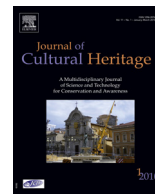




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Original article

Flood risk maps to cultural heritage: Measures and process



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ABSTRACT

Due to extreme climate change, catastrophe normality has become a global trend. The idea of “preventive conservation” is now the primary focus of cultural preservation worldwide. Risk maps have become the tool to predict cultural heritage vulnerabilities because of irreversible cultural characteristics that can never be duplicated after being destroyed. Because the concepts of risk maps and cultural heritage preservation are relatively new in Taiwan, this study attempts to create a set of cultural heritage risk maps. Using flood as its primary disaster type and New Taipei City in northern Taiwan as its targeted area, this study first analyses disaster-prone areas using current global preservation approaches. Thematic analysis and field study are also used for analysis. Finally, based on cultural heritage vulnerability, the study examines present heritage preservation strategies and rediscovers the three aspects of “sustainable management, disaster management, and climate change and adaptation” in response to cultural heritage management. In addition, this study analyses the feasibility of using parks as water detention areas to reduce flood damage temporarily not only to cultural heritage areas but to human lives and property, as well.

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1. Introduction

The normalisation of catastrophe has become an unavoidable trend. In 2009, typhoon Morakot brought heavy rainfall that hit Taiwan mercilessly, causing enormous loss and numerous fatalities. The loss of cultural heritage sites reached nearly USD 17 millions, including six national monuments, 11 municipal monuments, and 14 historic buildings [1]. Although a USD 9.3 million recovery project was later approved, recovery funds and delicate rescue measures could never replicate the value of the genuine cultural heritage lost. This typhoon was certainly not an isolated incident; extreme climate will become more severe and frequent. In addition to the enormous threat to life and property, irreplaceable artefacts of human civilisation are now disappearing so rapidly that the process has become a global crisis whose losses no nation can afford.

The present risk concept of cultural heritage conservation in Taiwan merely covers structural enhancement, fireproofing of facilities, insect-proofing, and preservative measures but lacks preventive strategies for large-scale disasters (i.e., debris flow, tsunami, and flood). Disaster management measures focusing on cultural heritage deserve more attention than ever. Tangible

cultural heritage is a component of its physical location; thus, avoiding certain hazard-prone areas is not necessarily possible.

Disasters are crucial challenges to the conservation of a country's cultural heritage, and an integrated protection program must be established and implemented. More tools must be developed and presented to address the rising uncertainty. Risk mapping is presently an important, sensible tool and the basic foundation for developing various strategies for disaster adjustment and relief. A risk map should not only reflect the present situation, but actively grasp and respond to the development of future dynamic trends for reducing uncertainty. Hence, this study attempts to examine the feasibility of a New Taipei City (NTPC) risk map with further non-structural measures to reduce damage caused by flood.

2. Literature review

2.1. Disasters and types of cultural heritage

2.1.1. Definition and scope of disasters

Disaster generally includes hazard as well as actual disaster. A hazard is the change in a situation or a series of situations that has the potential to cause harm or property loss. A disaster is the collapse of a series of social functions that cause loss of life, materials, economy, or the environment. In addition to the possibility of life and property loss, the meaning of disaster also includes damage to or loss of the general value of a country's cultural heritage and the

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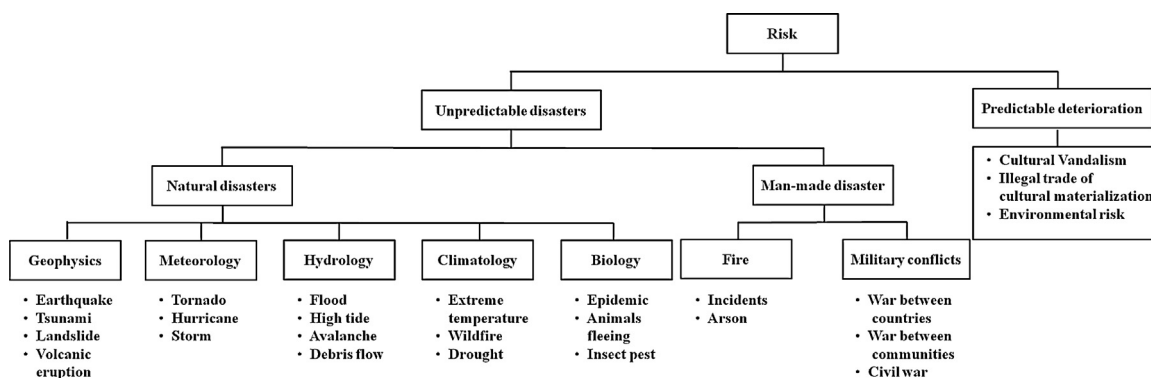


Fig. 1. Schematic diagram of common disasters and risks to cultural heritage.

ecological system and its environment [2]. UNESCO [2] notes that the disaster risk to cultural heritage comes from both external and internal causes. The external cause is the disturbance or damage to cultural heritage sites caused by typhoon, tsunami, destructive sabotage, or war. The internal cause is the fragility of the structure or materials of cultural heritage and their sensitivity to the environment.

2.1.2. Cultural heritage and flood

Ghose divided the disaster risks to cultural heritage into unpredictable disasters and predictable deterioration [3]. Unpredictable disasters include disasters caused by natural phenomena and human behaviours. The five categories of natural disasters are geophysics, meteorology, hydrology, climatology, and biology. Man-made disasters include fire, accidents and military conflicts. Predictable deterioration includes vandalism, illicit traffic in cultural property, and environmental deterioration (Fig. 1 [4]). Flood in this study is classified as an unpredictable natural disaster that includes torrential rain, spring tides, and typhoons.

Flooding relates to cultural heritage preservation in two major areas. One area is analysing a flood's effect on building materials, and the other is to investigate the effects of flooding on cultural heritage sites using a flood map. Both are beneficial in establishing a preventive conservation strategy to decrease flood damage.

Various studies have shown that floods have direct critical effects on cultural heritage structures and materials. Flooding not only damages structures that contact the flowing surface but also sabotages the base and subsoil [5]. Flooding weakens the basic infrastructure of architectural heritage sites, including individual structures, buildings, and artistic objects and components that are attached to the buildings. Floods render these objects vulnerable to various forces and effects [6] and increase building material weathering that destroys the importance and value of cultural heritage sites. Stone is a commonly used construction material in Europe, and essential components of civilisation were passed down by ash-lars and sculptures. Experiments clearly indicate that floods result in direct damage and contamination to the surfaces of historical stone sculptures and buildings [7,8].

Italy was the first nation to begin investigating the effects of flood on its cultural heritage via flood maps in the 1990s and divided disaster risks to cultural heritage into three basic categories: static structural risks, environmental and air risks, and human risks (Table 1 [9]).

Lanza [10] demonstrated threats by flood to the historic centre of Genoa, Italy, surveying the past 100 years of flood maps to assess risks comparing locations of relics and buildings. The survey also offers a low-cost preventive solution to restore the functions of Genoa's existing underground cistern. Prague is also affected by

floods, with major damage resulting from an inadequate geotechnical structure. Protective measures are based on predicting the extent of flow using historic flow analysis, which includes potential socioeconomic consequences and cultural heritage value loss to ease the effects of flood on the ancient city [11].

Global climate change has increased the frequency, scope, and unpredictability of floods, all of which decrease the effectiveness of various anti-flood facilities. A hydrological stimulation model, GIS technology, and regional vulnerability assessment provide useful tools for cultural heritage preservation so that needed resources for different cultural heritage sites are equally distributed [12].

2.2. The disaster risk management strategies of cultural heritage

Pre-disaster tasks include disaster risk reduction, prevention, and preparedness. During a disaster is the response phase. After the disaster, recovery and reconstruction become the most essential agendas. Once a disaster occurs, most cultural heritage sites cannot be protected from the imminent threat unless preparations have been effected to protect the sites because there are other priorities to address. However, global climate change increases the possibility and scale of natural disasters' ability to damage the environment and increase the difficulty of protecting one's cultural heritage. The value of cultural heritage lies in what is irreplaceable after it is destroyed. Thus, disaster risk assessment and prediction are critically important for the preservation of cultural heritage.

2.2.1. Risk management

Risk management is the steps and process of effectively managing possible events and reducing events' negative effects, preventing existing hazards from turning into disasters as well. Risk management should not only passively reduce the threat but actively pursue the possibility of innovation and public value. With the development of an ever-changing environment, risk management gradually becomes comprehensive emergency management. Three important elements should be included [13,14]:

- hazard: to review the present situation using past studies and scientific analysis and to understand and predict possible disasters in the future to reduce loss;
- risk: includes probability and/or likelihood. The probability analysis can be determined by the probability of certain disasters and their possible intensity;
- vulnerability: affected by constantly changing concepts, generally the result of the interaction between a dynamic natural environment and a complicated social and economic environment.

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