

# HERITAGE AT RISK

IMPROVING RESILIENCE  
AND AWARENESS TOWARDS  
PRESERVATION, RISK MITIGATION  
AND GOVERNANCE STRATEGIES

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EDITED BY  
MARCELLO BALZANI,  
FEDERICA MAIETTI  
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## HERITAGE AT RISK

It is assumed that the impact of natural and man-made hazards on society in terms of damage is constantly increasing. In order to reduce the levels of potential disaster and to assess which policies and measures can generate positive impacts, it is necessary to make a careful comparison of experiences at an international scale in risk mitigation and management.

The international scenario of calamitous events that still characterise all areas of the globe is deepened together with the experiences of the earthquakes and floods that have affected the Pianura Padana area and the central regions of Italy in the last ten years, included in the training project Academy “After the Damages”. Following the results published in the first volume *Built Heritage in Post-Disaster Scenarios*, *Heritage at Risk* aims to continue the debate on recent innovations and advances in risk management to contribute to the definition of strategies and the implementation of increasingly effective tools in terms of risk mitigation.

The volume provides insights into the dynamics and negative effects of natural and man-made hazards (i.e., earthquakes, fires, floods, droughts, and volcanic eruptions), including more updated approaches to deal with post-disaster phases. The book also offers tools to deal with possible international crisis scenarios and mitigate the social impact of vulnerabilities through risk reduction.

*Heritage at Risk* is aimed at public administration managers, government agency representatives, international organizations, researchers, and professionals in architecture, engineering, and earth science.



# Heritage at Risk

## Improving Resilience and Awareness Towards Preservation, Risk Mitigation and Governance Strategies

*Edited by*

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## Welcome message

In the wake of continuity with our commitment to the territory and its communities, we are pleased to introduce this new edition of the collection of proceedings dedicated to the International Academy "After the Damages", which, in the 2021 and 2022 appointments, once again provided space for in-depth studies on the post-2012 earthquake reconstruction in Emilia Romagna. This volume provides an opportunity for various professionals from both the public and private sectors to meet, united by an interdisciplinary approach aimed at addressing crucial issues for the future of our territory and communities.

The post-earthquake reconstruction of Emilia is an emblematic example of resilience and adaptability. The interventions documented in this volume range from innovative architectural and engineering solutions to urban and social planning strategies. The variety of contributions highlights the importance of an integrated approach, taking into account both technical aspects and social and economic dynamics. This holistic approach not only facilitates more effective physical reconstruction but also promotes the rebirth of affected communities, encouraging a return to normality and the construction of a more sustainable and secure future.

The testimonies collected here confirm the value and importance of this approach, which continues to provide tangible results and good practices for reconstruction. Moreover, this new edition stands out for its commitment to promoting the dissemination and exchange of results also at an international level, involving the academic and scientific world in broader contexts. Sharing Emilia's experiences with a global audience makes it possible to enrich the debate on how to deal with and overcome the consequences of natural disasters, creating a network of knowledge and skills that can be useful worldwide.

Confirming the quality of the work carried out and the integrity of the paths taken, this work is an important tool for those involved in the reconstruction of territories affected by catastrophic events and for all those interested in the sustainable development of the territory. We are confident that the knowledge and experience shared on these pages will help inspire and guide future projects and initiatives for the good of our communities. The case studies and in-depth analyses provided in this volume offer a valuable resource for administrators, planners, scholars and citizens engaged in the ongoing challenge of making our territories more resilient and capable of facing the challenges of climate change and other environmental threats.

In addition, the focus on training and further education underlines the importance of continuous preparation and shared learning. Through workshops, seminars and laboratories, the International Academy "After the Damages" aims to be not only a knowledge dissemination event but a true laboratory of innovation and experimentation, where ideas can be tested and perfected in a collaborative and stimulating environment.

In conclusion, this collection of proceedings is not only a testimony to the work done so far, but also an invitation to look forward, to keep collaborating and innovating to build a better future for our communities. We are grateful to all those who have contributed to this

project with their commitment and passion, and we trust that the lessons learned will serve as a guide and inspiration for increasingly frequent emergency contexts for which we must be prepared.

**Stefano Bonaccini**

*President of the Emilia-Romagna Region*

**Enrico Cocchi**

*Director of the Regional Agency for Reconstruction*

## Foreword

The second and third editions of *After the Damages*, which is the subject of this publication, testify to the value of a project promoted and nurtured by a genuine interdisciplinary approach at the heart of the training proposal. This approach was able to utilise highly qualified contributions from international experts, technicians, and policymakers who deal with the management and reduction of risks related to the impacts of natural and man-made catastrophic events on cultural heritage and the existing built environment.

The intensity and quality of the innovative pathway that the Emilia-Romagna Region has supported and shared with the Cultural Heritage Sector have been important factors in constructing a space for a genuine in-depth study and fruitful exchange, serving a vibrant multi-disciplinary community committed to developing high levels of both specialised and transversal skills in the cultural, economic and technological spheres to meet the demands inherent in the complexity of contemporary society.

The solid methodological and organisational framework that has characterised *After the Damages* across its three editions has highlighted on the international stage the dynamism, innovation and research characteristics that the Emilia-Romagna ecosystem is capable of deploying, even in the management of decision-making processes arising from disastrous events, whether natural or man-made.

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## Flooding risk profile: The Zanzibar case study

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**ABSTRACT:** The increasing frequency and intensity of disasters represent a significant threat, both direct and indirect, on different fronts and at different territorial levels. The environmental changes our time is facing are exacerbating the effects of natural hazards, becoming an increasingly central issue in global debates, both in terms of impacts but also how to manage these risks to reduce the former. Tropical rainfalls, cyclones, storm surges, floodings, tsunamis, weathering, sea level rise are only some of the major climate-change-related effects with respect to the hydrogeological risk, no stranger to the province of Zanzibar in Tanzania. The paper presents the results of the working group developed during the third edition of the International Summer School “After the Damages”, whose members work focused on some reflections in respect to the topics mentioned above with special attention to the case study of Zanzibar. Stone town, the old district of the city of Zanzibar - enlisted among the World Heritage Properties - and its community have been endangered for years now by a high level of hydrogeological risk. In 2016, as a first step in face of the environmental threat the GFDRR staff developed a Flooding Risk Profile for the area. The work provided a multi-hazard risk assessment for the implementation of appropriate disaster risk financing initiatives. Starting from the analysis of the good practices developed in Zanzibar, the contribution proposes some considerations on the state-of-the-art for the management of hydrogeological risk.

**Keywords:** Heritage , Hydrogeological risk, Disaster risk profile , Risk management, Zanzibar

### 1 INTRODUCTION

Hazards do not have to turn into disasters. To break the vicious cycle of “Disaster, respond, recover, repeat.”, we need a better understanding of disaster risk, in all its dimensions.

In 1979, the United Nations Disaster Relief Organisation of UNESCO, acknowledging the increasing destruction force of natural disasters, provided a first document with guidelines for the assessment of disaster risk (UNDRO/UNESCO, 1978). Probability, vulnerability, and the elements at risk - also known as exposure - are the three components to be considered when assessing the disaster risk of a given area in relation to a certain hazard. The first term corresponds to the probability that a phenomenon will occur with a given intensity in a defined area within a defined period. Exposure concerns all those elements at risk that may be adversely affected by the potential event thus including population, property, buildings, transportation,

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infrastructure, and economic activities. The last element represents the degree of loss of one or more elements at risk because of the occurrence of a natural phenomenon at a given intensity.

Risk is thus the expected value of loss with respect to the product of these three elements.

Despite climate change being recognized as a growing global phenomenon since the early 1990s, its impacts on cultural heritage started to be drawn together only in 2006 by UNESCO, highlighting the threat that the phenomenon and its interference with natural disaster is increasingly posing to our assets (UNESCO, 2006). The *Strategy for Risk Reduction at World Heritage Properties* calls on the State Parties to integrate risk reduction measures into national heritage planning and management documents by developing analyses to reduce local vulnerability with considerations also to the impacts of climate change (UNESCO, 2007). At global level, the *Sendai Framework for Disaster Risk Reduction (SFDRR)* (UNISDR, 2015) is a crucial document. The voluntary and non-binding 15-year agreement aims at promoting the strengthening for monitoring and assessing disaster risks. The Framework recognizes the primary role of the State in risk reduction actions, which must share responsibility with various stakeholders, including local governments and the private sector. Moreover, a crucial shift of the SFDRR is in raising awareness among policy makers of the connection between the protection of cultural heritage and territorial resilience (Pica, 2018). When it comes to risk management, one of the priorities of the Framework is the identification, assessment, and monitoring of disaster risks at World Heritage Sites. In fact, the first step to effectively address disaster risk should always be the identification of hazards and the determination of the potential extent of disasters (Tandon, 2013).

If at the beginning of the century natural disasters were perceived as isolated and quite circumscribed events, it is now more and more clear that the effects brought by the climatic changes are a new variable in the known equation and will not cease to increase (IPCC 2014). Slow and progressive atmospheric and environmental changes are amplifying natural hazards recurrence and magnitude bringing not only small but frequent events with disastrous impacts to affected areas, but also a more concerning and still evolving major global threat (Van Aalst 2003, Will and Meier 2007). Catastrophes triggered by the effects of climate change have become an increasing concern for the entire worldwide community. Slightly more than a decade ago, a World Economic Forum report revealed the increase in disaster events went from 150 per year on average in 1980 to more than 450 a year in 2007 (2008). The UNDRR defines a catastrophe as «an event, concentrated in time and space, through which a society is subject to severe danger and suffer such losses of life or material damage that the local social structure fails and all or some of the critical functions of the society can no longer be fulfilled» (1987). Again, UNISDR describes the concept of resilience as «the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely efficient manner» (2009). Following the two given definitions, the strict bond between the event and the coping capacity of the community is extremely explicit. Proactive governance, institutional preparedness, resources and expertise availability, risk awareness are only some of the key elements influencing the aftermath of a disaster. The ability and promptness of a community to respond to these situations is what could make a difference in certain situations, and it is sure that while in certain contexts anomalous situations can be managed effectively, in others they will lead to tragic consequences (Tandon, 2013).

Cyclones, floods, earthquakes, and tsunamis are increasingly affecting the Southwest Indian Ocean Island States (SWIO) which are already under pressure by a growing population and economic exposure. In 2011, in the hope to provide a solid disaster risk financing base, a Risk Assessment and Financing Initiative was activated. The aim of the initiative is to enhance the understanding of the risks for the area and identify appropriate solutions for an increased social, institutional, and financial resilience (The World Bank, 2017). A first step of disaster risk profiling will then lead to the development of evidence-based financing strategies and policy dialogues. Among the SWIO States, due to these natural hazards – and hydro-meteorological ones particularly - in addition to the threat posed to the community, Zanzibar suffers also the endangerment of its UNESCO World Heritage Site, Stone Town (The World Bank, 2016).

Starting from the analysis of the work done in the framework of the SWIO RAFI project, the present contribution proposes considerations on the current assessment and management strategies for the above-mentioned hazards.

## 2 ZANZIBAR AND STONE TOWN: AN OVERVIEW

Stone Town, in the modern-day Zanzibar city, has been recognized since 2000 as UNESCO World Heritage Site because of its unique preserved townscape and buildings that reflects the fusion of Swahili, Indian, Arab, and European cultures. Most of the buildings were built in the 18th and 19th Century being the Old Fort, the House of Wonder, the Old Dispensary, the Tippu Tip House and The Christ Church Anglican Cathedral, the most representative ones. The townscape of Zanzibar is also enriched by the large and traditional mansions facing the sea front. Particularly Stone town is also known for being the place where slave trading was finally terminated in 1873 (UNESCO,2000). The characteristic two storey houses of the Stone Town, were built principally in coralline ragstone, externally distinguished by elaborately carved and traditional double ‘Zanzibar’ doors, and richly decorated interiors reflecting the fusion of building techniques and cultures that makes Stone Town stand out.

Stone Town (Figure 1) is located on an island archipelago making it more vulnerable from the threats of climate change like floodings, droughts and cyclones (Myers, 2020). Recently it has been reported on the island of Zanzibar the increase of temperatures, rainfall variability, higher wind speeds and excessive high tide levels (Myers, 2020). This situation has led to considerable socioeconomic impacts on Zanzibar’s development and the impacts with the passage of the time are expected to be higher.



Figure 1. On the left, the streets of Stone Town of Zanzibar. On the right, portion of the city old buildings with the sea on the background. (Author: Ron Van Oers, <https://whc.unesco.org/en/list/173/gallery/&index=1&maxrows=12>).

### 3 METHODOLOGY

First of all, a SWOT analysis has been conducted in order to have an overview of the strengths and weaknesses regarding the Zanzibar archipelago, with particular reference to Stone Town; all the data analysed during the work came from a literature review and not from direct experience in the field.

Table 1. SWOT analysis developed for the Zanzibar archipelago taking into consideration also its built heritage.

SWOT ANALYSIS	
STRENGTHS	<ul style="list-style-type: none"> <li>- High Cultural Heritage and important socio-economic centre</li> <li>- Attention to the degree of naturalness of the environment</li> </ul>
WEAKNESSES	<ul style="list-style-type: none"> <li>- Tropical monsoon climate</li> <li>- Fragile heritage built</li> <li>- Shortage of stormwater management systems</li> </ul>
OPPORTUNITIES	<ul style="list-style-type: none"> <li>- Sustainable development</li> <li>- EU-funded ACP-EU Natural Disaster Risk Reduction Program and the ACP-EU Africa Disaster Risk Financing Program</li> <li>- Presence of scientific literature and data collection</li> </ul>
THREATS	<ul style="list-style-type: none"> <li>- Lack of a strategy to revitalise public spaces with a planning that allows to mitigate climate change and therefore the flooding risk</li> </ul>

The high artistic and cultural relevance and the socio-economic importance of Stone Town are factors that make an adequate risk analysis and management policy imperative, in order to preserve and give an effective response to the action of the disastrous events to which this area, as well as the whole archipelago of Zanzibar, is subjected. The presence of a monsoon-type climate, characterised by hot, moisture-laden winds that during the wet season often take on a thunderstorm character - even a very violent one - poses a great threat to the city's fragile artistic heritage, already partly in decline due to the friability of the local stone that characterises the buildings.

During this season, rainfall can in fact fall up to 40 cm in a day, making it one of the most destructive forces for historic architecture. Water penetrates the walls from above, slowly eroding the sandstone mortar and causing plaster detachments, while the lack of proper drainage systems in the roofs of buildings causes it to fall to the ground in an uncontrolled manner, accumulating in the base of the buildings and then rising from below into the walls by capillary action. The combined drainage and sewage network, in addition to being aesthetically unpleasing, becomes clogged and overflowing in heavy rains, constituting a public safety hazard, while the presence of several open intakes in the culverts for the flow of blackwater is a sanitation issue. In addition, the streets in Stone Town are very narrow and have rainwater management downspouts that are often damaged by vehicular traffic or obstructed by the presence of plants, as they are not maintained.

To date, there is also a lack of intervention plans that allow the revitalization of public spaces through careful urban planning, and the need for emergency management plans to mitigate the risks associated with climate change, of which floods are certainly the most present phenomenon. In contexts such as these, which are particularly prone to violent natural disasters, a good risk analysis is therefore essential, through the creation of databases that give us a picture of the hazard to which a certain area is subjected.

The strategy used by the SWIO-RAFI consists of creating a series of models that can generate probabilistic estimates of the frequency and intensity of the occurrence of catastrophic events, while also offering an empirical estimate of the possible effects, in economic and social terms, of these natural disasters. The risk profile analysed by SWIO-RAFI takes into account a number of factors, such as exposure, vulnerability of an area, hazards and loss, giving us a probabilistic but accurate picture of the post-disaster incidence and a tool to support the formulation of preventive policies.

The process used to develop the exposure data analysed by the World Bank Group are shown in Figure 1; starting with an analysis that considers several factors including building occupancy class, population, type of construction, and cost of reconstruction, a database is derived to calculate the economic losses incurred by buildings following the occurrence of a natural event.

Especially in fragile contexts such as this, the risk map proves to be an indispensable and necessary tool in order to prepare the community and stakeholders not only in the phase prior to the occurrence of a disaster event, but also to cope with the situation after it happens. Therefore, the importance of focusing on risk prevention and mitigation appears evident; the knowledge of the hazards to which an area is subjected and the most appropriate ways to reduce the associated dangers allows to lower the degree of vulnerability of a community.

Finally, the post-disaster reconstruction phase can be an opportunity to improve the resilience of cities and mitigate the effects of future further disasters. In this phase, non-structural interventions, aimed at reducing the extent of damage, are of particular importance, allowing the definition of land use classes, mapping the areas most prone to flooding and risk, implementing weather forecast analysis, and bringing in preventive interventions such as flood proofing.

#### 4 ZANZIBAR FLOODING RISK PROFILE

The Disaster Risk Profile done by the World Bank group on Zanzibar (2016) in the framework of the SWIO RAFI project identified flooding as the biggest hazard accumulating nearly 90% of the region's total annual direct losses from earthquake, floods, and cyclones (Figure 2). In this 90% of direct losses from flooding, nearly 90% comes from the residential sector, proving the vulnerability of houses in the island of Zanzibar and the possible direct impact to its inhabitants. It is estimated that annual emergency costs for floods are over 440,000\$.

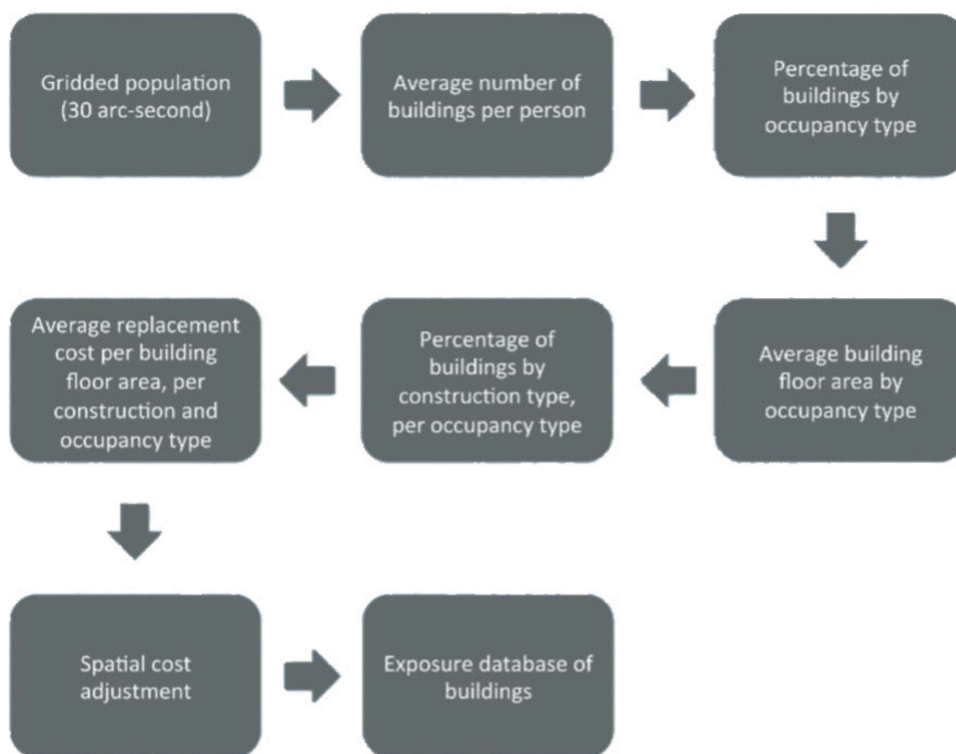


Figure 2. Schematic diagram illustrating the methodology used to develop the SWIO-RAFI exposure data. (The World Bank, 2016).

Preventive measures for the flood risk have taken place in the last years with the building of seawalls and mangrove plantations that reduced the impact of flooding in some parts of Zanzibar but not properly in Stone Town. In this context the government of Zanzibar has presented the Zanzibar climate change action plan (Zanzibar Government, 2014) with the aim to identify priority sites affected by climate change, specifically related to the areas affected by hydrological risks like flooding. Following this thread Badui (2020) elaborated a map indicating the most vulnerable areas for flood risk due to climate change in the city of Zanzibar. Some of these areas are close to Stone town, confirming the risk this World Heritage Site has regarding flooding. UNESCO in a 2021 report establishes the concern of the conservation status of some of the most representative buildings of Stone Town like the Tippu Tip House and the House of Wonders; these concerns might be aggravated due to the flooding risk.

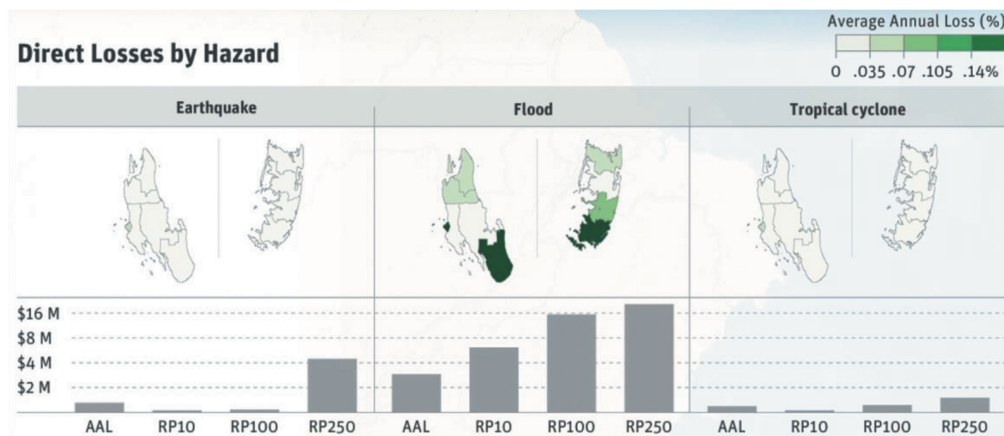


Figure 3. The picture shows how, according to the performed analysis, flooding is the most significant risk. The results show that this hazard causes almost 90% of the total average loss per year when considering earthquakes, flood, tropical cyclones. (The World Bank, 2016).

## 5 DISCUSSION

In recent years, the fight against natural disasters and the definition of strategies for the management of their effects have increasingly taken centre stage in the debate of the worldwide community. The intrinsic fragility of cultural heritage, which have already survived changes in its environmental context, is now facing further transformations which will be more and more severe in the coming decades (IPCC, 2014). The relevance of the topic in everyday life has brought to the urgencies of updated shared and effective operative practices in the field of disaster risk reduction and management.

These growing threats have led to the production of several documents, reports, and guidelines by hand of the multiple international organizations and activation of initiatives such as trainings and workshops in support of heritage managers facing these hazards. The *Report on predicting and managing the impacts of climate change on World Heritage* immediately brought to the acknowledgment of the threat and brought to the drafting of the *Strategy* for appropriate response of natural hazard-related disaster situations (WHC, 2006). In 2010, UNESCO released a series of Resource Manuals on the topics of World Heritage Properties management with particular focus on the disaster risk sphere. Beginning with the premise that at the time the number of World Heritage Properties that had implemented risk reduction measures, the objective of this handbook is to provide a preliminary reference for heritage managers in the development of plans, strategies, measures to reduce and contain the impacts associated with disaster risk. In 2015, right after the adoption of the SFDRR, UNESCO encourages once again all the Member States to act in the identification of risks and protection from the different natural hazards with the aim of preserving the integrity of the Properties (2015).

However, it is widely acknowledged that further steps need to be done in the field. Scholars argue that the recommendations and measures are presented on a large scale and on a plurality of aspects, consequently appearing sometimes too ‘generic’ to be adopted by site managers or, in other cases, appearing too often poorly disseminated and known in the more operational area of the sector (Phillips, 2015; Fatorić and Seekamp, 2017; Sesana et al., 2018). The research of the scientific community in recent years has focused mainly on the effects of climate change on heritage and on the simulation of future scenarios (Sabbioni et al. 2010; Fatorić and Seekamp 2017; Sesana et al. 2018) at the expense of defining strategies for managing and adapting sites to this new kind of challenge (Phillips 2015; Lefèvre 2017; Sesana et al. 2018).

The case of Stone town takes relevance considering the level of resilience and creativity their inhabitants need to adapt to flood risk with little economic resources. In this context an organised civil society protects their buildings with sandbags and small walls and works together in the reconstruction phase. Also, it is important to point out the ability of local governments to request resources from international organisations for the maintenance and implementation of preventive measures for flooding and heavy rainfall. All of this can be considered as good practices identified in the paper.

In the framework of the Summer School, an expeditive literature review on the topic was performed. The result consists of a series of documents from international organisations such as UNESCO, UNISDR and the World Bank and reports at national and local level from Zanzibar and Tanzania governments. Following the analysis of the retrieved documents, the paper proposes the next recommendations to reduce the impact of flood hazard in Stone Town.

Table 2. Good practices detected through the literature review in relation to direct and indirect initiatives for the management of water-related hazards.

<b>LOCAL</b>	<ol style="list-style-type: none"> <li>1. Local drainage system</li> <li>2. Urban water barriers</li> <li>3. Sand walls around buildings</li> </ol>	<ol style="list-style-type: none"> <li>1. Local drainage system that reconducts the water</li> <li>2. Small walls that prevents the entrance of water in residential areas</li> <li>3. Sandbags walls as an emergency measure to protect buildings in case of imminent flooding.</li> </ol>
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Finally, the paper proposes a vision for the future for the risk management in Stone Town regarding flood risk.

- Attention on good prevention practices.
- Active participation of citizens
- Focus not only on disaster response but rather on integration planning.
- Encourage specialisation on the qualification of field personnel.
- Raise awareness-building.

Stone Town is an UNESCO World Heritage Site that represents the fusions of cultures and is very well reflected in its architecture and urban landscape. This heritage is mainly at risk because of flooding due to its geographical condition and the impacts of climate change in the area. Socio economic factors also intervene because of the lack of resources of the local governments regarding risk management. This represents a challenge for policy makers that intend to preserve this important heritage. The paper as an introductory study that firstly intends to acknowledge the existence of World Heritage Sites that are at risk of natural disasters and have little resources to overcome them like the case of Stone Town and what are their strategies and what good practices can be identified. Then present a synthetic set of recommendations at the different government levels as a global strategy to reduce the risk and protect the heritage site. Finally, this paper has the objective to recognize the impact of climate change in World Heritage Sites and how policy makers can present a set of strategies that uses more creativity than economic resources.

## AUTHORS CONTRIBUTION

Conceptualization, A.C.G., B.M. and E.M.; methodology, A.C.G., B.M. and E.M.; resources, A.C.G., B.M. and E.M.; writing, Section 1—original draft preparation, E.M.; writing, Section 2—original draft preparation, A.C.G.; writing, Section 3—original draft preparation, B.M.; writing, Section 4—original draft preparation, A.C.G.; writing, Section 4—original draft preparation, A.C.G. and E.M.; writing-review, E.M., A.C.G., B.M.; writing – review and editing final version, E.M.; All authors have read and agreed to the published version of the manuscript.

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