of Sabalan it has also transformed it into a city with a potential earthquake hazard. Considering the seismic state of Iran and the vulnerability of cities to earthquakes one of the approaches taken by urban planners to deal with this phenomenon is addressing the issue of urban immunization and preventative measures to reduce the damage caused by the earthquake. In terms of fault structure, we can classify Sarein's range into three major faults:

The Balikhlichay fault is about 70 km from the northern lake of Ardebil and is covered by the southern Quaternary alluvium in the north-eastern plain of Ardebil and continues to Astar. One of the main

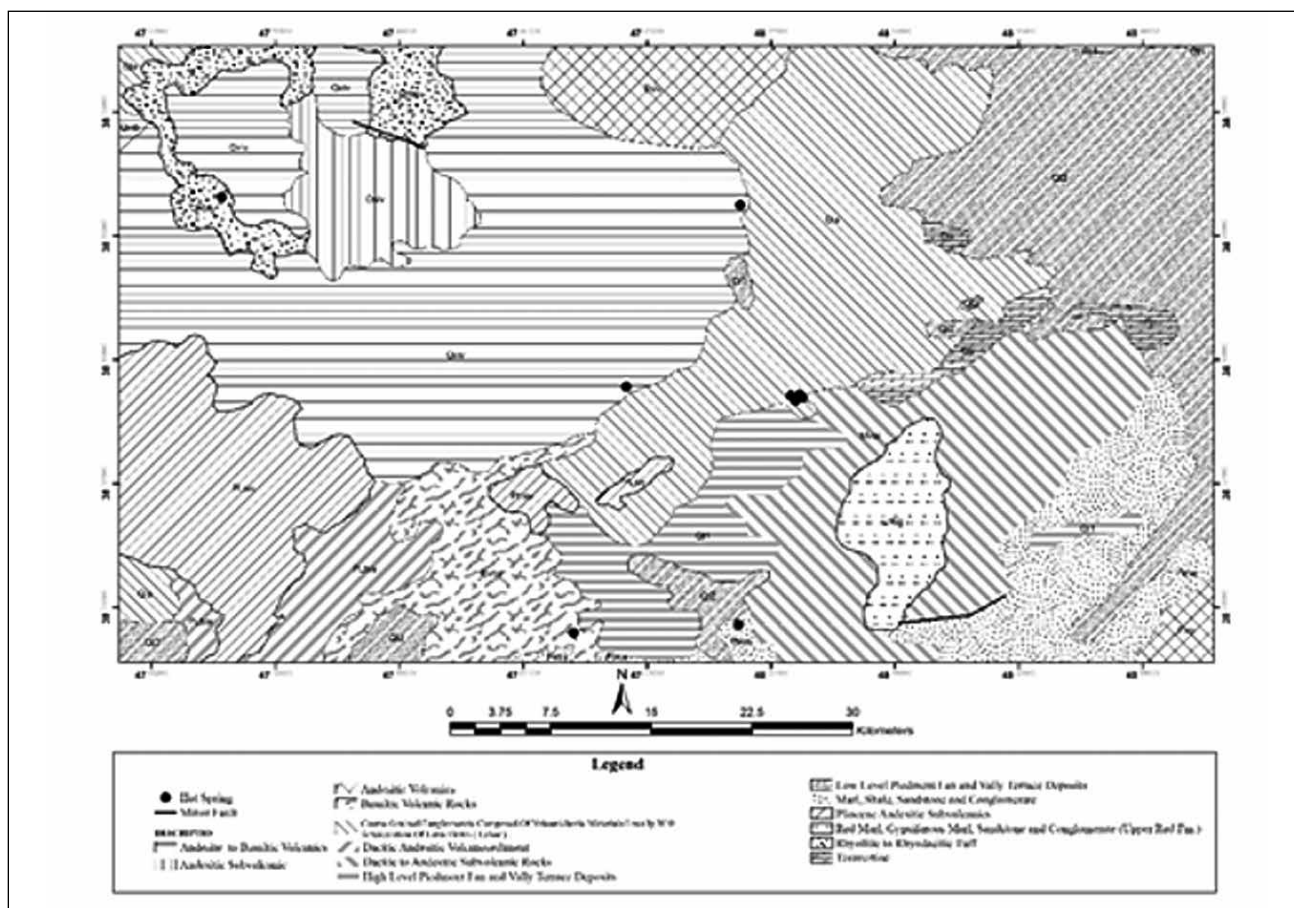


Fig. 6 Geological map of the study area with emphasis on the location of springs and faults.

signs of neo-terrestrial activity is the displacement of Miocene sediments and tilting of the Quaternary alluvium. A lot of spa springs run from the site of this active fault. The Alvares fault is 15 kilometers long with a northwest process extending south-east of the village of Alvares to Caldera in Sabalan. An important part of the Darwish river runs along this fault. Villadera fault begins with the northern and southern trend of the village of Sardabeh (north of Sarein city). A branch of it along the primary route is divided into two parts in the north of the city of Sarein; one branch of which passes through the city of Sarein and is again divided into two branches in the commercial area of the city. One branch ends in the village of Wind Kalakhoran and the other branch ends about 3–4 km from the city. Several spa springs have been formed along the Sarein fault. The location of the city of Sarein despite its adjacent active faults and faults in the city are highly threatened by tectonic and seismicity. Any displacement of these faults will result in earthquakes with destruction and damage to the city of Sarein. On the other hand with the onset of the earthquake the likelihood of blockage of hot water will be very high. By changing the direction of the springs practically some water treatments will be closed and the characteristics of the city’s tourist performance will be changed.

Ardebil province is located on five earthquake faults including Barghoosh in the western part of Ardebil highlands, Dasht Moghan fault in Parsabad, Ardabil fault along the northeast to the northwest of the province, Masooleh fault in the southeastern part of Khalkhal and Rudbar fault in Astara in Namin area. On February 28 1997 an earthquake of 6.1 magnitudes occurred at a depth of 15 km. The number of people killed was about 965 and the number of injured was estimated at 2600. In this earthquake about 36 000 people became homeless. Studies in the area indicate that the highest severity of the earthquake is located in southeastern Sabalan and the greatest damage was reported in villages Golestan and Shiran. The magnitude of the high aftershocks occurred a few days after the main shake causing more damages and the collapse of buildings that damaged in the main shock and caused significant damages to the city of Sarein. Field observations after the earthquake showed that gradient thickness and sediment type had a significant effect on the severity of degradation. In the region the landslide phenomenon has not been significantly influenced by the slope due to the low slope during the earthquake. In the event of an earthquake rural houses were mostly made of inadequate material of poor quality mud. Such buildings have been completely destroyed in areas close to the earthquake site and



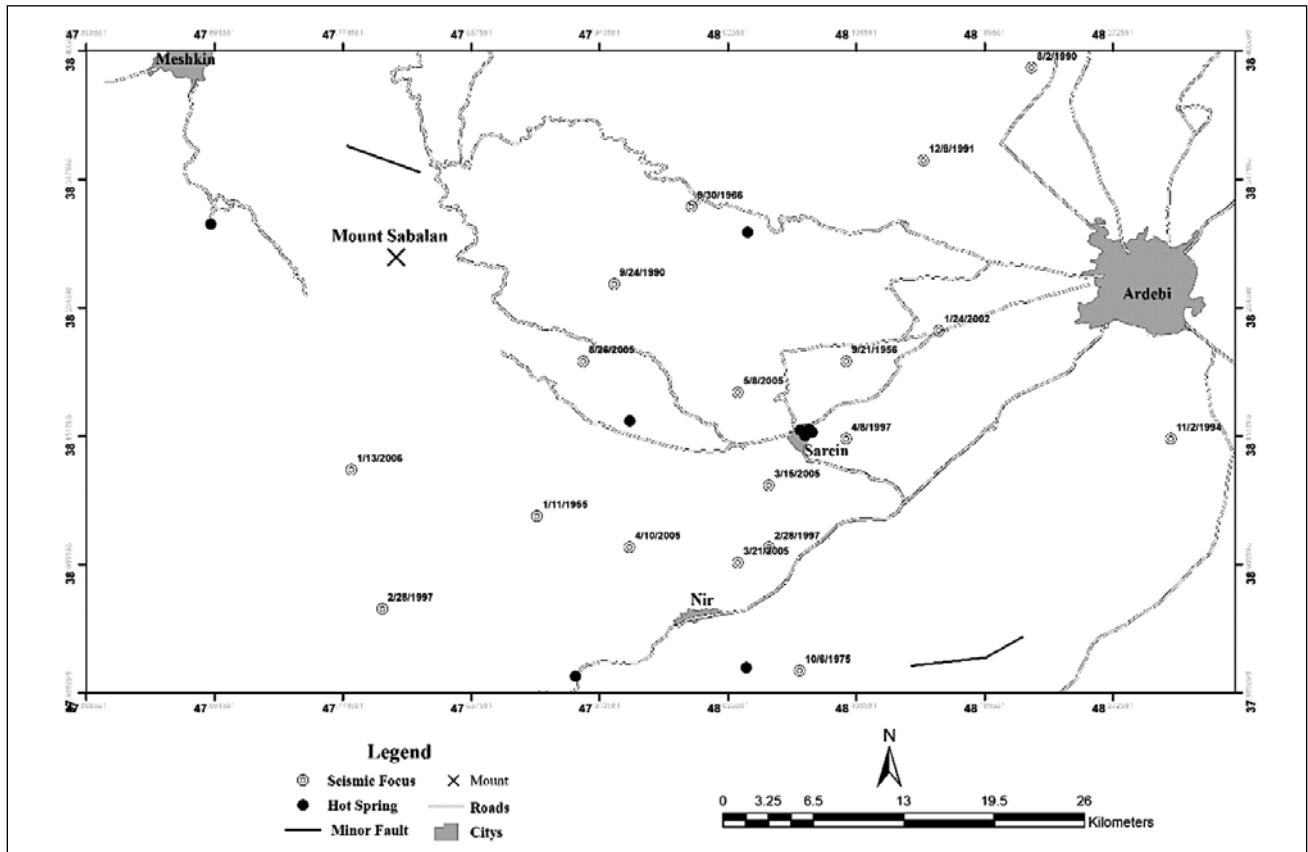


Fig. 7 Map of earthquake occurrence and location of springs in the studied area.



Fig. 8 An overview of the earthquake that occurred in 1997 in Sarein.



Fig. 9 An overview of the earthquake that occurred in 1997 in Sarein.

have been found to be deep-seated cracking in the distant regions and their local downturns. In most of the urban residential houses and some of the rural buildings except brick buildings the technical notes of the earthquake code were observed. The damage to such buildings has been less than that of mud-made houses. A few brick buildings were also found in nearby areas of the earthquake which due to non-observance of some technical points only suffered minor damage. The one that increased the depth of the disaster and increased the death toll was a severe snowfall at night of the earthquake and wolf attacks on the injured.

In spite of the severe earthquake and significant human damages within 20 years after the February 28,

1997 earthquake the city of Sarein has grown rapidly due to its natural attractions and has become one of the attractions of the Middle East and has witnessed rapid development. In this period mountaineering camps, ski resorts, spa pools and cable cars have been developed.

Another factor that threatens the city of Serein is the downfall of the earth. Earth subsidence is exacerbated in both cases naturally and sometimes also by the interference of humans on the earth and is an environmental hazard for urban construction. The center of the city is located from east to the west parallel to the fault valley. Today more than 10 to 15 floors of towers and modern hotels are rapidly expanding



**Fig. 10** Growth and development of the city of Sarein after the earthquake of February 28, 1997. It is clearly seen in the image the Sabalan volcano that dominates the city and its construction.



**Fig. 11** Another view of construction in the city of Sarein after the 1997 earthquake.

in the active tectonic zone. The core of the city is the location of fault division. In addition, the main stream along the fault line has been adapted. The site of the buried volcanic geological layers underneath the alluvial Quaternary alluvial deposits has created basis for formation of hot springs in the city. In the 1997 Ardabil earthquake by breaking part of the igneous section of the infrastructure hot water erupted in the middle of the city at an altitude of about 12 meters. It is expected that some earthquakes will dry up during earthquake due to physicochemical reactions within the earth or there may be created several hot water springs in the areas adjacent to them. So far after the start of huge and heavy construction the city of Sarein has not experienced a severe earthquake. An examination of all geological issues tectonics and hot water in the region indicates the instability of urban infrastructure.

According to Abedini (2013) most hot springs come out of the place and also adjacent places to faults. The existence of faults has led to the tectonic instability of the city lands. On the other hand the displacement of faults is one of the important factors in the gradual downsizing of the city on the path to the fault valley. The results of the sampling conducted by Abedini (2013) indicate a high percentage of clay (46%) silt (32%) and sand (25%). Therefore high presence of clay, high topographic slope and fault activity during earthquake could be risky. The higher the percentage of clay in the formations, the higher the amount of inflation, elasticity and fecundity. Continuous wetting of structures of foundation, chemical degradation, dissolution, decrease of internal resistance of materials and increase of shear stress cause bending, cracking the foundation and even falling it. Topographic and geological slopes with the high groundwater and hydrothermal velocities and trapping characteristics especially in low slopes and pits like the middle of the city play an important role in the risk-taking of structures. In the beginning the position of the city of Sarein was formed in relatively

flat topographic lands but gradually with the expansion of physical space the city occupied more lands and encountered many hydro geomorphological bottlenecks. Considering the above-mentioned cases in the event of an earthquake exceeding 5.5 magnitude the city will suffer great damage

#### 4.2 Analysis of hazards associated with biological agents in Sarein hot water springs

Given the increasing progress of human knowledge in controlling and eradicating fungal diseases including dermatophytosis in humans, the statistics still indicate that the disease is one of the most important health and therapeutic issues in the world and in Iran. Human fungal infections have increased considerably in recent years, one of the common causes of which is the increased exposure of people to the environment and public places infected with the transmission of disease to humans. The use of public places such as hot water pools is one of the ways in which superficial and cutaneous fungal infections spread to humans because they have a long life of up to 6 months (Rippon 1988).

Considering that to produce fungal skin disease other than the presence of pathogens in the environment other factors such as ambient temperature, relative humidity, age, occupation, living conditions and non-compliance with health standards are important for the development of fungal skin diseases (Rippon 1988) many researches and studies have been accomplished on the dermatophyte contamination in the environments and public places and their role in the transmission of the disease and how to prevent them in the world and in Iran.

In the study of pollutants in the southern barracks of the south of the country from 374 samples 90 cases (24.06%) of dermatophytes were isolated from the equipment and environment of the patients and 2 types of dermatophytes from one patient. They prove dermatophytes in sampling 7 bathrooms (63.63%) out of 11 baths (Emami et al. 1974).

**Tab. 4** Service and operation status of hot water pools in Sarein tourist city in the summer of 2005 (Seyedmousavi et al. 2007).

Pool number	Pool status																
	Private	Governmental	Half private	Indoor	Outdoors	Lending				Shower situation		Dressing room		Disinfection	Service type		
						Slippers	Towel	Swimming suit	Hat	There must be	It does not have to exist	Solo	Share		Masculine	Feminine	Mixed
Pool No. 1	-	-	*	-	-	-	-	-	-	-	*	-	*	*	*	*	-
Pool No. 2	-	-	*	-	-	-	-	-	-	-	*	-	*	*	-	-	*
Pool No. 3	-	-	*	-	*	*	-	-	-	*	-	*	-	*	-	*	-
Pool No. 4	-	-	*	-	*	*	-	-	-	*	-	*	-	*	*	-	-
Pool No. 5	-	-	*	*	-	-	-	-	-	*	-	-	-	*	-	-	-
Pool No. 6	-	-	-	*	-	-	-	-	-	*	-	-	-	*	-	-	*
Pool No. 7	-	-	*	-	*	-	-	-	-	-	*	-	-	*	-	-	*
Pool No. 8	-	-	*	*	-	-	-	-	-	-	*	-	-	*	-	-	*
Pool No. 9	-	-	*	-	*	-	-	-	-	-	*	-	-	*	-	-	*
Pool No. 10	-	-	*	*	-	-	-	-	-	-	*	-	-	*	-	-	-
Pool No. 11	-	-	*	-	*	*	-	-	-	*	-	-	-	*	-	-	-

**Tab. 5** Frequency distribution of fungi isolated from hot water pools of Sarein tourist city in summer 2005 according to type of pool (Seyedmousavi et al. 2007).

Title of Fungi	Pool number											Number of samples	Percentage
	1	2	3	4	5	6	7	8	9	10	11		
Aspergillus fumigatus	1	5	4	11	7	3	4	2	2	2	3	44	22.79
Aspergillus flavus	-	-	6	6	4	2	4	3	1	2	2	30	15.54
Aspergillus niger	2	3	2	5	5	4	3	1	3	2	-	30	15.54
SP penicillium	1	1	4	7	1	-	2	2	3	1	6	28	14.50
Mucor	-	1	2	1	1	-	2	-	-	-	1	8	4.14
Fusarium Oxysporum	-	-	1	1	1	-	1	-	1	1	2	8	4.14
Aspergillus	-	-	1	-	1	1	-	-	1	-	-	5	2.59
Geotrichum	1	-	3	1	-	-	-	-	-	-	-	5	2.59
Alternaria	-	-	-	-	-	-	-	1	-	1	-	4	2.07
Candida (fungus)	2	-	2	-	-	-	-	-	-	-	-	4	2.07
Scopulariopsis	-	-	1	-	-	-	-	1	-	1	-	3	1.55
Unknown	-	-	-	-	2	-	-	-	-	-	-	3	1.55
Mycelia sterilia	-	1	-	1	-	-	-	-	-	-	-	2	1.03
Rhizopus	1	-	-	1	-	-	-	1	-	-	-	2	1.03
Trichosporon	-	-	1	-	-	-	-	-	1	-	-	2	1.03
Acremonium	-	-	-	-	-	-	-	-	-	1	1	2	1.03
Curvularia	-	-	-	-	1	1	-	-	-	-	-	2	1.03
Trichotecium	-	1	-	-	-	-	-	-	1	-	-	2	1.03
Pseudoallescheria boydii	-	-	-	-	-	-	-	-	-	-	2	2	1.03
Chyso sporium	-	-	1	-	-	-	-	-	-	-	-	1	0.51
Ulocladium	-	-	-	-	-	-	-	-	-	-	1	1	0.51
Sepedonium	-	-	-	-	-	-	-	-	-	-	1	1	0.51
Bipolaris	-	-	-	-	1	-	-	-	-	-	-	1	0.51
Paecilomyces	-	-	-	-	-	-	-	1	-	-	-	1	0.51
Stemphylium	-	-	-	-	-	-	-	-	-	-	1	1	0.51
Sreptomycin	-	-	1	-	-	-	-	-	-	-	-	1	0.51
Total	8	12	29	36	24	11	16	12	13	11	21	193	100

Since there has not been any study on the status of fungal growth in hot water pools in Sarein tourist town, therefore in this section the study of epidemiology of fungal diseases identification of fungal contamination and their sources, determination of dominant fungal species, identification of ways to transmit the disease and how to prevent them in hot water pools of Sarein tourist city are discussed.

In a study by Seyedmousavi et al. (2007) 284 samples were taken at different points in the Sarein Hot Springs Pools. In this study 284 specimens were collected from different parts of the pools 193 fungal plates (67.95%) and 43 positive plates (15.14%) and none of the 48 plates (16.9%) were extracted. *Aspergillus fumigatus* was isolated with 44 positive plates (22.79%) *Aspergillus feltus* and *Aspergillus* spp. with 30 positive plates (15.54%) and *penicillium* with 28 positive plates (14.50%) the most abundant fungi.

In this study no dermatophyte fungi nor any real dimorphic pathogens were isolated from carpet and water samples. One of the factors of the absence of human dermatophytes in the pools examined in this study is the presence of chlorine in the pool water and the spread of this water around the pool because there are more commuted and the contact of the legs and body of swimmers in this place has been more. On the other hand, given that the amount of chlorine in most pools is not standard one can not specifically comment because in talking to the authorities responsible for these pools they often did not know the exact amount of chlorine intake and expressed their dependence on the number of swimmers and water pollution and most of the pools were discharged every 24 hours and disinfected with perchlorin. Therefore, it is likely that another reason for the lack of dermatophyte agents in the pools is that the pool managers as well as the health authorities in the hot water pools of the Sarein tourist town pay more attention to the cleaning and control of the pools.

According to the results of this study it can be stated that it is possible that another reason for not finding dermatophytes in these pools is the high temperature of the mineral water so that the pool areas are heated above 40 degrees Celsius and the temperature inside the sauna room was 40 to 45 degrees Celsius. Therefore the high temperature of mineral water is considered as a preventative factor for the growth of pathogenic fungi. It should be noted that all findings of this section are the result of research by Seyedmousavi et al. (2007) which was conducted on Sarein hot springs.

## 5. Conclusion

This research investigates the attraction and hazards of the geothermal springs of Sarein district spa. Therefore, the research structure was divided into two sections of attraction and hazard. The hazards

segment was also divided into two sections of the hazards associated with the earthquake and the risks associated with the disease outbreak. Regarding the potential of spa springs about 11 hot springs were selected and features such as discharge temperature pH and anion and cation values were extracted in each source separately.

In the context of natural hazards an analysis of the earthquakes in the area especially the earthquake of February 28, 1997 was carried out and accordingly it was necessary to draw geological maps, topography slope and direction of gradient and earthquake centers mentioning the location of the spa springs. Investigations showed that there was no reported earthquake occurring on this date due to the low slope of the occurrence area such as landslide or rock falls but due to the straw structure of buildings, high human casualties were observed. One of the most problematic measures in this area is the development of construction towards the high slopes in the mountain range of Sabalan.

In the final section of the study the risk factors related to biological factors in the pools of Sarein spa springs were analyzed. To this end with the emphasis on research by Seyedmousavi and colleagues (2007) of 284 samples no dermatophytic fungi were extracted from water and spa pools. The main reason for this is the complete disinfection of pools by chlorine. So the pools used by tourists do not contain any dermatophytes.

According to the above-mentioned items it can be accurately stated that the recreational and tourist area of Sarein has been high in terms of geo-tourism capabilities and has resulted in economic flourishing in the Sarein area.

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