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Understanding the geo-heritage and geo-conservation for intrinsic globally significant geotourism site - A case of Lonar Crater, Maharashtra

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ABSTRACT

The study provides an overview on the geoheritage and geoconservation of globally significant geosites emphasizing on understanding its definition, history, breadth, and scale. Geoheritage is much more than simply maintaining, unearthing, exhibiting, or restoring the tangible parameters of the site. The relevance of the geological feature, whether it is international, national, state/regional, or local in importance, needs to be assessed using rigorous criteria regardless of the scale of the geological phenomenon being studied, be it terrane-scale, outcrop or bed scale, or crystal scale. The deeper knowledge explains that geoheritage, which is now crucial for local cultural reasons, land management, natural resource management, research, education, and tourism and focuses on geology and geomorphology globally. This paper seeks to delve into the geo-heritage and geo-conservation of the Lonar Crater, Maharashtra, a unique geotourism site of immense global significance. The crater, caused by a meteor impact, presents unique geological, ecological, and cultural facets. This research explores its need for conservation, the importance of its geo-heritage, and potential for sustainable geotourism development.

Keywords: Geoheritage, Geoconservation, Geotourism, Geosites, Lonar crater

1. INTRODUCTION

Man and nature are closely associated since the very beginning of the time, furthermore we can acknowledge that humans have significantly contributed to shaping the essence of the existing surroundings, whether it be by means of customs, governmental affairs, financial systems, spiritual convictions, or other discernible and imperceptible elements. While man is alleged to possess the ability to shape landscapes; it is also an integral part of his physical and psychological environment. At any present day interpretation, significance and appraisal of such hugely complex yet significant existential landscapes necessarily require a contextual consideration. The approach adopted to grasp the understanding of its importance are prorated further into understanding and inferring to their occurrence, cultural practices, existing landscapes and pertinent landscape & tourism issues. Determining the worth of geological sites in terms of their heritage enhances our comprehension of natural resources, aids in effective conservation planning, facilitates the identification of protected areas, and fosters positive interactions between humans and the environment. To preserve certain geodiversity components that are crucial for understanding Earth's origin and development, studies and conservation projects on geological heritage have been growing all over the world. In addition to its scientific worth, geoheritage may also have other sorts of values, which serve as the foundation for its sustainable usage in national and local initiatives for tourism, education, and recreation.

Fig 1*:* Showing interrelation of heritage, conservation, diversity & tourism of geological sites.

1.1. ABOUT LONAR CRATER

Around 50,000 years ago, the Earth experienced a significant event when a massive meteorite weighing 2 million tons collided with it, resulting in the formation of a unique impact crater made of basaltic rock. This crater, which is the only one of its kind with hyper-velocity impact, measures 1.83 kilometers in diameter and has a depth of 150 meters. The basin is surrounded by a series of gentle hills and has an oval shape. As time passed, the area became overgrown with jungle vegetation, and a perennial stream transformed the crater's floor into a peaceful and verdant location.

- **History**:

Ancient scriptures like the Skanda Purana, the Padma Purana, and the Aaina-i-Akbari contain mentions of the lake. Located in Maharashtra's Buldhana district, the lake resides in an area steeped in historical significance. It was once a part of Ashoka's empire and later came under the reign of the Satavahanas. The Chalukyas and Rashtrakutas also exerted control over this region. Subsequently, the Mughals, Yadavas, Nizam, and British gained power, leading to a flourishing trade in the area. Surrounding the lake, there are numerous temples, specifically known as Yadava temples and Hemadpanti temples, which reflect the architectural influence of those respective periods.

- **Religious setting**:

The lake has gained religious significance due to local legends surrounding a demon and the mysterious properties of its water. Lonar Lake is not only a place of religious importance but also an archaeological treasure trove. Within its crater, there are over 20 temples that date back to the 11th century. While most of these temples now lie in ruins, one notable exception is the temple of Daitya Sudan, located at the center of Lonar town. This temple was constructed to commemorate Vishnu's triumph over the formidable Lonasura and stands as a remarkable example of early Hindu architecture. Adjacent to the lake, the Kamalja Devi Temple showcases intricately carved images, while the Gomukh Temple is situated along the crater's rim. Flowing continuously from the lake, there is a perennial stream that holds great significance for pilgrims who visit the temple. It is customary for these pilgrims to partake in a purifying bath in this stream. Within the crater of the lake, one can discover additional temples, including the Sita Nahani temple, the Dhara Shankar Ganesh temple, which is partially submerged and renowned for its rectangular Shiva statue, and the Ram Gaya temple.

- **Local & International enthral:**

Lonar Lake stands out as a remarkable sanctuary of biodiversity and serves as a haven for wildlife. It is a landlocked lake with exceptional water qualities, devoid of any inlets, outlets, or water seepage into the ground. The lake receives its water supply from underground streams, which unfortunately are now experiencing depletion due to human actions. The distinctive shape, size, and composition of celestial remnants within the crater have contributed to the lake's unparalleled uniqueness. These extraordinary characteristics have captured the ongoing attention of ecologists, geologists, and astronomers from around the world. Numerous scientific studies have been conducted on various aspects of the crater's ecosystem, yet it remains relatively unfamiliar to the general public.

- **Current Challenges:**

The impact of urbanization and a rapidly growing population on Lonar is apparent, as *human activities* have encroached indiscriminately, posing a continuous threat to the ecosystem and its remarkable biodiversity. Additionally, the lake itself is confined and unable to freely interact with its surroundings. Consequently, the concentration of chemicals in the lake has been steadily increasing, resulting in irreversible *pollution*. *Unregulated tourism, deforestation, agricultural practices, and the improper disposal of waste* are taking a toll on the ecosystem. Another critical challenging factor is the cultural and historical significance of the Lonar Crater. However, *neglect and improper conservation practices* have put these structures at risk. Preserving the cultural heritage associated with the crater is not only important for historical reasons but also for promoting tourism and sustaining the local economy.

Fig 2: Arial view of Lonar *Source:* Aaditya Thackeray's Twitter, Nov 2020

Landscapes hold significant importance for individuals and communities. They contribute to the formation of national, regional, and local identities, impact the quality of life, and serve as the backdrop for both development and conservation efforts (Appleton, 1975; Scott, 2002).

1.2. NEED FOR INTERVENTION

Despite its exceptional qualities, Lonar Lake remains relatively unknown to the wider public, with only locals, researchers, and occasional trekkers being familiar with its existence. The majority of tourists visiting Maharashtra flock to nearby Aurangabad to explore the renowned Ajanta and Ellora UNESCO World Heritage Sites, often overlooking the

opportunity to discover Lonar. It is disheartening that this lake, which supports a unique ecosystem and has played a role in human civilization's pursuit of understanding the enigmas of the universe, is currently in dire need of intervention. To address the above mentioned challenges, a comprehensive intervention plan is necessary. It should include the involvement of various stakeholders such as government bodies, environmental organizations, local communities, and scientific experts.

2. METHODOLOGY

- Literature Review: a comprehensive review of existing literature on geoheritage conservation, tourism development, and relevant case studies will provide a theoretical framework and help identify knowledge gaps in the field.
- Data Collection Methods: a. Field Surveys: Conduct field surveys to gather primary data. b. Geospatial Data: Collect geospatial data using remote sensing techniques, satellite imagery, and Geographic Information System (GIS) tools. This data can provide valuable information on land use, vegetation cover, and changes in the crater over time. c. Secondary Data: Gathered secondary data from reports, academic publications, government documents, and databases. This information will complement the primary data and provide a broader understanding of the site.
- Data Analysis: Employ suitable qualitative analysis methods to examine the gathered data. This involves discerning patterns, trends, and connections within the data in order to derive meaningful and relevant insights.
- Results and Findings: Summarize and interpret the results in a clear and concise manner to provide insights into the conservation and tourism development of the Lonar Crater site.
- Recommendations: Based on the research findings, propose practical recommendations for the conservation and tourism development of the Lonar Crater site, considering aspects such as sustainable tourism practices, community involvement, policy recommendations, infrastructure development, and capacity building.
- Conclusion and Discussion: Summary of the key findings and their implications, discussing the limitations of the study and suggested areas for further research to continue advancing the conservation and tourism development efforts at the Lonar Crater site.

Fig 3: Diagrammatic representation of Methodology

3. LITERATURE REVIEW

The idea discussed below elaborates on the global geotourism through the lens of history, sustainability, management & community enhancement.

To understand various heritage sites, Herbert W. Meyer (2018) writes in his book chapter that in addition to comprehending diverse heritage sites, it is crucial to prioritize the protection and conservation of fossils, gather information about their condition and whereabouts, implement effective museum management programs, promote scientific research for the generation of new knowledge, and share research findings to facilitate public education. To ensure the effective preservation and promotion of local geoheritage assets, it is crucial to demonstrate to local communities that they are the primary beneficiaries in terms of both economic and educational gains. (Gray, 2018) elaborates on Geo-diverse sites serve as the foundation of geoheritage, providing essential regulatory, supporting, provisioning, cultural, and knowledge services. These services are depicted in the figure below.

Fig 4: Showing interrelation of geo-diverse sites to various services it offers

Comprehending the readings involves grasping the relationship and differences between geodiversity and geoheritage, with the latter referring to specific elements of geodiversity that are considered worthy of preservation. Throughout history, geodiversity has offered numerous advantages to successive generations of humans. Consequently, the preservation of geodiversity becomes increasingly crucial for the current and future populations.

4. GEOHERITAGE & GEODIVERSITY OF LONAR CRATER

- Geology: The geological attributes of the Lonar crater have been categorized into five distinct zones, each showcasing unique geomorphic characteristics. These zones are as follows: i) The outermost ejecta blanket ii) The crater rim iii) The slopes of the crater iv) The crater basin, excluding the lake v) The crater lake.

- The geophysical investigations show that lake brine, sediments, rocks, vegetation do not show any anomalous concentration of nickel or cobalt or other such elements. Seismic data indicates the presence of two zones overlying the hard trap: 1. An upper 70 m. thick zone presumably constituting lake silt and highly weathered trap. 2. Lower 101 m. thick zone that might be made up of less weathered highly fractured trap. Below map illustrates the geomorphological & geologically important zones in & around the crater landscape

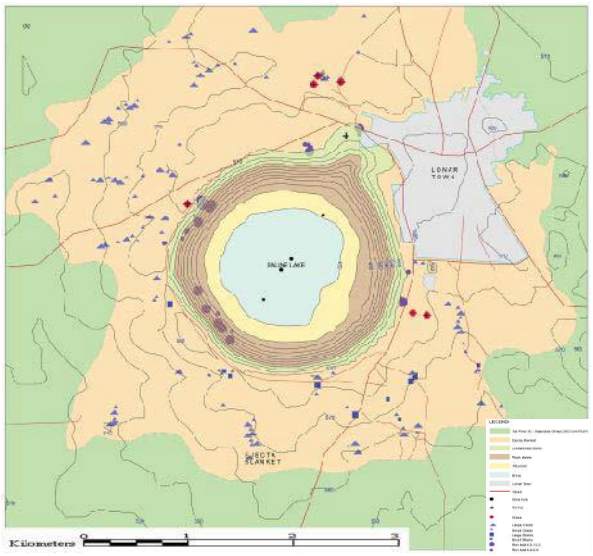
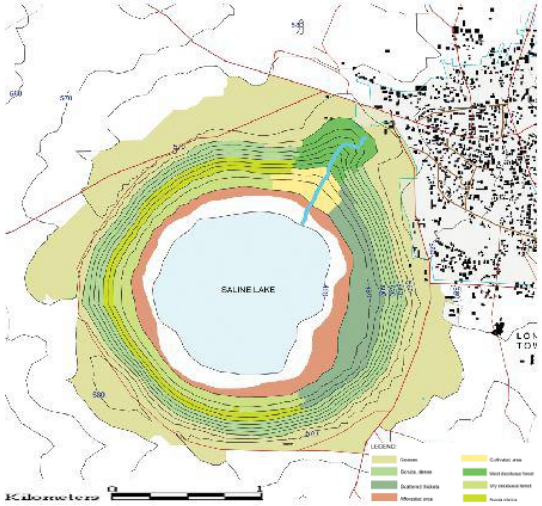


Fig 5: Geological features of Lonar crater

- Geomorphology: - Lonar experiences a unique magnetic phenomenon. The Earth's magnetic equator, positioned approximately 80 degrees north of the equator, forms an angle of about 110 degrees with the equator. Within a radius of 10 kilometers around the Lonar crater, there are significant amounts of magnetic dust and rocks beneath the Earth's surface. This magnetic presence causes a notable alteration in the compass needle's direction, shifting it by 15 degrees.
- Vegetation: - FLORA: Historical records from the British period indicate that this location was initially covered in forests, but over time, unauthorized tree cutting occurred for the purpose of producing salts commercially through burning. The vegetation surrounding the lake, where the soil is highly saline, now only supports a narrow strip of Acacia Nilotic trees. In recent years, the water level has been rising, leading to a decline in the thick belt of Acacia trees. Some parts of the area are wooded and consist of a mixture of dry deciduous and moist deciduous forest types. The forest has an open structure, with Tectona grandis (teak) being the dominant species in this particular type of forest. Up till now a total of 237 species of plants belonging to 153 genera representing 70 families have been identified by the experts, out of which there are 126 herbs, 30 shrubs, 5 undershrubs, 19 climbers, 57 trees. FAUNA: Despite being a brackish water lake, the vicinity of Lonar hosts a diverse array of migratory birds. These birds can be found in various habitats such as the lake itself, the dense surrounding forests, cultivated areas, and more. Among them are species that rely on saline water organisms for sustenance, as well as those adapted to freshwater environments in dry or moderate regions. So far, researchers have identified approximately 75 species of birds and 17 species of mammals in the area. Given the wide range of habitats and the presence of numerous bird species, Lonar possesses the potential to be developed into a bird sanctuary.



Fi g 6: Existing Vegetation of Lonar crater

- Ecological value: - The ecological values include flora, fauna, Eco niches as well as the specific ecological parameters responsible for their emergence, these are: - 1. Relative seclusion of the crater basin. 2. Higher humidity levels in the basin. 3. Higher ground water levels in the basin. 4. Perennial sweet water springs. 5. Perennial salt water reservoir. 6. Dry deciduous ecosystem around crater. 7. Dry bushy vegetation on the rim and slopes. 8. Salt tolerant vegetation along the lake shore. 9. Sandy silty shoreline. 10. Microbial world of the crater lake. 11. Natural landscape features like streams, steep slopes, etc.
- Cultural value: - In total, there are 32 temples, 17 monuments, 13 kunds, and 4 inscriptions in Lonar. Among these, 27 temples, 3 monuments, and 7 kunds can be found inside the crater. Since 1906, the Archaeological Survey of India has been safeguarding 19 temples in Lonar, both inside and outside the crater. The four temples outside the crater that are currently protected are as follows: 1. Dharam Shala/Anna Chatra 2. Square Kund, located on the east side of the town known as Lambi Bharav

3.Gomukha/Dhar
4. Daitya Sudhan temple.

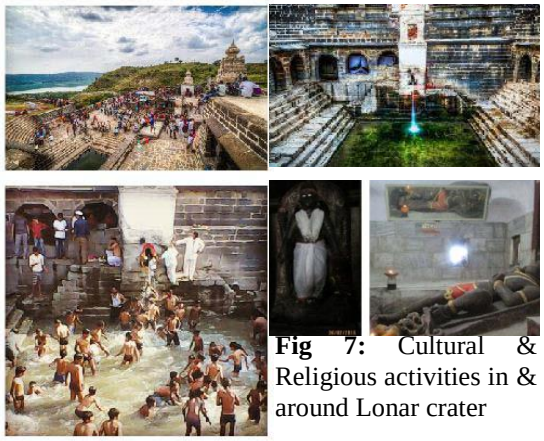


Fig 7: Cultural & Religious activities in & around Lonar crater

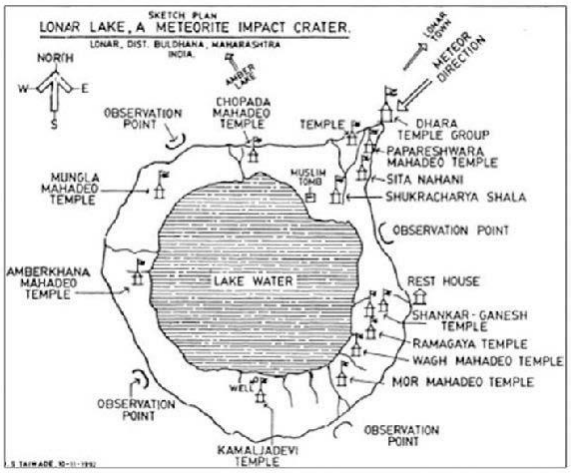


Fig 8*:* Map showing the location of religious places in & around Lonar crater

5. DISCUSSION

A deeper understanding reveals that the profound significance of Lonar geoheritage site extends beyond local cultural purposes, encompassing land management, natural resource management, research, education, and global focus on geology and geomorphology. Conducting empirical research to examine the positive and negative effects of geotourism on geoheritage, including its impact on the natural environment, local communities, and other stakeholders in geotourism destinations, represents a viable research methodology for safeguarding and efficiently managing geoheritage. Utilizing these assessed resources of the crater for geotourism and geoheritage can significantly enhance various aspects such as cultural values (both tangible and intangible), community engagement and empowerment, place identity, scientific fascination, and economic development. However, it is imperative to protect these resources through the establishment of Geoparks or other national legislation to ensure their long-term survival. Consequently, inventories of geoheritage and geosites play a crucial role in identifying, describing, and evaluating their significance for conservation, preservation, and geotourism. Nevertheless, there are certain challenges in this field, particularly the absence of national laws on geoconservation which hampers effective measures for conserving and utilizing natural resources. Therefore, the need for unified local and global strategies for geoconservation is strongly recommended.

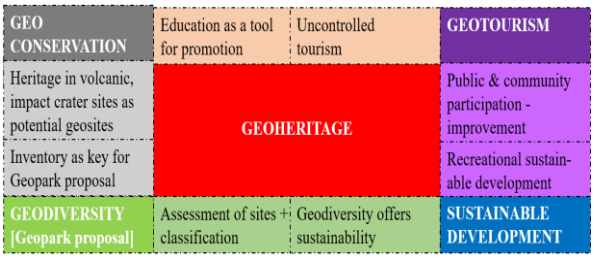


Figure 9: Synthesis of information & data analyzed

6. CONCLUSION

In summary, to ensure the comprehensive understanding and preservation of Lonar Crater as a globally significant geo-site, a comprehensive approach is necessary. This approach should encompass economic advantages, sustainable development practices, active involvement of the public, and the implementation of effective policies. By adopting these principles, Lonar Crater can serve as an exemplary model for the sustainable conservation and management of geosites worldwide, safeguarding their intrinsic value for future generations.

Future recommendations for the research include a detail study on Geological Investigations, Environmental Impact Assessment, Cultural Significance and Heritage Studies, Community Engagement and Livelihoods, Visitor Experience and Tourism Management, Conservation Strategies and Policy Framework, Comparative Studies. By addressing these research recommendations, a comprehensive understanding of the Lonar Crater's geoheritage value can be achieved, leading to effective conservation strategies, sustainable tourism practices, and the preservation of this globally significant site for future generations.

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