GEOEDUCATIONAL AND GEOTOURISM VALUES OF AGGREGATE QUARRIES, MISSAN, SOUTHEASTERN IRAQ

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ABSTRACT

The geoeducation and geotourism potential capabilities were quantitatively estimated in nine quarries locations in eastern Missan, SE Iraq. A quantitative approach is used to compute the scientific, educational, functional, and touristic categorises values for each quarry. categorised values were weighted for three types of audiences: university students, school pupils, and tourists then, the previous geoscientific studies about quarries areas were searches of different geoscience branches and registered. The results show that geoeducation values are greater than geotourism ones in all quarry sites. All quarries show high weight for the education values while the geotourism values are affected by functional infrastructure in each site. The diversity of scientific values of each site are also studied where the petroleum and hydrological activities increased the geoeducation weight of the specific site and supplied more geological knowledge.

Keywords: University; Students; School pupil; Tourists; Geoscience knowledge; UNESCO

INTRODUCTION

Geotourism, or tourism related to geological sites and features, including geomorphological sites and landscapes, relatively it is a new phenomenon that resulted from a subgroup of geology and tourism. Geotourism charter, which was developed by the National Geographical Society (NGC) is focused on the geoeducation to improve the relation between the visitors and hosts in the geoeducation and geotourism sites, “Interactive interpretation engages both visitors and hosts in learning about the place. Encourage residents to show off the natural and cultural heritage of their communities, so that tourists gain a richer experience, and residents develop pride in their locales” (Herzog et al., 2008 and Errami et al., 2009). Awadh (2016) determined the outstanding values of the Sawa Lake, western Iraq as a world natural heritage.

Strba et al. (2020) focused on the economic and environmental benefits of the geotourism and find that the geotourism related activities will contribute to promoting the protection of

geosites in protected areas. The geosites evaluation has been developing since the 1990s, in three main domains: within the context of Environmental Impact Assessment (EIA) procedures, (for the elaboration of geographic knowledge on the geomorphological heritage in the context of land planning; and finally, in the context of geoheritage promotion (geotourism and cultural heritage in a broad sense). Tomić, and Božić, (2014) developed the Geosites Assessment Model (GAM) used in the assessment of the three aforementioned geosites in Lazer Canyon in Serbia, and concluded that the tourists in the assessment process have a decisive role on model final results. Geoeducation is an important prerequisite for any region to be a geopark according to UNESCO demands “Education at all levels is at the core of the UNESCO global Geopark concept. From university researchers to local community groups, UNESCO Global Geoparks encourage awareness of the planet story as read in the rocks, landscape, and ongoing geological processes” (Henriques and Brilha, 2017). The outdoor studies and the geosite visits are vital requirements to develop student practical skills, Weather, geoscience university departments students, or school pupils (Gajek et al., 2019; Tipon et al., 2016 and Tetik, 2016).

Aggregate quarries and surface mining industry make a giant leaps expansion in the last decade through the boom concrete constructions and road pavements in Maissan. The quarries can be considered as an artificial outcrop, where the rock successions, minerals, fossils and sedimentary structures are exposed for the visitors, and samples can take at any depth of quarry section (Collis and Smith, 2001; Sinclair, 2012). Gajek et al. (2019) developed a quantitative approach to evaluate the scientific, educational, functional, and touristic validity of the quarries for three audience groups, university students, school pupils and tourists. This assessment procedure was used in recent study to assess the validity of the study area quarries as educational and tourism purposes. In this study, Gajek procedure is used to evaluate the geoeducational and getourism values of nine quarry sites located at east Missan governorate area (Southeastern Iraq) were estimated, the scores of three audience categories (university students, school pupils and tourists) are weighted. Finally, a comparison between the geoeducation and geotourism capabilities of current circumstances.

STUDY AREA

Eastern Missan governorate area (Fig.1) is about 46% percent of the province area. It is characterized by beautiful nature; many local and foreign tourists visit it during year (Fig. 2). This area also has a rich society diversity including agriculture villages, Bedouin communities and sheep herders with presence of oil sites, groundwater wells and aggregate quarries. The quarries are active and non-active clay, sand, gravel, and subbase quarries (Fig. 3). Nine quarries were selected in different parts of the area (Table. 1) to cover the requirements of the

current study. The study area is covered with Zagros foothill deposits like, alluvial fan, dunes, and colluvial deposits which derived from the mountains lies to the East North direction across Iraqi Iranian border (Ameen, 2005) (Fig. 4). The lithology and geological ages of the outcropped formations are represented in Table.1, while the geological succession represented in Table 2 (Al-Siaede, 2019). The geoeeducational and geotourism importance of this area are resulting from the topography, geological diversity of the sediments and the sedimentary structures. Also, the area includes a wide range of rare wild animals and natural plants that grow in this environment. The area is characterized by tourist potential, especially for the families of the province or from the nearby provinces, although there are no tourist centers in it. Many graduate students and researchers from geological, geographical, biology and oil engineering disciplines have completed their studies on the natural resources and phenomena of the region.

Fig. 1. The locations map of the study area sites

MATERIALS AND METHODS

Several geoheritage evaluation techniques were reviewed such as Štrba (2015); Tomić, and Božić (2014). Gajeck et al. (2019) technique was followed in this study because it is a quantitative approach dedicated to the evaluation of the areas of the quarries in addition to focusing on the geoaeducation and geotourism topics.

Table 1. The lithology and coordinates of the selected quarries in the study area

Location	UTM Coordinates (D M S)	Local Name	Notes
Q1	680127, 3606579 (32 35 47 N, 46 55 52 E)	Chlat	Gravel, sand and subbase Quarries, water wells and many sedimentary and structural features.
Q2	693626, 3587005 (33 24 09 N, 47 03 39 E)	Manzilyea	Area of seismic activity located on blinding faulting system. Sand dunes and water wells are located with many sedimentary structures.
Q3	698432, 3585511 (32 23 17 N, 47 06 23 E)		
Q4	704405, 3591846 (32 25 09 N, 47 10 06 E)	Teeb	These quarries are near Teeb river on the area, area included many petroleum drilling and water wells, geologically area rich with different kinds of sedimentary rocks.
Q5	703304, 3588063 (32 26 39 N, 47 10 33 E)		
Q6	707696, 3576179 (32 18 30 N, 47 10 33 E)	Band	Band hills is beautiful area with many heritage sites
Q7	717921, 3574636 (32 13 32 N, 47 18 19 E)		
Q8	749158, 3551396 (32 04 17 N, 47 38 20 E)	Dwerige	Cross Bedding sedimentary structure. Outcrop of silt sand and gravel layers.
Q9	716481, 3593523 (32 22 36 N, 47 19 20 E)	Zubidat	Mudstone, Siltstone, and sandstone outcrop

Fig. 2. Quarries of the east Missan Area

Fig. 3. Satellite images (Digital Globe Images, Scale 1:100000) of Q1 and Q7 Quarries

Fig. 4. Geological map of the study area (modified from GEOSURV, 2000)

Table 2. Lithology and geological ages of the study rock formations (Aqrawi, et al. 2010)

Formation	Geological age	Lithology
Quaternary Deposits	Recent	Sand dunes, Sand sheets alluvial and colluvial deposits comprised mainly of gravel, pebble, sand, silt and clay. Sand dunes and river terraces are formed.
Bai Hassan	Late Pliocene	Mudstone and conglomerates with some sandstones and siltstones
Mukdadiya	Upper Miocene-lower Pliocene	Thick massive sandstones beds changed to pebbly with thin conglomerates. The lithology changed in upper part to light brown claystone with few sandstones and lenses of pebbles.
Injana	Early to Late Miocene	Marls and siltstones with beds of sandstones. Freshwater limestones and lacustrine clay and bentonite are occasionally occurred.

This technique relies on estimate four criteria in each quarry (Table 3), scientific, educational, functional, and touristic. The criterial topics were evaluated on five elements, with a maximum score of 10 (40 for the total score). To evaluate the effect of these criteria on the visitors for each quarry site, the quantitative values are generated in Table 3 are multiplying them by weighting factors (Table 4A). The focus has been on three types of audiences, university students, school pupils and tourists. The results were analysed by comparing with a classes interval for the final scores of the quarries and for the audiences (Table 4B). The selected Quarries in this study are quantitatively evaluated by new method depends mainly on Gajek et al. (2019) scoring value and weight factors tables (Table 3 and 4A) as following:

1. The study area was surveyed by remote sensing images, previews maps, and field visits to select the suitable quarries for geoeducation and geotourism purposes. The main factors for quarries selection controlling are, security, scientific importance, validity of different geological activation in the area and the distance from the main paved roads.
2. Scientific, educational, functional and tourism scores are computed with maximum 10 points for each part (Table 3). The results are multiplying by weight factors to find the group audience values for three audience groups, university students, school pupils, and tourists (Table 4A).
3. Previous geoscience studies (M. Sc, Ph. D thesis and papers were published in scientific journals) on the East Missan region have been revised to determine the geoscience information available on each quarry sites (Fig. 5).
4. Finally, the results of each quarry values are represented in Table 4. The scientific and educational score marks are collected to represent the geoeducation score value, the functional and tourism scores marks collected to represent the geotourism scores.

Fig. 5. Geoscience specialization taken in the study

Table 3. Quantitative scores for quarries assessment (modified from Gajec et al., 2019)

Criteria	Low value 0 pts	Medium value 1 pts	High value 2pts
Scientific			
Representative	Lacks outcrop	Incomplete outcrop	Typical outcrop
Rarity	>3 similar sites in the region	One of 3 sites in the region	Only site in the region
Scientific knowledge	Lack in scientific literature	3-5 publications	>5 publications
Geological Diversity	One feature	2-3 features	>3 features
Extensiveness	< 10m	10 to 20 m	>20 m
Educational			
Observation condition	high vegetations and weathered materials cover	Partially vegetations and weathered materials cover	No vegetations and weathered materials cover
Education tools	Lack of products	1-2 products	More than 2 products
Features clarity	Students and specialist only	Students of secondary schools	All education levels
Sampling possibility	No possibility	Only with permission	Unlimited
Education diversity	Geological value only	Geological and biotic values	Abiotic, biotic and cultural values
Functional			
Capacity	<10 persons	10-20 persons	>20 persons
Safety	Threats occur	Taken moderate precautions	No threats
Limitations of access	Difficult access	Seasonally access difficulties	Good access conditions
Distance from paved roads	>20 min	10 to 20 min	<10 min
Other education sites	Lack of others for 5 km radius.	2-3 sites for 5 km radius	>4 sites for 5 km radius
Tourists			
Scenic values	Lack	Moderate	Interesting vantage point
Location relation to tourist trails	1 km from trail	100m to 1km from trail	Site located on path
Degree of degradation	High human impact surrounding	Moderate degree of human impact	No signs of degradation
Distance from tourist centers	>15km	5-15km	<5km away
Accommodation and Restaurants	>30 km away	10-20km away	<10 km

Table 4. The categorise weighting values of different audience and the resulting ranking intervals (modified from Gajek et al., 201

Quarry No.	Audience values					Audience values		
	Scientific (10 pt.)	Educational (10 pt.)	Functional (10 pt.)	Touristic (10 pt.)	Total (40 Pt)	University Students	School Pupils	Tourists
Q1	6	8	9	5	28	38	40.5	37.5
Q2	8	8	6	3	25	37	36	32
Q3	8	7	6	3	24	35.5	34	30
Q4	10	10	9	6	35	50	49.5	45.5
Q5	10	10	7	6	33	48	46.5	42.5
Q6	10	10	6	4	30	45	43	37
Q7	10	8	7	6	31	48	36.5	42.5
Q8	9	8	5	5	27	43	41.5	36.5
Q9	10	10	6	8	34	49	47	45

Table 5. The quarries score values of Missan area

Note: The results of Table (1) are weighted by multiply by weighting categorise vales (A) and compared with ranking classes intervals (B).	A. Weighting of categorise of values for different audiences							
		Scientific	Educational	Functional	Touristic			
	University students	2	1.5	1	1			
	School pupils	1	2	1.5	1			
	Tourists	1	1	1.5	2			
B. Ranking classes intervals for different categorises of values an audience related assessment								
class	Categorize of values				Total	Audience-related assessments		
	Scientific	Educational	functional	Touristic		School pupils	University students	Tourists
Very low	2-3.4	1-2.8	3-4.2	0-1.8	12-16.4	16.5-21.9	15.5-21.9	16-22
Low	3.41-4.8	2.81-4.6	4.21-5.4	1.81-3.6	16.41-20.8	21.91-27.3	21.91-28.3	22.01-28
Medium	4.81-6.2	4.61-6.4	5.41-6.6	3.61-5.4	20.81-25.2	27.31-32.7	28.31-34.7	28.01-34
High	6.21-7.6	6.41-8.2	6.61-7.8	5.41-7.2	25.21-29.6	32.71-38.1	34.71-41.1	34.01-40
Very high	7.61-9	8.21-10	7.81-9	7.21-9	29.61-34	38.11-43.5	41.11-47.5	40.01-46

RESULTS

Final selected quarries assessment is represented in Table 5. Scientific, educational, functional, and touristic scores are computed after many field assessments visits for the quarry's sites. The geoscience available knowledge was taken from masters and doctoral theses and published papers about the study area. The results of each quarry were represented in the same Table. The study area subdivides mainly to six regions, Chlat (Q1), Manzilyea (Q2, Q3), Teeb (Q4, Q5), Band (Q6, Q7), Dwerige (Q8), and Zubidat (Q9) (Table.1). the results of each area are affected by its geological properties like topography, hydrology minerology, and also affected by the occurrence of paved roads and other infrastructure services.

DISCUSSION

The final quarries assessment and the results audience types weighting are represented in Table 5. These results are classified according to ranking classes interval (Table 4B) for the purpose of understanding the value of each studied quarry and comparing between them to identify the location weakness points of each one, to work on developing it in the future to be an educational and tourism centre. The scientific and educational score vales are collected together to represent the geoeducation, while Functional and touristic scores together represent the geotourism (Table 6), while, Fig. 6 represents the graphic representation of the Table 6 values. The ranking classification of the study area quarries, (according to Table.4b classes), is shown in Table 7.

Fig. 6. Audience values of the study selected categorise

Table 6. The quarries geoeducation and geotourism values of east Missan Area

Quarry No.	Geoeducation	Geotourism	Geoscience available knowledge
Q1	14	14	Sdg., Hyd., Mig., Feg., Gch., Eng.
Q2	16	9	Min., Stg. Gem., Sdg.
Q3	15	9	Min., Stg. Gem., Sdg.
Q4	20	15	Ptg., Eng., Stg., Gmg., Mig.,Gch.,Hyd.
Q5	20	13	Ptg., Eng., Stg., Gmg., Mig.,Gch.Hyd.
Q6	20	10	Ptg., Eng., Stg., Gmg., Mig.,Gch.,Hyd, Gmg.,Lig.
Q7	18	13	Ptg., Eng., Stg., Gmg., Mig.,Gch.,Hyd, Gmg.,Lig.
Q8	17	10	Ptg., Eng., Stg., Gmg., Mig.,Gch.Hyd.
Q9	20	14	Ptg., Eng., Stg., Gmg., Mig.,Gch.,Hyd, Gmg.,Lig

Fig. 7. Geoeducation and geotourism score values of selected quarries

Table 7. The Final quarries assessment of the results categories

Quarry	Categorise value					Audience related assessment		
	Scientific	Educational	Functional	Touristic	Total	Univ. St.	Sch. Pupils	Tourists
Q1	M	H	VH	M	H	H	VH	H
Q2	VH	VH	M	L	M	H	H	M
Q3	VH	H	M	L	M	H	M	M
Q4	VH	VH	VH	H	VH	VH	VH	VH
Q5	VH	VH	H	H	VH	VH	VH	VH
Q6	VH	VH	M	M	VH	VH	VH	H
Q7	VH	VH	H	H	VH	VH	H	VH
Q8	VH	VH	L	M	H	VH	VH	H
Q9	VH	VH	M	M	VH	VH	VH	VH

L: Low, M: Medium, H: High, VH: Very High

CONCLUSIONS

The final analysis of quarries assessment represents in the following:

1. Generally, quarries in the study area have a high and a very high assessment scores for geoeducation values (scientific and education) than the geotourism values (functional and tourism).
2. All Quarries are suitable for audience related assessment.
3. Q2 and Q3, (Manzilyea area) are the lowest touristic scores result because their locations are away from the main paved roads as shown in the satellite images.
4. Q4 and Q5 (Teeb area) are the highest values and heights audience assessment because of their proximity to Teeb river and availability of paved roads and bridges.

5. Q6 and Q7 high geoeeducation score value cause the different geological projects in this area like, oil company activities and ground water drilling. This causes increasing in the scientific and educational visitor numbers. Topography of this area is contributed to the attraction of the local families to visit the location many times each year.
6. Q1, Q8 and Q9: are located near the Iraqi Iranian international borderline. These sites have a highly geoeeducation and geotourism importance but the infrastructures must develop by local government and community people.

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