

Investigating the Effect of Malicious Factors and geological studies on Ancient Sites to Maintain and Protect Them Using new technology the Geographic Information System (GIS); Case Study: Budda-Bamiyan

Keywords: Budda-Bamiyan — Geographic Information System — cultural heritage planning and Risk Assessment.

Abstract Ancient works are in the worst conditions due to the instability of their materials after exploration, which requires more monitoring and protection. Many factors, including natural and human, threaten ancient works and historical buildings which identifying and analyzing them and providing results in the form of risks map can help explorers to protect the monuments optimally. This article is about the historical area of Bamiyan idols which are selected according to their historical dating and importance. In this study, all threatening factors for the study area including 5 natural factors (earthquake, rainfall, humidity, temperature difference and erosion) and 4 human factors (road networks, construction in the historical area, tourism and unauthorized drilling) were determined and weighted using hierarchical analysis method in order to systematically monitor the maintenance and management of ancient works and cultural heritage sites.

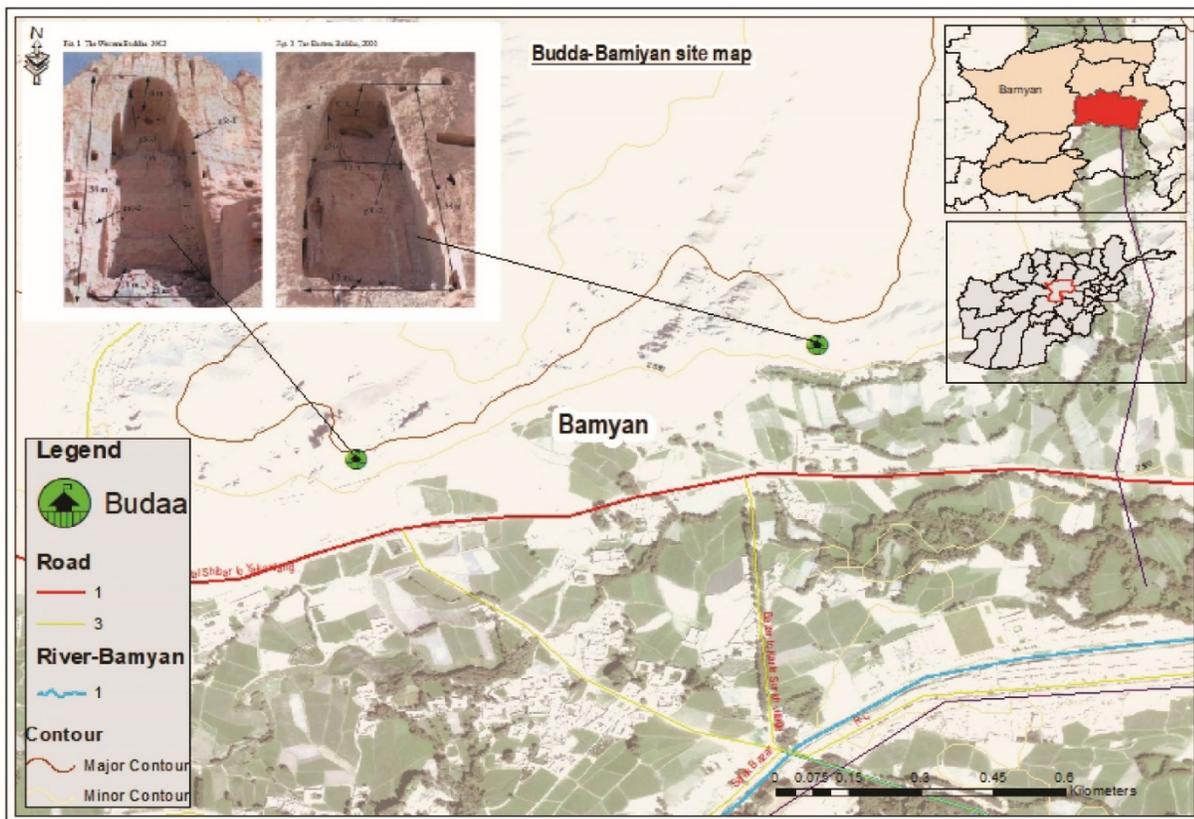


Fig 1. Budda-Bamiyan site map

In this study, risk map of the historical sites of Bamiyan idols is provided due to the changes caused by human and natural risks by multi-criteria decision-making method for Analytic Hierarchy and Geographic Information System (GIS). Analytic Hierarchy method has been used to prioritize risks.

The Analytic Hierarchy Process (AHP) model is a decision-making method by which decisions could be made that are dependent on various criteria or multi-criteria decisions. Remote sensing for the application of archaeology tries to identify the effects and patterns of human activities on the ground. Types of multi-spectrum sensors are capable of identifying ancient remains. Archaeological discoveries and printed works of Eric Schmidt have been the first technical project in this area. Four overall stages are provided according to the Fig (2) to evaluate each risk and its impacts, as well as the classification of ancient works studied based on the vulnerability. In this regard, the available maps, satellite imagery and ground operations were used to prepare required information and the spatial database has been developed has been in the Geographic Information System (GIS). Fig (3) shows the study area at high, moderate and low risk level.

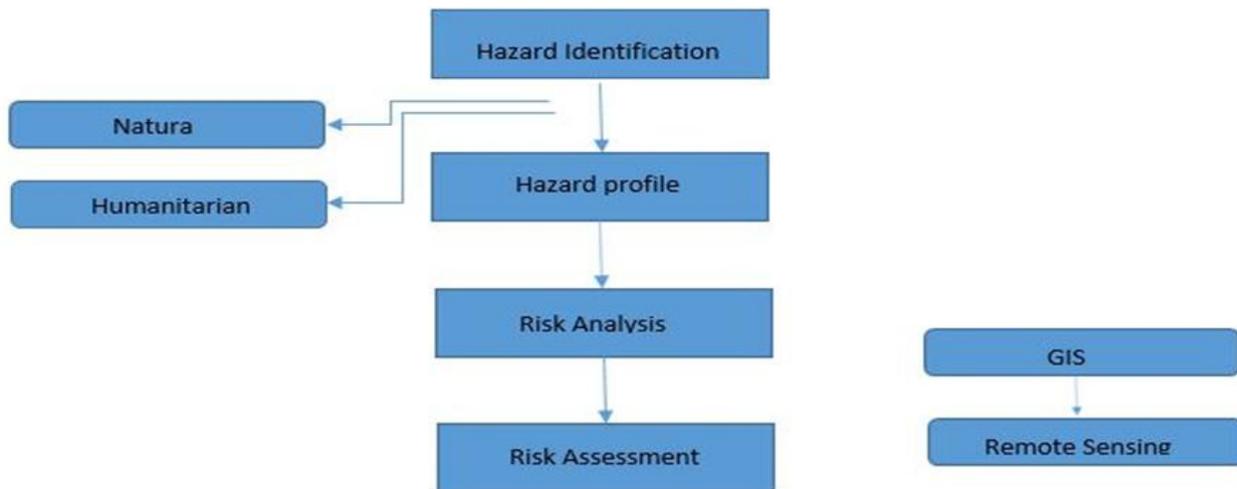


Fig. 2 The overall stages of the risk assessment of historical and ancient sites

The risk factors considered in this study include construction inside the area and the areas having experienced erosion, earthquake, rainfall, temperature difference, unauthorized drilling, road networks and tourists' route. To provide relevant information, available maps and satellite photos have been used. Fault maps are used to display the effects of earthquake. The data achieved from the National Environmental Protection Department, Meteorological Organization and their corresponding analyses were used for risks caused by rainfall and the temperature difference, respectively.

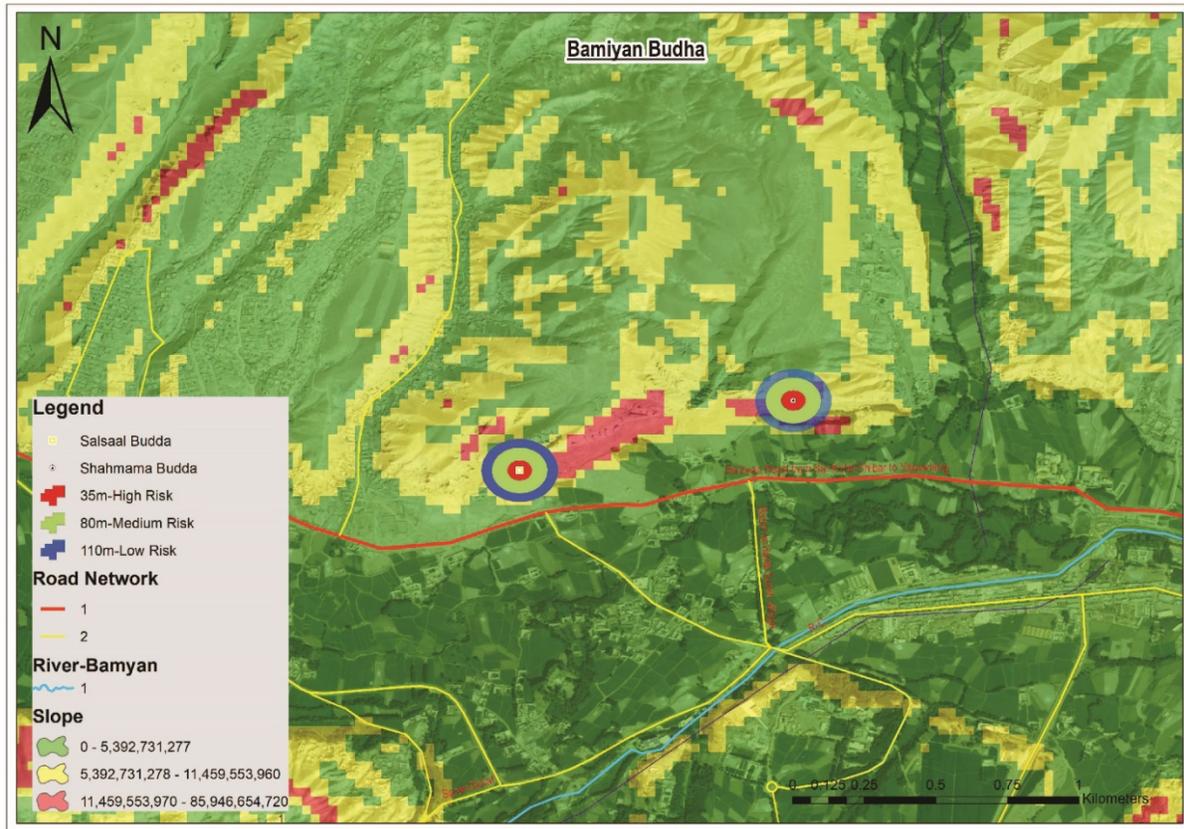


Fig. 3 Final distinction map of the Buddha's historical area divided into three classes; high, moderate and low-risk

The Zoning Concept of the Cultural Master Plan

As one of the research results, five zonings were defined. The zoning concept of the Cultural Master Plan (CMP) is symbolized by a pyramidal scheme marking the CMP zones 1–4 for the cultural landscape. CMP Zone 5 is not containing elements of CMP zones 1–4 and is demarked separately indicating particular development areas (see Table 1 and Fig. 8).

| CMP Zone | Name of Zones | Area in KM ² |
|----------|---|-------------------------|
| Zone 1 | World heritage protection zone | 5 |
| Zone 2 | Archaeological heritage protection zone | 6 |
| Zone 3 | Build heritage protection zone | 5 |
| Zone 4 | Landscape protection zone | 23 |
| Zone 5 | Regulated development zone | 6 |
| Total | | 45 |

Table 1. Zoning overview of the cultural master plan CMP

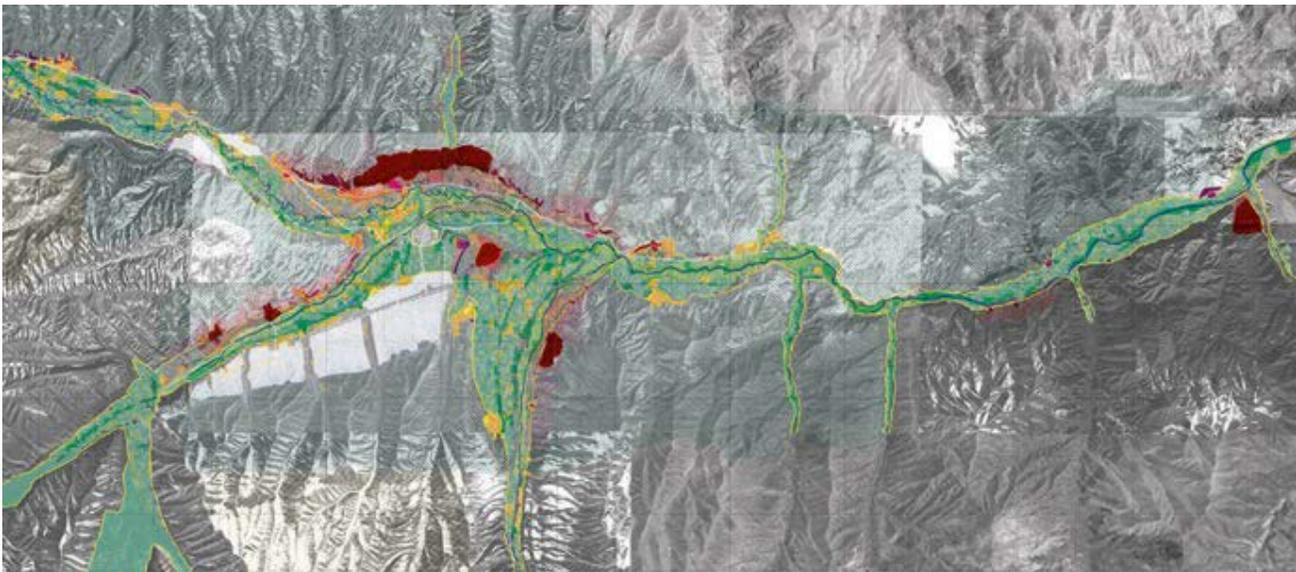


Fig. 4 Overview cultural master plan Bamiyan – colors indicate the different protection zones

Conclusion:

In order to maintain and protect the historical sites, the presence of a systematic method increases the ability of planning and ability to evaluate and model the way of risk performance. In most sites listed in UNESCO, the experts enjoy the abilities of geographical information system tools. In this regard, researchers chart the nature of the risks and scope of their impact in order to reach a general zoning map of region risk in order to show the risk areas with low, moderate and high levels. In this research, initially, the natural and human factors effecting in destroying historical monuments are identified and then, Fig (3) is produced after preparation of spatial layers for any factor and weighing them by the Analytic Hierarchy Process with use of the Geographic Information System (GIS) application, the map of risk-taking potential of Bamiyan's Budda.

This map has a significant impact on solving of many repairing problems, as well as the focus of archaeologists' opinion in understanding of systematic monitoring in order to optimize the risks. This method is designed to be used in historical sites and created a systematic process and a proper tool for providing risk maps of historical and ancient monuments.

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