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The Solutions of Tourism Development in Gorgan Bay with Special view on its Mud volcano

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Abstract
In this research, the solutions of tourism development in the northeast of Gorgan Bay, with a special view on its mud volcano were studied. The result of field and laboratory studies on the mud volcano of Gorgan Bay show that the mud volcano, besides recreational tourism, has an important role in health tourism and curative geotourism. As this mud volcano has no significant toxic substances and contains a high amount of useful elements and has a therapeutic aspect and can be one of the essential destinations for curative geotourism and health tourism. In addition to therapeutic effects, the mud volcano contains important scientific information about evaluating gas and oil reservoirs, salt domes, and the tectonic situation of the region; therefore, as an educational geo-site, it can attract a large number of domestic and foreign scientific tourists, especially geological tourists. Also in the line sustainable tourism development of Gorgan Bay volcanic mud area, some solutions are suggested such as: Establishing therapeutic centers in interaction with traditional medicine group and modern medicine group, Establishing suitable lodging places, Creating lavers filled with mud and water for entertaining activities and games, Developing and reconstructing access roads, Cultivating the preservation of geological heritage, presenting media publicity nationally and internationally about therapeutic potential of Gorgan Bay mud volcano, Establishing health tourism and geotourism educational and research centers in the area, Carrying out complementary and up-to-date studies on the mud volcano and the geological environment around it by researchers, Installing signboards and establishing security in the area
Keywords: Gorgan Bay, Health tourism, Development solutions, Mud volcano.

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1. Introduction

Tourism, within the national, regional and local frameworks is one of the important tools in development and removing deprivation. Tourism is a crucial regional construction factors and it is the activity which leads to enhancement of social and economic conditions in regional level and also justly distribution of income and increase of employment. Iran because of having various tourism attractions is one of the top 10 worlds around the world (Dolatabadi, et al., 2010). And because of having environmental and climate features and also natural capabilities and biological variations has the sufficient ability for attracting the tourists. (Rezvani, 2008). One of the most interesting and unique geomorphologic processes in attract of tourist is mud volcano which is highly important because of Geo tourism. Mud volcano is a natural phenomenon similar to volcano which is in the form of a conical hill and instead of lava coming out from its mouth; gas and mud come out (Wai-Gee,etal., 2012).

Mud volcano in cosmology culture is defined as " mud and hot water which is throwing out of the volcano's mouth and generates temporary conical and sometimes natural gases combined with oily sediments are mixed with these materials as well" (Negaresh, etal. 2008).

The important point about the mud volcano is that even though they have unique features which might be more attractive while compared to similar samples in other countries, but unfortunately well they have not been introduced and recognized yet. the Gorgan Baymud volcano is one of the unique geomorphologic phenomenon in east of Caspian sea in Golestan province (northeast Gorgan Bay)which has high the potential of health tourism and remove deprivation and poverty and generate employment and income in this province.

2. Literature review

Gorgan Bayis the third access point to the Caspian Sea in Golestan province. This area is recognized as a geo-site due to its significant geomorphological attractions such as beaches, lagoon, bay, and mud volcano. Geo-site is a place with rare forms and attractive processes of geology and geomorphology with a potential of aesthetic uniqueness, scientific, cultural, touristic, and educational (Vujičić et al. 2011). which mainly divided into two groups: those that outcrop as natural or synthetic forms of remarkable geology and geomorphology within open boundaries limitations a like mud volcano ,glacial cirques, cliffs, deserts, or volcanoes with scientific value in-situ (Brilha,2016) and the other is Geo-tourism access centers in confined spaces like earth sciences museum ,etc. with scientific value ex-situ. Therefore, both types are essential for tourism development. The other term that is equivalent

to Geo-site is the German word of Geotope (Habibi,et al.,2018,Herrera-Franco,et al.,2021). also, a Geo-site is a natural structure in the form a group of rocks, minerals or fossils, stratum, ground Formation, or geological structure resulting from an event during the creation or evolution of the earth's crust that put a process or formation into existence, that needs scientific documentation and in some cases visual attraction qualities and studies about this geomorphological features very noticeable (Cascarilla, et al., 2009).
Geo-sites have considered one of the best forms of sustainable tourism that will provide jobs and production of goods and services. (Bentivenga et al., 2019).Indeed, Geo-sites have been able to generate novel ideas for business development for local people (Farsani et al., 2011) which can attract many domestic and international tourists. in geo-site of Gomishan, there is a interesting geomorphological phenomenon as mud volcano .as you know , the mud volcanoes are one of the most interesting and unique geomorphologic processes in world which besides recreational tourism about health tourism are highly important (Negaresh,etal., 2016). In total, the mud volcanoes in the world are of two types, hot and cold. The hot mud volcanoes are associated with igneous volcanoes, and the temperature of the extruded water and mud varies from 70° to 90°C, much higher than the ambient temperature (Negaresh,etal., 2010). cold mud volcanoes are sedimentary-tectonic in origin and are entirely unconnected with the igneous activity with water and mud at the same or lower than ambient temperature.these eruptions are associated with seismic activity, fracture formation, ground deformation, and emplacement of mud breccia flows (Yazdi, 2013). Also morphology of mud volcanoes also depends on the special weight of outflowing materials or mud and their eruption or jump sequence (Negaresh, 2004).based on studies done, the mud volcano of Gorgan Bayis cold and sedimentary-tectonic type and is located in Tertiary - Quaternary sequences of the coastal region.The sequences mainly are calcareous, marl, clay and sand and consist of gastropod fossils. In this article, for the first time, the solutions of tourism development are studied in Gorgan Baygeo- site with special view on its mud volcano within the framework of geo-tourism and health tourism.

3. Research methods

In order to study the solutions of tourism development in Gorgan Baywith a special view on its mud volcano after library studies and a detailed examination of geological maps with a scale of 1:100,000 and topographic maps of the region, and analysis of Landsat, Spot (Google Earth software) and SRTM satellite images,several field visits made in area during july,2024 and important comments were noted.
Also several samples of water and mud were collected from depth of about 10-20-30 cm from different parts of mud volcano and placed in sterilized

containers.these samples were analyzed by XRD and XRF methods.Temperatures were measured in-situ with a thermocouple thermometer.(25 -27 c) .Mud and water were separated from each other by settling, filtered and analyzed at laboratory. And the appearance characteristics of mud and water in field were noted. As the color of the curative mud exiting from Gorgan Bayvolcano was light to dark gray.The boiling of water in this mud volcano , along with the release of methane gas, is seen in several places, especially in its center.

4. Result

4.1. Geologic setting of Gorgan Bayregion

The Gorgan Bayplace in 54° 00′ to 54° 15 ′E and 37° 05′ to 37° 27′ N at northeast of Gorgan Bay . This region contains a attractive geomorphological phenomenon as name Gorgan Baymud volcano which locate in Tertiary – Quaternary sequences in the studied area (fig 1)

4.1.1 Gorgan Baymud volcano

The geographical location of Gorgan Baymud volcano recorded using a GPS is 54° 02′ 10″E and 37° 23′ 05" N. (fig 1).This mud volcano is about 2 meters higher than the surrounding land, being 120 meters in diameter. Its crater is nearly 15 meters in diameter. Outflow mud of this mud volcano is flowing and gas bubbles exist in it. (Fig 2).Around the mud volcano, many grooves created by erosion, which exhibit tracks alternating layers of salt, clay, and silt sedimentary structures such as mud cracks are visible. This mud volcano, in the rainy season's looks like a lake. Also It is surrounded by salt water with traces of petroleum substances.

4.2. Geomorphology and composition and main elements of sludge and waters out of Gorgan Baymud volcano

Generally, the mud volcanoes on base of morphological characteristic are classified as the following features mud cone, mud pool and mud lobe .on base of studied done, the morphology of Gorgan Baymud volcano is mud cone .From among materials forming mud volcano, one can refer to sands, silt, and types of clay, in some cases rubble, clasts, abundant water, and hydrocarbon gases. The color of the mud exiting from mud volcano is light to gray.

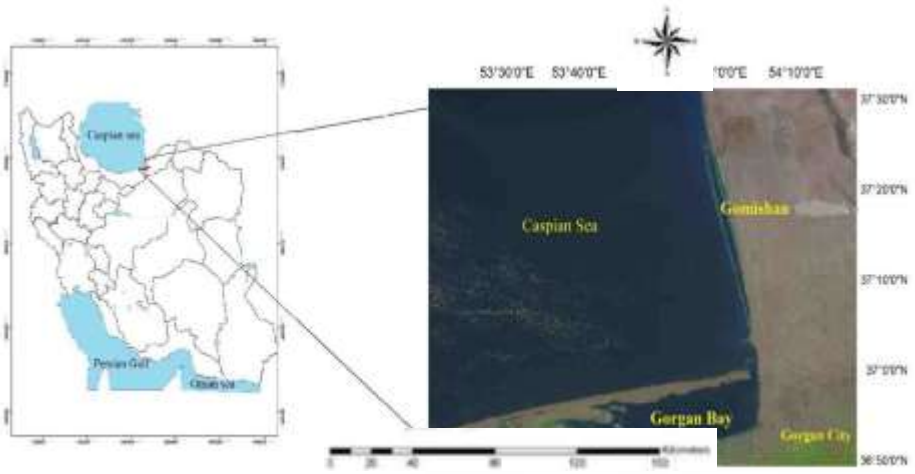

Fig 1. Position of mud volcano in the Gorgan Bay

Fig2. Images of Gorgan Bay mud volcano

Outflow materials from the mud volcano, including oil-saturated terrigenous and carbonate rocks, clay, and silt and is large amounts of methane and carbon dioxide. The most common gas, other than methane, is usually carbon dioxide. Nitrogen and hydrogen sulphide may be present in significant concentrations, but most often they are trace gases. The mineralogical analysis, X-ray powder diffraction (XRD) on bulk samples and <20 and < 2 μm fractions, has been undertaken in order to identify the constituent minerals of the sediments. On the basis of the results of the bulk mineralogical and its variability, a group of samples was selected in order to determine clay mineralogy. Suspensions of <20 and <2 μm fractions were separated by centrifuge. Oriented aggregates of <20 and <2 μm sizes over glass slides were analyzed by means of XRD on airdried, glycolated and heated samples(Moore,etal.,1997)

The clay mineralogy of the <20 and <2 μm fractions of all the samples is characterised by illite, chlorite, kaolinite and smectite.based on XRD mineralogy of samples ,The most abundant clay mineral at Gorgan Baymud volcano is smectite and illite. And The most abundant of carbonate is calcite and dolomite.based on XRF analysis, water properties of Gorgan Baymud volcano has been measured. The major element composition of the expelled waters is controlled by the depositional environment (marine/non-marine, presence of evaporites), diagenetic processes, temperature and mixing (Worden, 1996). On base of studied done, the mud solution has no significant toxic substances and the mud ،has been found to contain quantities of curative properties (iodine, bromine, calcium, magnesium, organic acids and aromatic hydrocarbons.

4.3. The solution of tourism development

Gorgan Baywith the important feature of proximity to the Caspian Sea is a rich county appropriate for tourism development. Despite its many valuable attractions and growth potential, the tourism has faced various problems that have slowed or even prevented its expansion. So, in order to plan to address these challenges, we need to identify them. In total,based on a literature review and thematic analysis, six different categories of challenges are presented: management and planning, political problems, socio-economic, cultural; legal aspects; infrastructure; community awareness and knowledge; and environmental challenges. The study results indicated that the most significant challenges facing the tourism industry in this area management, and planning issues.

The following solutions are suggested for tourism development in the area.

-Presenting media publicity nationally and internationally about scientific and therapeutic

Benefits of Gorgan Baymud volcano

-Establishing therapeutic centers in interaction with the traditional medicine group and the

Modern medicine group

-Establishing health tourism and geotourism educational and research centers in the area

-Creating lavers filled with mud and water for entertaining activities and games

-Cultivating the preservation of geological heritage

-Establishing suitable lodging places,.

-Developing and reconstructing access roads

-Carrying out complementary and up-to-date studies on the mud volcano and the geological

Environment around it by researchers.

-Installing signboards and establishing security in the area

4.4. The importance of Gorgan Baymud volcano

Based on studies done, the Gorgan Baymud volcano has common characteristics with the mud volcanoes of the eastern shore of the Caspian Sea, and all of them especially those located in the coastal zones are mostly connected with volcanoes and subduction zones and can be a sign of subduction in the region or development rate of volcanic activities. Based on the field studies, Gorgan Baymud volcano is sign of subduction in region. Also the mud volcano attract many tourists through beautiful and unique scenes they exhibit. Outflow of mud and water accompanied with hydrocarbon gases that sometimes go into flames, as well as the forming of some lavers filled with mud and also the manner bubbles burst making some sounds, downturn of mud volcanoes from mud volcanoes' craters are quite wonderful. These can be noteworthy for scientific researchers and tourists. As mud volcanoes have direct relationship with oil reserves and hydrocarbon gases, researchers regard them as natural exploratory estimations through which the regions' deep hydrocarbon reserves and information on oil and gas movement can be accessed freely. Due to the presence of a slight smell of oil in Gorgan Bayarea, it can be associated with oil and gas reserves, which is effective in attracting scientific tourists.

The Mud volcanoes also are well used in the pottery industry and enjoy especial attributes. Unlike clay, it doesn't take so long for this mud to be ready to use in pottery, it is polished better than clay, and it is stickier than clay, it is flexible, it doesn't curl, it doesn't get cracked, it has a fixed volume, endures high temperature even up to 800 degrees and it turns creamy and beautiful

having been baked. Based on geochemical studies in this research , there is a high amount of elements boron, copper, iodine, bromine, vanadium, magnesium, sodium, calcium and bicarbonate in Gorgan Baymud volacano that people by using of this mud can make up for the lack of some elements such as sodium, calcium, iodine and other substances their bodies need .In other word as regards the presence of organic and inorganic substances in the mud and sludge of mud volcano, mud- therapy is nowadays of an especial status and many physicians have realized its effectiveness. Due to the existence of the mentioned elements, many patients can go to this place for treatment.Due to its geochemical composition, Gorgan Bay mud volcano has a therapeutic aspect and can be one of the important destinations for medical tourism .also the Gorgan Baymud volcano apart from its therapeutic effects contains applied scientific information and as a scientific educational geosite, can attract many scientific tourists.And these features of mud volcano as geotourism phenomena are in line with the definition of modern tourism, which is tourism that corresponds to the acquisition of knowledge.

5. Discussion and Conclusion

Mud volcano is one of the interesting and unique geomorphologic phenomenon which has important role about recreational tourism, health tourism and curative geotourism .so,it is not right to pay attention to this geological attraction just for enjoyment. In this research, for the first time, the solutions of tourism development were presented in Gorgan Baygeo- site with special view on its mud volcano within the framework of geo-tourism and health tourism.Based on geochemical studies,there is no any toxic substances in mud volcano and contain a high amount of elements boron, copper, iodine, bromine, vanadium, magnesium, sodium, calcium and bicarbonate and its correct and principled use compensates for the lack of these elements in the body.thus this mud volcano has therapeutic effects and can be one of the important destinations for health tourism .as know , mud- therapy is nowadays of an especial status in world and many physicians have realized its effectiveness Based on geochemical researches, thus Gorgan Baymud volcano ,Due to its geochemical composition, and it's therapeutic potential can be one of the important destinations for medical tourism. And many patients can be guided to this place for treatment.

Morpholog ,beautiful scenes outflow of mud and water accompanied with hydrocarbon gases that sometimes go into flames, as well as the forming of some lavers filled with mud and also the manner bubbles burst making some sounds, pouring mud from mud volcanoes' craters are quite wonderful and can be noteworthy for scientific researchers and tourists. Moreover practical application in the exploration of hydrocarbon reserves& salt domes,

recognition earth fractures and subduction and application in pottery can attract a large number of domestic and foreign tourists and geotourists. Thus implementing tourism development strategies about mud volcano, and planning and making the right policies, can play a role in foreign exchange and entrepreneurship. Based on studied done, the following solutions are suggested for development of tourism in the area:
Presenting media publicity nationally and internationally, about cientific and therapeutic benefits of Gorgan Baymud volcano , Establishing therapeutic centers in interaction with the traditional medicine group and the modern medicine group , Establishing ecotourism educational research centers ,Creating lavers filled with mud and water for entertaining activities, games, Establishing hotels and suitable lodging places, developing and reconstructing access roads ,Publicizing the culture of using natural phenomena, Carrying out complementary and up-to-date studies on the mud volcano and the geological environment around it by researchers. In final, Gorgan Baymud volcano is one of the main factors of sustainable development in the economic, social, cultural and environmental levels that within the international, national, regional and local frameworks can one of the important tools in development, income generation, creating jobs and removing deprivation.

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