

APPLICATION OF THE CLIMATE VULNERABILITY INDEX FOR THE RUINS OF KILWA KISIWANI AND THE RUINS OF SONGO MNARA, TANZANIA

CVI



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EXECUTIVE SUMMARY



Climate change is a major threat to World Heritage (WH) and many sites are already experiencing impacts from climate change related hazards. As the climate crisis intensifies, there remains an urgent need to understand the vulnerability of heritage sites.

This report describes the outcomes from an application of the Climate Vulnerability Index (CVI) for the *Ruins of Kilwa Kisiwani and Ruins of Songo Mnara* (hereafter RKK and RSM) WH property in Tanzania. The CVI methodology is an emerging technique to rapidly assess the vulnerability of natural and cultural WH, which assesses realised and potential impacts to both Outstanding Universal Value (OUV) and the associated community. It was held as part of the United Kingdom Arts and Humanities Research Council (AHRC) and Department for Digital, Culture, Media and Sport funded *Values-based Climate Change Risk Assessment: Piloting the Climate Vulnerability Index for Cultural Heritage in Africa Project* (hereafter CVI-Africa project). The CVI-Africa project was the first time the CVI had been applied to African WH properties.

The CVI was held on 18th and 19th October 2021, and applied the Consult mode, a more concise and rapid assessment than a full CVI Workshop. It was held in-person and involved the site manager, a representative from the National Museum of Tanzania, the Chairman and members of the site Ruins Committee and a translator. Facilitators and other project team members joined remotely. It was preceded by three preparatory webinars with contributions from experts from a wide range of backgrounds which fed directly into the Consult.

Within the CVI process, participants selected ca. 2040 as the future time scale on which to assess vulnerability and chose to consider a high-emissions scenario (Representative Concentration Pathway, RCP8.5). Participants identified the three climate stressors of greatest threat: Intense Precipitation Events, Sea level rise (trend), and Coastal erosion.

Examples of actual and potential impacts include the percolation of rainwater into structures, the erosion of gullies during heavy rainfall and the erosion of archaeological remains along the coast near the Gereza Fort.

The potential impact on the OUV, derived from exposure and sensitivity, was determined as extreme (the highest on a four-point scale, low to extreme) for Coastal erosion; high for Intense precipitation events; and as moderate for Sea level rise. Once adaptive capacity was taken into account, the combined **OUV Vulnerability** for the sites was determined to be **Moderate**.

The potential community vulnerability varied considerably. Economic values related to conservation and management were perceived to experience a future increase in economic activity resulting from a predicted increase to impacts, while those linked to tourism and services would be negatively affected by a loss of values. Impacts to cultural and social values were deemed to be negative at a moderate level. The adaptive capacities were deemed to be moderate for economic and low for social and cultural, resulting in the **Community Vulnerability** being determined as **Low**.

It was abundantly clear that previous adaptive measures taken at the site had a beneficial impact on both OUV and community adaptive capacity. These also contributed significantly to the local economy. As such, the RKK and RSM WH property represents a good example of how climate adaptation measures can both preserve the OUV of WH properties while simultaneously supporting local communities. It also highlights the value of local knowledge and experience locally, nationally and internationally.

I

INTRODUCTION



1.1 Background

This report outlines the results of applying the Climate Vulnerability Index (CVI) to assess the UNESCO WH listed property of the RKK and RSM WH in the United Republic of Tanzania.

“...climate change has become one of the most significant and fastest growing threats to people and their heritage worldwide...”

ICOMOS (2017)

Climate change is the fastest growing global threat to WH properties, many of which – natural, cultural, and mixed – are already being impacted. The International Council on Monuments and Sites (ICOMOS) stated in 2019, “The impacts of [climate-related] changes are already damaging infrastructure, ecosystems and social systems – including cultural heritage – that provide essential benefits and quality of life to communities” (ICOMOS 2019). The Intergovernmental Panel on Climate Change (IPCC) has predicted with ‘high confidence’ that “global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate”. The impacts of this temperature increase have been starkly detailed in the report ‘Climate Change 2021: The Physical Science Basis’ – the contribution of the IPCC’s Working Group I to the Sixth Assessment Report released in August 2021 (IPCC 2021).

The report on the results of the Third Cycle of Periodic Reporting in the Africa Region identified climate change and severe weather events as one

of the top six factors affecting WH properties in the region (UNESCO 2021). Among the top climate stressors identified were temperature change, drought, flooding and storms. One of the management priorities identified in the report includes the integration of climate change risks in the disaster risk reduction strategy of sites. This point is addressed in the accompanying regional action plan (2021-2027) which proposes solutions from the strategic and capacity building. In particular, the RKK and RSM WH property reported that the occurrence of tidal waves caused the masonry to disintegrate.

1.2 Why was the Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage Property chosen for the CVI process?

In May 2020, a bid for funding to the UK Arts and Humanities Research Council (AHRC) Global Challenges Research Fund scheme was submitted by a UK-based consortium based at Queen’s University Belfast partnering with various overseas organisations and individuals. The project was titled *Values-based Climate Change Risk Assessment: Piloting the Climate Vulnerability Index for Cultural Heritage in Africa* (hereafter CVI-Africa project), and part of the bid was for applications of the Climate Vulnerability Index (CVI) in two African WH properties (Figure 1.1):

- 1) Ruins of Kilwa Kisiwani and Ruins of Songo Mnara in the United Republic of Tanzania, and
- 2) Sukur Cultural Landscape in Nigeria.

These two WH properties were chosen as part of the CVI-Africa project, as both were at risk from climate change impacts yet represented diverse heritage typologies and hazard profiles.

Section 1

Introduction

The funding application was successful with the award running from 2020-21 from the UK AHRC and the Department for Digital, Culture, Media and Sport.

1.3 The hybrid CVI process

The CVI process outlined in section 4.1 is best undertaken through an in-person workshop of diverse stakeholders (including site managers, researchers, community representatives, management agency representatives, and other stakeholders). The CVI is a facilitated process and, due to travel restrictions caused by the global Covid-19 pandemic, it was not possible for facilitators to travel. To ensure a strong internet connection for remote facilitation, a shorter and smaller hybrid workshop following the CVI Consult mode (see Figure 1.2) was organised over two days on the 19th and 20th October 2021 away from the site in Dar es Salaam. Eight participants joined, both in-person and remotely (Appendix 3), from different sectors engaged in the process. A further three participants, including the workshop facilitators, joined remotely.

The Consult also provided an opportunity for some representatives of other WH properties in Africa to experience the CVI process. This included six trainees from a separate training course run by the CVI-Africa project who joined remotely from Cabo Verde, Kenya, Nigeria, Tanzania, Tunisia and Uganda.



Figure 1.1: CVI-Africa project sites in Nigeria and Tanzania

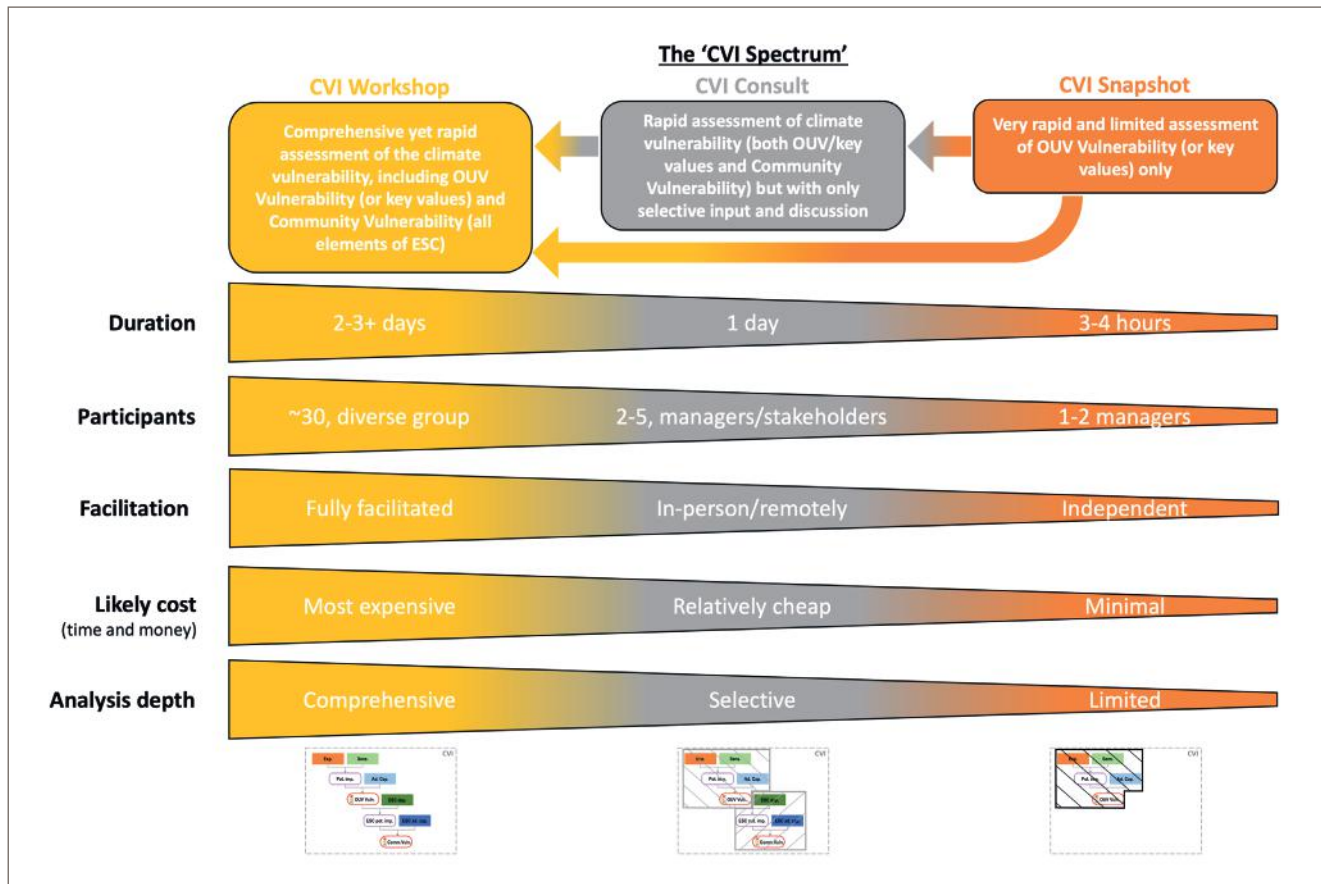


Figure 1.2: The CVI Spectrum (after Day et al. 2020)



2

RUINS OF
KILWA KISIWANI AND
RUINS OF SONGO MNARA
WORLD HERITAGE
PROPERTY

2.1 Country, location and World Heritage property overview

The United Republic of Tanzania is globally acknowledged for its cultural and biological diversity. It is home to over 120 different ethnic groups, resulting in a very high number of historical and ancient cultural sites. More than 500 heritage sites have been identified, 132 gazetted and 18 sites are regularly managed.

The islands of Kilwa and Songo Mnara are situated close to each other off the coast of Tanzania approximately 280 kilometres south of the capital of Tanzania, Dar es Salaam (Figure 2.1). These have archaeological and historical sites from between the 11th and 19th centuries, although there are also

substantially older archaeological deposits. On each island, the remains of two great East African ports have been preserved under the protection of the government of the United Republic of Tanzania. The islands were together inscribed in 1981 on the WH List, and the site is one of seven WH properties in the United Republic of Tanzania. Others are the Kilimanjaro and Serengeti National Parks, Selous Game Reserve, Stone Town of Zanzibar, Konda Rock-Art Sites and Ngorongoro Conservation Area. As shown in Figure 2.1 (B), both islands are fringed with mangroves to the west, and have open sea with a fringing reef to the east. Kilwa Island is about 5 kilometres long, 4 kilometres wide, and 23 kilometres in circumference.

A.



B.

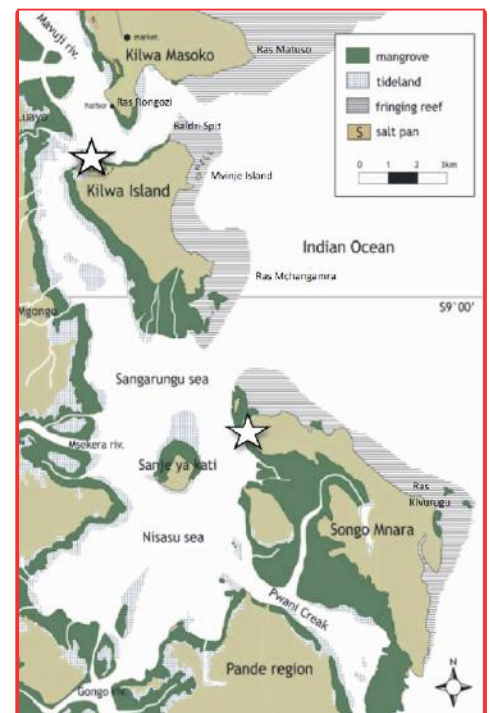


Figure 2.1: Location and detail of Kilwa Kisiwani and Songo Mnara, Tanzania

(A: left map) Tanzania showing the location of Kilwa Island and Songo Mnara (within red box);
 (B: right map) Kilwa Island and Songo Mnara showing broad-scale habitats (stars show location of main ruins).
 Source: Modified from Nakamura (2011)

Section 2

Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage Property

The name Kilwa takes its origin from the ancient medieval coastal city-state Quiloa as it was written in Portuguese travelling accounts, and the word Kisiwani means an Island. It is therefore called Kilwa. The name Songo Mnara originated from two words; Songo and Mnara, Songo representing the local natives of the place known as Wasongo and the language spoken is Kisongo and Mnara means a pillar.

The remains of these archaeological sites cover much of Kilwa Island with many parts of the port city still unexcavated. The substantial standing ruins, built from coral and lime mortar, include the Gereza Fort and the Great Mosque of Kilwa Kisiwani, the oldest standing mosque on the East

African coast. The mosque's great dome was the largest dome in East Africa until the 19th century, and its sixteen domed and vaulted bays have a unique layout (Figure 2.2).

The RKK and RSM include archaeological sites of prime importance that together provide exceptional architectural, archaeological, and documentary evidence for the growth of Swahili culture and the extraordinarily prosperous Indian Ocean trade along the East African coast (Chami 1994). They offer understanding of the Swahili culture, the Islamization of East Africa, and important insights regarding economic, social and political dynamics in the region from the 9th to the 19th centuries.



Figure 2.2: Vaulted bays in the Great Mosque of Kilwa Kisiwani (Photo: Megarry 2018)

From the late 12th to mid-14th centuries, Kilwa Kisiwani flourished as the most influential Islamic settlement along the Swahili Coast, thanks to extensive trade with other Indian Ocean centres (Perkins et al. 2014). Much of the Indian Ocean trade passed through these ports, and these ports were much admired by early European explorers. The merchants of RKK and RSM dealt in gold, silver, pearls, perfumes, Arabian crockery, Persian earthenware and Chinese porcelain.

The medieval scholar and explorer, Ibn Battouta, stopped at Kilwa Kisiwani (then Quiloa) and described it as one of the most beautiful cities of the world. Francisco d'Almeida (soldier, explorer, and the first viceroy of Portuguese India) seized it in 1505 and established a fortress there. The Portuguese named it the island of Quiloa; it was known by this name in the west and Milton made mention of it in his epic poem *'Paradise Lost'*.

The property was inscribed on the WH List in 1981 on the basis of cultural criterion (iii), bearing a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared (UNESCO n.d).

In recent years, the main livelihoods on the two islands have been fisheries and agriculture. In 2002, the Tanzanian national census figures identified a population on Kilwa Island of 924, residing in 163 houses, with 304 of the residents practicing agriculture and 260 engaged in fisheries. The property remains of religious importance to both local communities and to pilgrims who visit specific structures including the Great Mosque.

The protection and management of Tanzania's cultural heritage resources is through the *Antiquities Act* Cap 333 of (R.E. of 2002). This was first enacted by the independent government

in 1964 and amended in 1979, replacing the Monuments Preservation Ordinance of 1937 as the basic legislation for the protection and preservation of the country's cultural heritage. In 1977, Tanzania became a State Party to the 1972 UNESCO convention concerning the protection of the world's cultural and natural heritage. Since its ratification the country's rich and unique cultural and natural values have been recognised by the inscription of the seven WH properties.

2.2 Property conservation history

The RKK and RSM conservation history goes back to the 1900s during the German colonial rule when Berhardit Parrot, an amateur interested in antiquities, collected and took some architectural elements to Germany. Two years later in 1902, a protection zone (Kronland) was established using stone, incorporating the Malindi Cemetery, Makutani Palace, Husuni Kubwa and Husuni Ndogo. Following this, the district administrator (the Bezirksamtman) received funds, technicians and workers for conservation works at the site which were cancelled due to the outbreak of World War I. This conservation project is evidenced by a building, known as "Kwa Mdachi" or German House, at the site of Kilwa Kisiwani.

The property was declared a national monument in 1937 when the Monument Preservation Ordinance was enacted. Subsequently, conservation works were focused mainly on site cleaning and on the consolidation of dangerous and damaged walls. More robust conservation works were begun between 1952 to 1956 by the newly established Department of Antiquities; however, work intensified between 1958 to 1965 by Neville Chittick and the British Institute in Eastern Africa, focusing on all major monuments at both Kilwa Kisiwani and Songo Mnara.



Figure 2.3: Protective Wall in front of the Malindi Mosque at Kilwa Kisiwani (Photo: Megarry 2018)

After Tanzania independence, the property was declared a National Monument under the Antiquities Act of 1964 (Antiquities Act CAP 330, amended in 1979). Under this Act, both the monument and their adjacent grounds were protected. It is this fundamental instrument that guides all research, conservation, protection and management of heritage resources in the country. The period between 1972 to 2002 was marked by minor conservation works and site cleaning. In 1981, the RKK and RSM WH property was inscribed on the WH List.

Between 1999 and 2016, a new phase of conservation works focused on addressing impacts from natural and anthropogenic pressures which had resulted in the destruction of monuments and structures across both sites. During this period,

in 2004, the property was inscribed in the List of WH in Danger at the 18th Session of the WH Committee. The process facilitated significant international support to tackle a number of threats, including:

- Sea wave erosion from ocean wave action;
- Vegetation and plant infestation on the ruins particularly at Husuni Kubwa, The Great Mosque, Makutani Palace, Malindi Mosque, Husuni Ndogo, the Sultan Graves, the Songo Mnara Palace and the Gereza Fort;
- Deep and long cracks in domes at the Small Mosque and at the Great Mosque;

- Rain water penetration and infiltration particularly at the monuments without roofs;
- Deterioration of the architectural heritage fabric due to natural degradation and structural failures;
- Encroachment due to human settlements; and
- Inadequate implementation of the conservation and management plan.

Conservation responses focused on improving the state of conservation of monuments and capacity building with the local community in built heritage conservation. These included the construction of the Kisiwani jetty under the support of the Japanese Government and the Antiquities Division of the Ministry of Natural Resources and Tourism and the 'Kilwa Project', which was carried out between 2002- 2004, and focused on the conservation of the Great Mosque and the Small Dome Mosque. This project also trained more than 20 youths as conservation technicians. Further conservation works were funded by the French Government and undertaken by a volunteer organisation called CHAM in collaboration with conservation architects (Figure 2.3). By 2013, the RKK and SM WH property had attained the desired state of conservation and was removed from the List of WH in Danger in 2014.

2.3 Identifying and assessing the key values of Kilwa Kisiwani and Songo Mnara

A WH property is inscribed because it has values that have been recognised as being of international significance. Those values are underpinned by *attributes* (tangible or intangible characteristics) which can be used to manage the property. The key values and attributes are

derived from the Statement of Outstanding Universal Value (SOUV – Appendix 1).





Analysis of the SOUV to determine key values of the property is a foundational component of the CVI process. Excerpts from the SOUV were identified and grouped into common themes and were assigned a name as a list of 'key values' (shown as coloured groupings of excerpts in Table 2.1). The list of key values for the RKK and RSM was initially compiled by the CVI developers and subsequently endorsed by the property managers.




Participants in the CVI Consult assessed the current condition and recent trend (since inscription) of the key values and attributes (Table 2.1, legend below table).

Section 2

Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage Property

Table 2.1 - Key values derived from the Statement of Outstanding Universal Value, together with the assessed current condition and recent trend since inscription in 1981

Key values	Excerpts taken directly from the Statement of OUV	Attributes (at the level at which management is undertaken) for each key value	Assessment of current condition and recent trend (since 1981)
1. Ruins of Kilwa Kisiwani	the remains of two port cities... the larger, Kilwa Kisiwani	Tangible attributes	
	exceptional architectural, archaeological and documentary evidence	Intangible attributes	
	ability of the islands to continue to express truthfully their values has been maintained in terms of design and materials due to limited consolidation of the structures using coral stone and other appropriate materials,	<ul style="list-style-type: none"> standing ruins construction methods (e.g., stone coral and lime mortar) truthfully expressing the values 	
2. Swahili trading history	occupied from the 9th to the 19th century and reached its peak of prosperity in the 13th and 14th centuries. In 1331-1332, the great traveller, Ibn Battouta made a stop here and described Kilwa as one of the most beautiful cities of the world	Tangible attributes	
	Swahili trading cities and their prosperity was based on control of Indian Ocean trade with Arabia, India and China, particularly between the 13th and 16th centuries, when gold and ivory from the hinterland was traded for silver, carnelians, perfumes, Persian faience and Chinese porcelain.	Intangible attributes <ul style="list-style-type: none"> traded items (e.g., gold, ivory) was one of the most beautiful cities of the world trading routes 	
3. Diverse cultural history	...documentary evidence for the growth of Swahili culture and commerce along the East African coast from the 9th to the 19th centuries, offering important insights regarding economic, social and political dynamics in this region.	Tangible attributes	
	...occupied from the 9th to the 19th century and reached its peak of prosperity in the 13th and 14th centuries.	<ul style="list-style-type: none"> Kilwa's own currency in 14th C Portuguese fort 	
	The islands of Kilwa Kisiwani and Songo Mnara bear exceptional testimony to the expansion of Swahili coastal culture, the Islamisation of East Africa and the extraordinarily extensive and prosperous Indian Ocean trade from the medieval period up to the modern era.	Intangible attributes	
	Kilwa Kisiwani minted its own currency in the 11th to 14th centuries. In the 16th century, the Portuguese established a fort on Kilwa Kisiwani, and the decline of the two islands began.	<ul style="list-style-type: none"> documentary evidence for the expansion of Swahili culture economic, social and political dynamics 	
4. Great Mosque	...built of coral and lime mortar...include the Great Mosque constructed in the 11th century and considerably enlarged in the 13th century, and roofed entirely with domes and vaults, some decorated with embedded Chinese porcelain;	Tangible attributes	
	Great Mosque of Kilwa Kisiwani is the oldest standing mosque on the East African coast and, with its sixteen domed and vaulted bays, has a unique plan. Its true great dome dating from the 13th was the largest dome in East Africa until the 19th century.	<ul style="list-style-type: none"> Great Mosque embedded porcelain The palace, Husuni Kubwa 	

Key values	Excerpts taken directly from the Statement of OUV	Attributes (at the level at which management is undertaken) for each key value	Assessment of current condition and recent trend (since 1981)
5. Other key buildings	the Gereza Fort constructed on the ruins of the Portuguese fort and an entire urban complex with houses, public squares	Tangible attributes <ul style="list-style-type: none"> the Gereza Fort the palace, Husuni Kubwa Little palace, Husuni Ndogo 	
	the palace Husuni Kubwa built between c1310 and 1333 with its large octagonal bathing pool; Husuni Ndogo, numerous mosques		
6. Archaeology remains many parts of the city still unexcavated.	Tangible attributes <ul style="list-style-type: none"> archaeological remains ruins of Portuguese fort burial grounds? Intangible attributes <ul style="list-style-type: none"> documentary evidence 	
	exceptional architectural, archaeological and documentary evidence		
	burial grounds, etc.		
7. Ruins of Songo Mnara	The ruins of Songo Mnara, at the northern end of the island, ...	Tangible attributes <ul style="list-style-type: none"> five mosques palace complex domestic dwellings 	
	the remains of five mosques, a palace complex, and some thirty-three domestic dwellings constructed of coral stones and wood within enclosing walls.		

LEGEND


RKK and RSM – CURRENT CONDITION AND TREND

CURRENT CONDITION

Rating	Criteria
Good	The site's values are in good condition and are likely to be maintained for the foreseeable future, provided that current conservation measures are maintained.
Good with some concerns	While some concerns exist, with minor additional conservation measures the site's values are likely to be essentially maintained over the long-term.
Significant Concern	The site's values are threatened and/or may be showing signs of deterioration. Significant additional conservation measures are needed to maintain and/or restore values over the medium to long-term.
Critical	The site's values are severely threatened and/or deteriorating. Immediate large-scale additional conservation measures are needed to maintain and/or restore the site's values over the short to medium-term or the values may be lost.

TREND (since inscription in 1981)

 STABLE
  IMPROVING
  DETERIORATING
  UNKNOWN



Section 2

Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage Property

2.4 Other significant property values

The CVI process is primarily based on the vulnerability of the SOUV. While those WH values are internationally recognised as being outstanding, WH properties invariably have other important values, whether they are heritage values (tangible or intangible) or other values (e.g., economic, social, spiritual, environmental, scientific). These values may be important locally, regionally, or nationally, and may even be considered ‘significant’ under local or regional by-laws, or even national legislation. For the CVI, these are referred to as other Significant Property Values (SPVs), recognising that these other values will also be subject to impacts from stressors like climate change. While not assessed in the CVI process, identifying these SPVs can be useful for site managers, custodians and communities when making site conservation and management decisions. Of note is that the list of SPVs is more variable and interpretative and can continue to grow (compared to the values within the SOUV which are ‘etched in stone’ and fixed at the time of inscription).

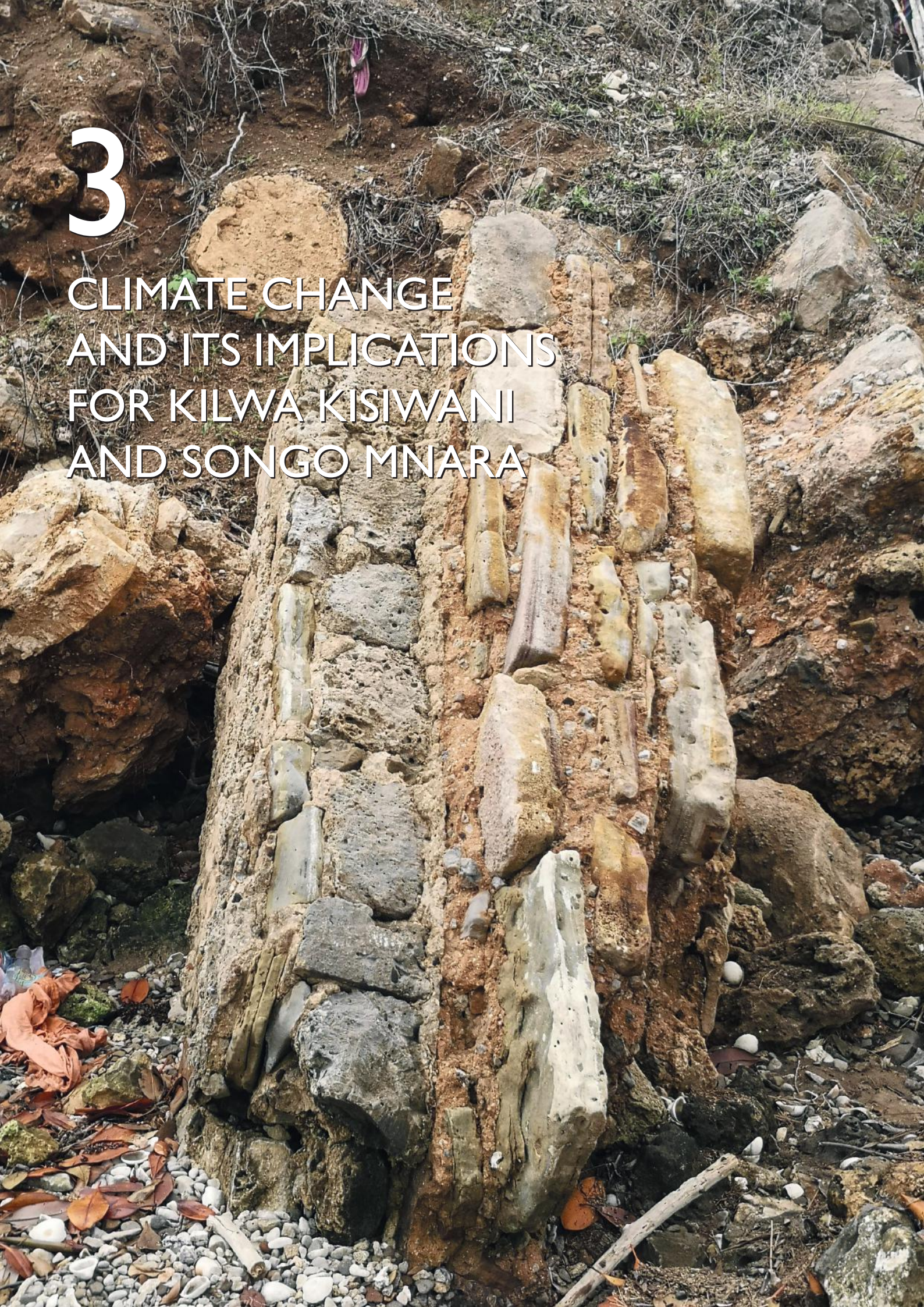
For RKK and RSM WH property, the hybrid CVI process, and the preliminary webinar in particular, sought to identify and document some (but not necessarily all) SPVs for the property. A summary of these is presented in Table 2.2 with the full list in Appendix 4.

Table 2.2 - Examples of other significant property values (SPVs) for the Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage property identified during the CVI process. The full list is provided in Appendix 4.

Broad groupings of SPVs	Key SPVs	Additional justification
Biological diversity (e.g., other flora, fauna, or habitats of significance not in the SOUV)	The site is rich in terrestrial and marine natural assets which are important to the community.	The terrestrial forest and mangroves and sea contain many species of fauna.
Aesthetic values or phenomena (e.g., any special scenic qualities or phenomena that are significant)	The combination of cultural and natural scenery has aesthetic value	The terrestrial forest and mangroves and sea contain many species of fauna
Economic values (e.g., provide income or employment opportunities through tourism, fishing, or other commercial activities, etc.)	Including employment, fishing, agricultural, trade and commerce, communications, construction, research and production opportunities	Various scales of activities. Tourism and research offer opportunities through trade and transport. The site has traditionally also been a source for building materials.
Recreational values (e.g., provide for recreational activities like hiking, camping, wildlife viewing, etc.)	The natural amenities offer great recreational opportunities	The landing places and ports used around the estuary are often sandy beach locations and have value for activities and to hotel building and swimming.
Historic/cultural values (e.g., features or locations that represent history or enable traditions or ways of life to continue, etc.)	Archaeological evidence from other important periods at the site and in the surrounding area. Also intangible traditions like oral histories and bead making	There is a long history of occupation prior to that already recorded in the Outstanding Universal Value (OUV), from the Middle Stone Age to Late Stone Age into the Iron Age. These periods remain understudied.
Learning/ Scientific values (e.g., opportunities for scientific research, nature interpretation, etc.)	Traditional crafts and local knowledge and education opportunities	This includes boat making and craft work which are still practiced at the site. There is an opportunity to help preserve this knowledge by training others at the sites.
Spiritual/ Philosophical fulfilment (e.g., areas that are sacred, religious, or spiritually significant, etc.)	International value for religious visitors and the local community. There are also strong mythological values.	International Islamic tourism to the mosque sites, local use of sites for ritual activities which remain focal points for community activities.
Health/ therapeutic values (e.g., areas that enable people to feel better physically or mentally, etc.)	Oral histories about the site and the value of bead culture	These record the medicinal aspects of plants and places while bead culture at Kilwa reflects medicinal or health-related concerns and cures.

3

CLIMATE CHANGE AND ITS IMPLICATIONS FOR KILWA KISIWANI AND SONGO MNARA



3.1 Current climate

Kilwa Kisiwani and Songo Mnara are located on islands off the southern coast of Tanzania in Kilwa district of the Lindi region, at around 9°S (Figure 2.1). The climate is typical of maritime tropics with hot and humid periods regulated by coastal processes (e.g., sea breeze). The warmer wet season from November to April coincides with winds from the north and higher solar radiation levels, contrasting with the cooler dry season (May-October; Table 3.1). Air temperature ranges between 18°C (June, July and August) and 32°C (November), rarely exceeding 33°C. Solar radiation is typically highest in November with an average of 27 MJ/m² (1979-2014 data) compared with the June minimum of 18 MJ/m². Wind from November to March is predominantly north-easterly, in contrast to south-easterly winds from April to October (Mahongo et al. 2011). Wind speeds are seasonally highest from May to October (average of ~3.5 m/s), with the highest wind speeds typically in July. The lowest wind speeds occur in March and December (~2.2 m/s) coinciding with the seasonal change in wind direction (Mahongo et al. 2011). Annual rainfall in Kilwa is around 1180 mm, with the greatest contribution typically in March. In the dry season (June-September), rainfall is typically scarce¹.

Sea surface temperature along the property's coast remains above 25°C year-round, peaking in March/April but typically not exceeding 30°C² (Heron et al. 2015). Warm periods of SST are usually associated with phases of the Madden-Julian Oscillation (MJO), which increases the convective activity of the Indian Ocean and enhances rainfall and cyclone formation. Over 70 years, only one tropical cyclone made landfall close to the property – in 2019, cyclone Kenneth was reported to make landfall in southern Tanzania (Msemo et al. 2021). In late-April 2021, tropical cyclone Jobo was forecasted to make landfall in the region; however, the cyclone weakened with heavy rains reported in the region (IFRC 2021)³.

1 Data from Tanzania Meteorological Authority. <http://maproom.meteo.go.tz/maproom/Climatology/>

2 Data from NOAA Coral Reef Watch's CoralTemp climatology. <https://coralreefwatch.noaa.gov>

3 Data from NOAA Coral Reef Watch's CoralTemp climatology. <https://coralreefwatch.noaa.gov>

Section 3

Climate Change and its Implications for Kilwa Kisiwani and Songo Mhara

Table 3.1 - Seasonal variation in climate variables for the region around Kilwa

Parameter	J	F	M	A	M	J	J	A	S	O	N	D
Air temperature												
Solar radiation												
Wind speed and direction*	NE						SE					
Rainfall												
Sea temperature												
Tropical cyclone occurrence												

* Wind speed indicated by depth of shading; direction by colour.

3.2 Observed climate trends

Climate variables provide evidence of climate change that has occurred in the last few decades in the region. Reanalysis data from National Centers for Environmental Prediction (1979-2014) for the Lindi region indicate increases in annual minimum and maximum temperature have occurred (Figure 3.1-left), consistent with instrumental records from Tanzania Meteorological

Authority (1961-2013). The rate of increase in minimum temperature (0.17°C/decade) has been consistent with that in maximum temperature (0.171C/decade; 1979-2014). Monthly-averaged wind speed has increased by 0.1 m/s per decade (1979-2014). There has also been an increase in annual rainfall during the historical period (97 mm/decade; Figure 3.1-right). Relative humidity has increased by 3.3% annually with the greatest change in March and April (1979-2014).

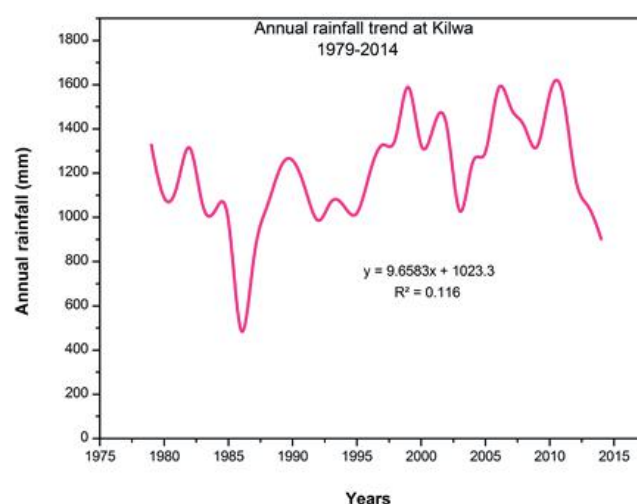
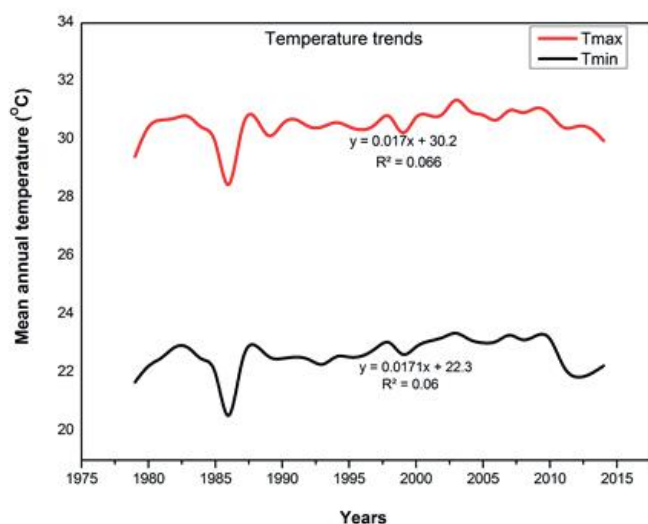


Figure 3.1: Observed annual temperature (left panel) and rainfall (right panel) in the Lindi region, 1979-2014

3.3 Anticipated climate change

RCP 4.5 describes an intermediate scenario in which emissions peak around 2040 and then decline, leading to a stabilisation of atmospheric greenhouse gas concentrations; in this scenario, air temperature will reach around 1.1°C and 1.5°C in the middle and at the end of this century, respectively. Climate projections for the Lindi region, from the Coupled Model Intercomparison Project Phase 5 (CMIP5; IPCC 2014, 2019) indicate continued and accelerating climate change. Under a high-emissions scenario (Representative Concentration Pathway, RCP 8.5), air temperature is projected to warm in the southern coast regions by around 1.5°C mid-century and more than 3°C by 2100 (above 1986-2005 levels; Figure 3.2). Temperature increases are projected to be greater in May-July (the cooler months) than at other times of year, in both mid-century and end-of-century analyses. These projected levels of warming will increase the number of very hot days (maximum temperature >35°C) in the region by 0 days in 2020-2039 to around 160 days in 2080-2099 (Figure 3.3).

Rainfall in the region is projected to increase during the wet season and decline in the dry season, varying in the amount of change based on future time frame and climate scenario (Figure 3.4). Changes in evaporation (and transpiration) in southern Africa are projected to reduce soil moisture, increasing risk of drought. Changes in other climate variables are informed by considering global and/or regional projections. Sea level is projected to rise globally by 0.32 m mid-century and 0.84 m by 2100 (IPCC 2019), which is likely to increase vulnerability of low-lying coastal areas to erosion and increase the risk of storm surge. Groundwater resources in coastal areas are vulnerable to saltwater intrusion related to sea level rise (Niang et al. 2014).

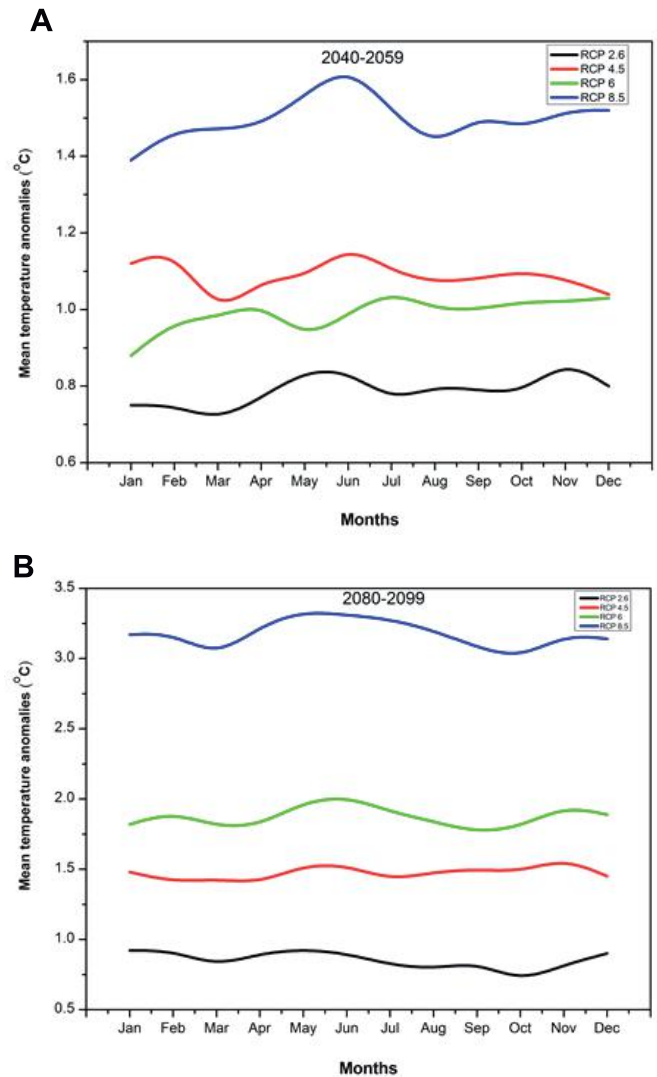


Figure 3.2: Projected monthly temperature increase relative to 1986-2005 for the Lindi region under different climate scenarios Representative Concentration Pathways (RCP) for (A) mid-century and (B) end-of-century.

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Climate Change and its Implications for Kilwa Kisiwani and Songo Mhara

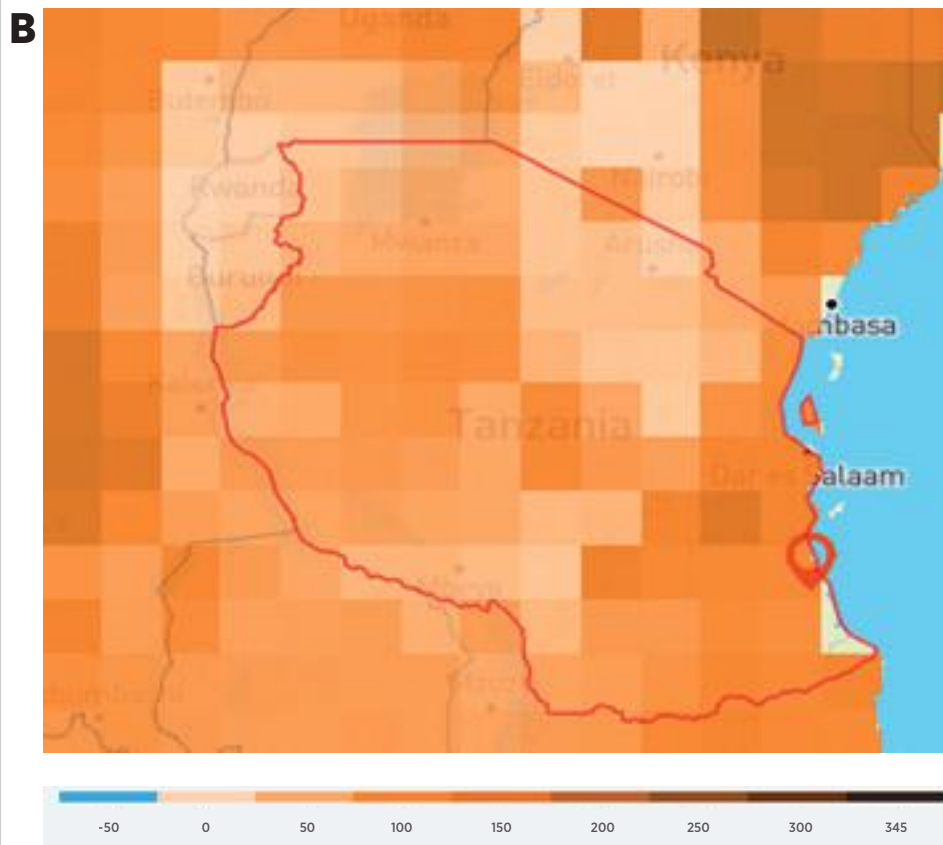
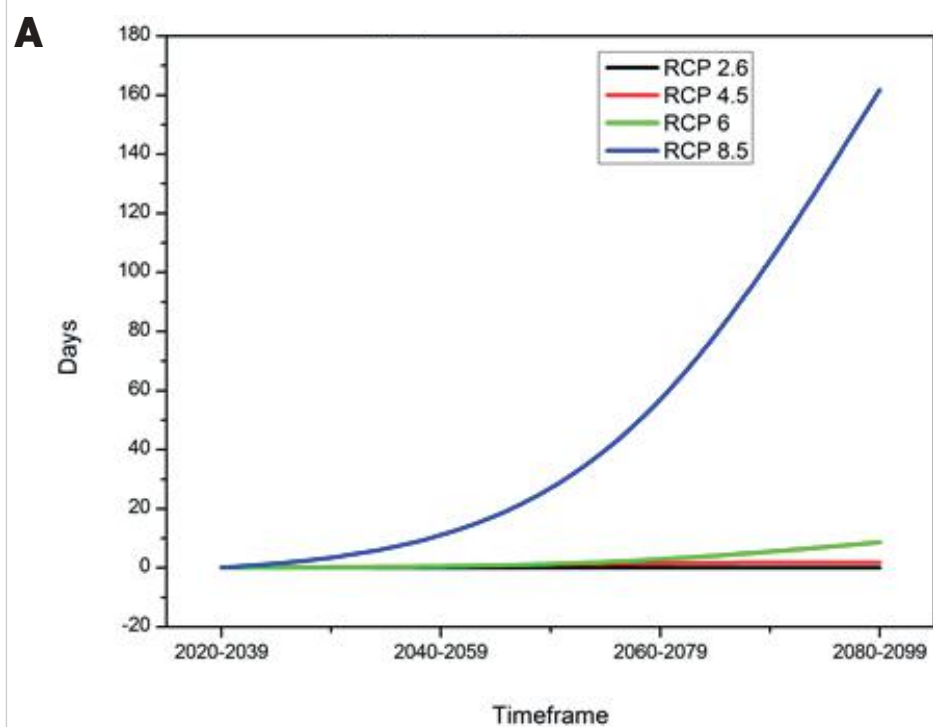


Figure 3.3: Projected change in annual days above 35°C (A) under various climate scenarios (Representative Concentration Pathway (RCP); and (B) under RCP8.5 for 2080-2099. The red marker in (B) indicates the Kilwa location.

Climate projections of sea surface temperature in the tropical Indian Ocean indicate a range of warming of 1-3°C at the end of the century under intermediate (RCP4.5) and high-emissions (RCP8.5) scenarios. One condition for the formation of tropical storms (i.e., cyclogenesis) is that sea surface temperature is above 26°C; the

projected ocean warming will likely increase the frequency of tropical cyclones in the Kilwa region. The western Indian Ocean has high rates of evaporation and leading to high levels of salinity; increased ocean temperature will further increase ocean salinity (IPCC 2014).

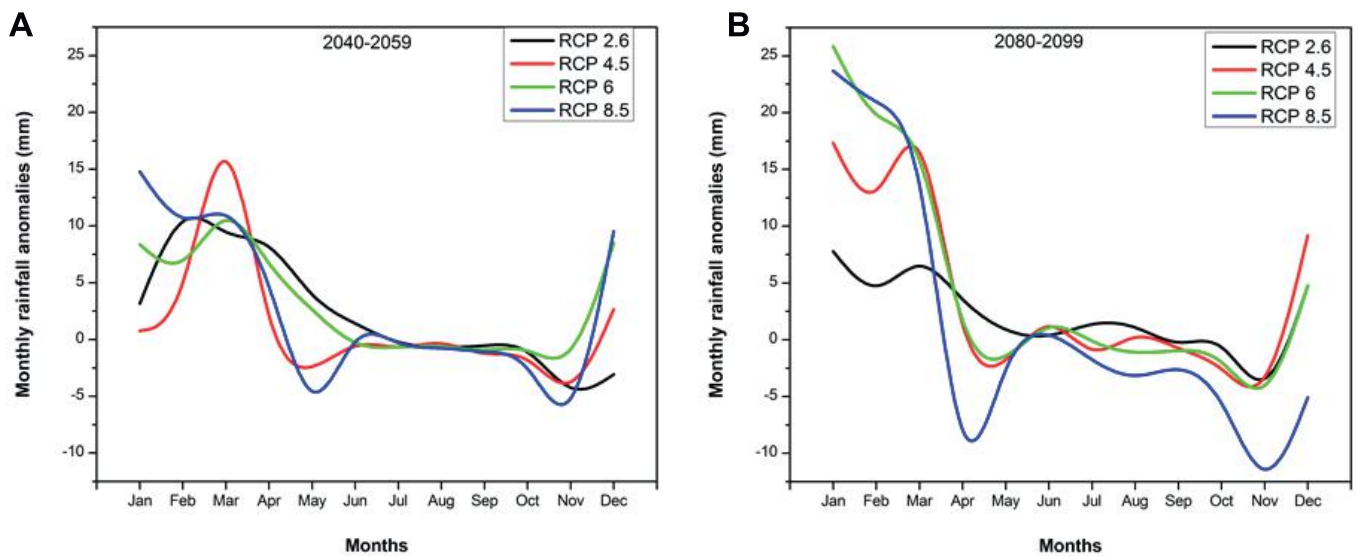
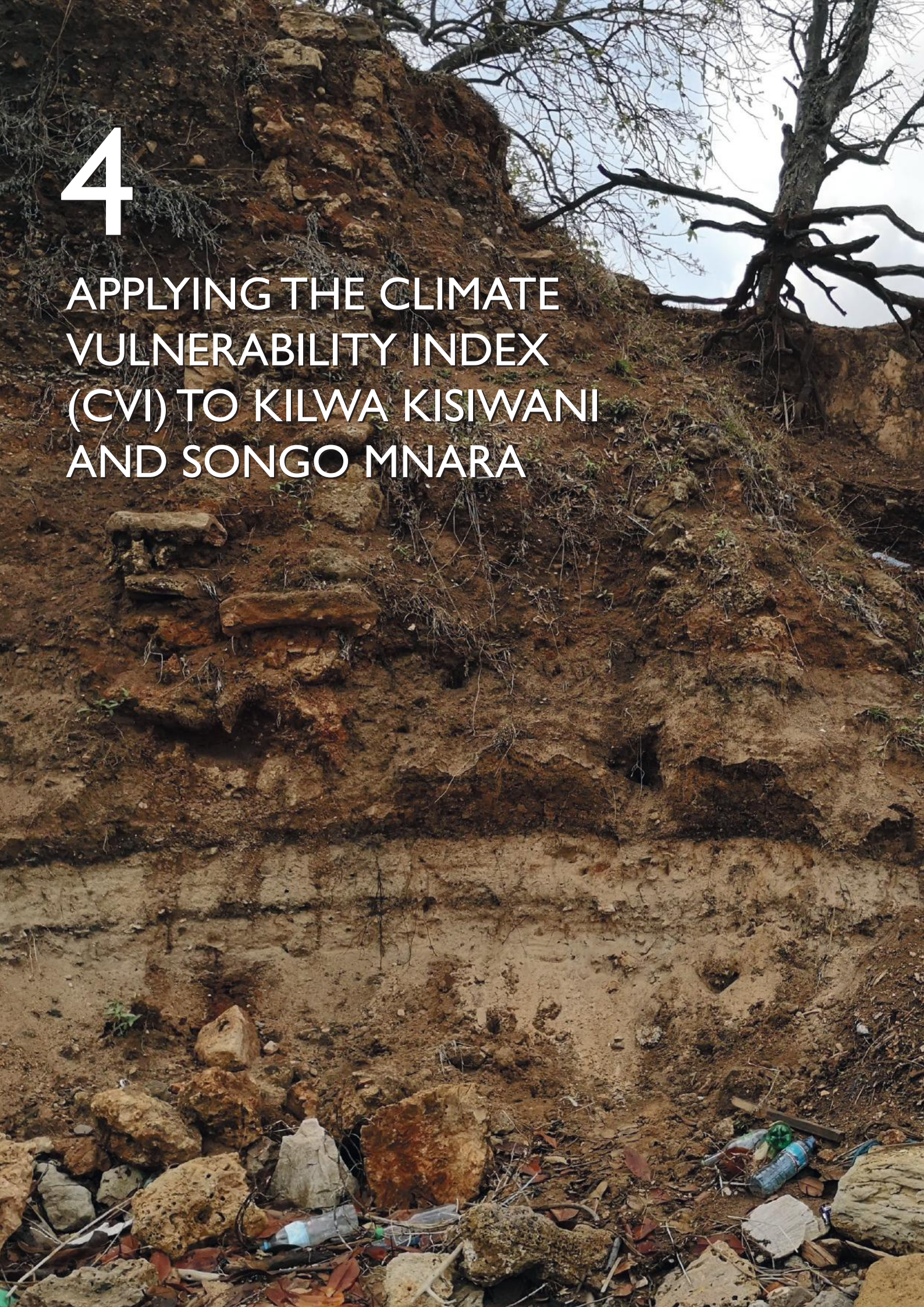


Figure 3.4: Projected change in monthly rainfall under different climate scenarios (RCP) for (A) 2040-2059; and (B) 2080-2099.

4

APPLYING THE CLIMATE VULNERABILITY INDEX (CVI) TO KILWA KISIWANI AND SONGO MNARA



4.1 The Climate Vulnerability Index

The Climate Vulnerability Index (CVI) is a systematic and rapid assessment tool that is values-based, science-driven and community-focused. It was initially developed to assess the impacts of climate change upon all types of WH areas, considering the Outstanding Universal Value (OUV) and the associated 'community' (local, domestic, and international). However, with climate change being increasingly recognised as a major threat globally, there is growing interest in applying the CVI process to other heritage sites and properties.

The CVI framework builds upon the vulnerability framework approach described in the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007). Vulnerability of OUV is determined by assessing

the exposure, sensitivity and adaptive capacity with respect to determined climate stressors. The OUV Vulnerability becomes the exposure term to assess the vulnerability of the community associated with the property, combining with assessments of economic-social-cultural dependency (sensitivity) and adaptive capacity (Figure 4.1). A customised spreadsheet-based worksheet is used to determine outcomes based on user inputs. A more detailed outline of the CVI methodology is provided by Day et al. (2020).

At the time of this report, applications of the CVI had occurred in various natural WH properties in Australia, Germany/Netherlands/Denmark and Seychelles, and in various diverse cultural WH properties in Scotland, Norway and in Africa. The CVI was also the focus of a comprehensive online training course for six African trainees as part of the CVI-Africa project.

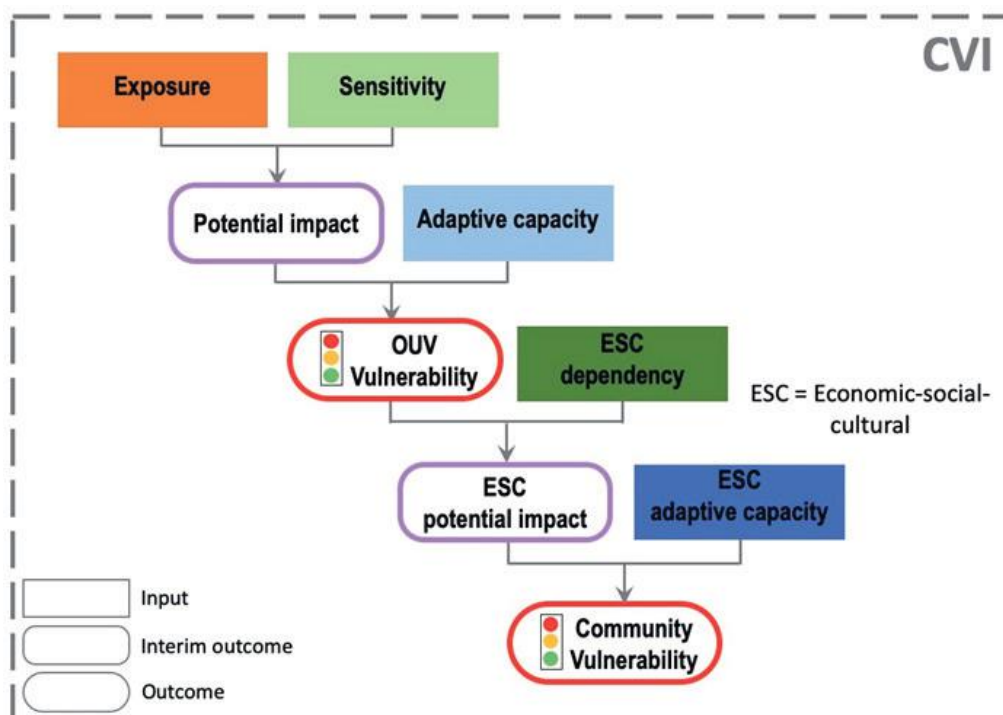


Figure 4.1: The CVI framework to undertake rapid assessment of climate change vulnerability of World Heritage properties and associated communities.

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Applying the Climate Vulnerability Index (CVI) to Kilwa Kisiwani and Songo Mnara

4.2 Applying the CVI process for the Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage property

Well in advance of the CVI workshop for the RKK and RSM WH property, a Steering Committee was established to arrange logistics and to ensure the required outcomes of the project would be achieved.

Three preparatory webinars were held to provide background in Climate Science; Heritage Values; and Socio-Economic Values (see Appendix 2). The reports/videos of these were available for participants before and during the workshop.

The actual CVI process was undertaken as an online Consult (see Figure 2.2, Day et al. 2020), a more concise and rapid process undertaken with key stakeholders. For the RKK and RSM WH property, this comprised two four-hour sessions (19th & 20th October 2021). The majority of participants (see Appendix 3) were present at the Seashells Hotel in Dar es Salaam, Tanzania, with others joining online from elsewhere in Tanzania, Ireland and Australia. Each session commenced at 06.00hrs GMT to account for the time differences.

4.3 Selection of key climate stressors

Within the CVI process, a list of 15 climate stressors considered likely to impact a broad range of WH properties has been developed. Definitions of these were clarified during the Consult sessions, including the characterisation of each as either 'chronic' (i.e., acting over years-to-decades, also known as trend or press stressors) or 'acute' (i.e., acting over a shorter periods of days-to-weeks, also known as event or pulse stressors). The two climate stressors relating to snow and ice were not included in the assessment for RKK and RSM WH property. There is also scope within the process to nominate a climate

stressor that is particularly relevant to the specific property but not featured in the standard list; however, this was deemed not necessary for the RKK and RSM application.

The time scale on which to assess vulnerability was determined by the participants to be ca. 2040, reflecting conservation management planning at the property. The participants also chose to conduct the assessment considering a high-emissions scenario (Representative Concentration Pathway, RCP8.5), noting that future climate change progression until 2050 is anticipated to be fairly similar under other RCPs (e.g., stabilisation scenario, RCP4.5) due to committed warming from historical greenhouse gas emissions.

For each of the identified key values from the SOUV, the participants analysed which three climate stressors would be likely to have the greatest impact. The two key values related to historical values (i.e., Swahili trading history and Diverse cultural history) were not evaluated as they pertain to cultural remembrance that will not be impacted under climate change. Only two climate stressors were selected by participants regarding potential impacts to the Great Mosque, whilst the diversity of components within the 'Other key buildings' key value led to selection of four climate stressors. The climate stressors were ranked according to the frequency with which they appeared among the top three for each value under a high-emissions climate scenario (Table 4.1, Figure 4.2).

Table 4.1: Climate stressors identified as likely to have the greatest impact, assessed for five of the seven key values of OUV (not for key values describing cultural history). Marked cell indicate that the climate stressor was selected for that key value. Impact were assessed for ca. 2040 under a high-emission scenario.

Key values of OUV	Temperature trend (air and/or water)	Extreme temperature events	Precipitation trend	Intense precipitation events	Flooding (fluvial, pluvial)	Drought (severity, duration, frequency)	Mean wind trend	Storm intensity and frequency	Sea level rise (trend)	Coastal flood	Storm surge	Coastal erosion	Changing currents
Ruins of Kilwa Kisiwani				X					X			X	
Swahili trading history													
Diverse cultural history													
Great mosque				X				X					
Other key buildings				X					X			X	X
Archaeological remains				X					X			X	
Ruins of Songo Mnara				X				X		X			
Total	0	0	0	5	0	0	0	2	3	1	0	3	1

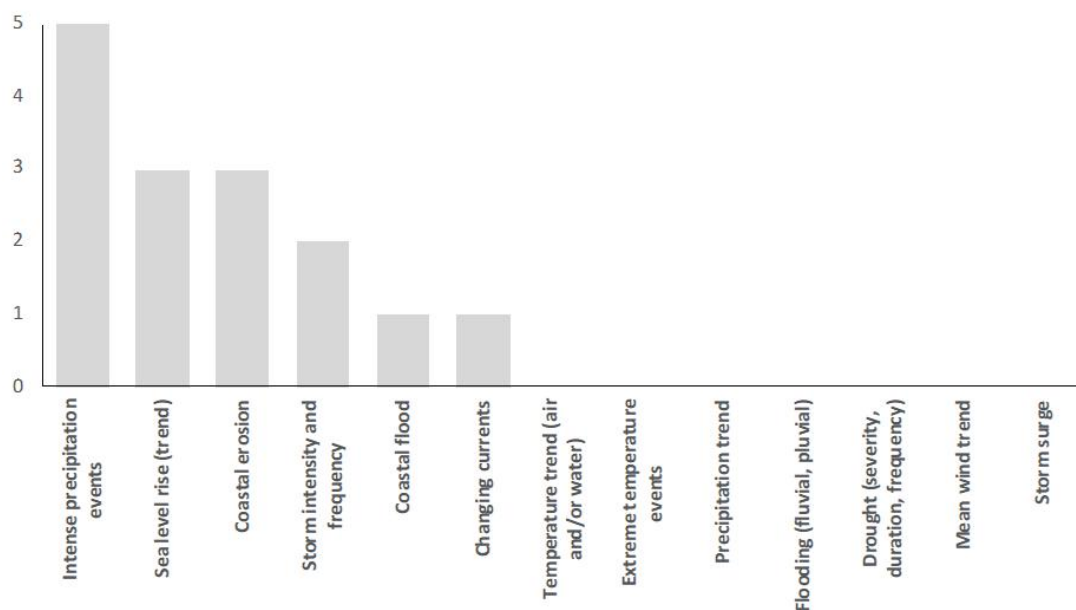


Figure 4.2: Histogram of the number of times that each of 13 climate stressor was identified as most likely to impact five of seven key value of OUV (not for key value describing cultural history). Impact were assessed for ca. 2040 under a high-emission scenario.

Section 4

Applying the Climate Vulnerability Index (CVI) to Kilwa Kisiwani and Songo Mnara

The three climate stressors likely to have greatest impact on the OUV of the property for ca. 2040 were thus determined as:

1. Intense precipitation events;
2. Sea level rise (trend); and
3. Coastal erosion.

Examples of impacts identified from these stressors were: open roof of the mosque allowing rainfall into the building that loosens the floors and percolates through the walls; erosion of gullies during heavy rainfall (Intense precipitation events); and erosion of archaeological remains and the Gereza Fort (Sea level rise & Coastal erosion).

As previously noted, in addition to the values within the OUV, there are other values of local, national or international significance. Participants compiled a list of other SPVs for future consideration and reference (Table 2.2 and Appendix 4). While these values were not included in the CVI analysis, which focused only on the key values, the climate stressors identified may also affect these other SPVs.

4.4 Assessing OUV Vulnerability

For the identified three key climate stressors, assessments of exposure and sensitivity of the entire OUV system to each stressor were undertaken using a five-point categorical scale, adapted from categories used by IPCC and IUCN analyses (see Day et al. 2020 for details). These assessments were undertaken in discussions involving all participants. Exposure to Intense precipitation events and Coastal erosion was determined as very likely (>90% likelihood), while for Sea level rise was assessed as possible (34-66%). Sensitivity of OUV to impacts from Intense precipitation events and Sea level rise were each assessed as moderate (third of five categories),

indicating some loss or alteration of some key WH values will occur, while for Coastal erosion this was determined as high, indicating potential for loss or alteration of many key WH values. Many key attributes of the property are located on the coast and while currently intact are at risk of damage from climate-related disturbance events.

The potential impact on the OUV, derived from exposure and sensitivity, was determined as extreme (the highest on a four-point scale, low to extreme) for Coastal erosion; as high for Intense precipitation events; and as moderate for Sea level rise (Table 4.2).

The capacity of a system to adapt to stress can mitigate (i.e., reduce) the potential impacts of that stress. The adaptive capacity of the OUV system was assessed for each key climate stressor by considering the levels of local management response and scientific/ technical support (four-point scale; no/low/moderate/high capacity), as well as the effectiveness of these to address impacts from each stressor (four-point scale).

Participants reported that seawalls exist at the property and that mangrove areas have been expanded in recent years with a view to mitigating impacts from oceanic stressors (Sea level rise, Coastal erosion). Regarding heavy rainfall, participants reported good knowledge on adaptive strategies (including traditional approaches) but limited financial resourcing to implement them; capping on monuments and strong mortar on roofs, as well as installing drainage channels to divert flow were mentioned as possible options (Intense precipitation events).

Table 4.2: Consult rapid assessment of OUV Vulnerability to the identified three key climate stressors. Assessed value of exposure, sensitivity and adaptive capacity contribute to the derived outcomes for the potential impact and OUV Vulnerability. Colours refer to the element of the framework (Figure4.10).

Key Climate Stressors:	Intense precipitation events	Sea level rise (trend)	Coastal erosion
Exposure	Very likely	Possible	Very likely
Sensitivity	Moderate	Moderate	High
Potential impact	High	Moderate	Extreme
Local management response	Low	Low	Low
Scientific/technical support	Low	Low	Moderate
Effectiveness	Moderate	Low	Low
Adaptive capacity	Moderate	Low	Low
OUV Vulnerability	Moderate	Moderate	High
Combined OUV Vulnerability	Moderate		

With respect to Intense precipitation events, the adaptive capacity was determined to be moderate (four-point scale, very low to high), whilst for Sea level rise and Coastal erosion the assessment was of low adaptive capacity (Table 4.2). Based on these assessments, the OUV Vulnerability (three-point scale, low to high) was determined to be moderate for Intense precipitation events and Sea level rise, and high for Coastal erosion. The combined OUV Vulnerability for RKK and RSM WH property was therefore determined to be Moderate (Table 4.2).

It is important to acknowledge that the assessed Moderate level of OUV Vulnerability is contingent upon the implementation of identified adaptive capacity strategies. In the absence of these, RKK and RSM would likely be subject to the full effect of the assessed potential impact, which (when considered across the three key stressors) was at the second-highest level (High).

4.5 Assessing Community Vulnerability

In the CVI process, Community Vulnerability is evaluated by considering economic, social, and cultural (ESC) aspects of the community associated with the property. Economic aspects are considered as broad business types associated with the property. Social and cultural connections are evaluated for three groups of people: locals, other nationals (or regional people) and internationals. This was especially important for sites like the RKK and RSM where communities live within and around the ruins and may have different values (other than heritage) associated with it. The key difference between these analyses is that social connections require a physical interaction with the property, whereas cultural connections are about individual and communal identity for which a physical interaction is not necessary.

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Applying the Climate Vulnerability Index (CVI) to Kilwa Kisiwani and Songo Mnara

Table 4.3: CVI Consult rapid assessment of Community Vulnerability to loss of World Heritage values, related to the assessed OUV Vulnerability for ca. 2040 (Table 4.2). Assessments of economic, social, and cultural (ESC) dependency and adaptive capacity contribute to derived outcomes of ESC potential impact and Community Vulnerability. Colour refer to the elements of CVI framework (Figure 4.1)

Economic	Low-positive
Social	Moderate-negative
Cultural	Moderate-negative
ESC dependency	[-] Low-negative [+]
ESC potential impact	Low
Economic	Moderate
Social	Low
Cultural	Low
ESC adaptive capacity	Low
Community Vulnerability	Low

For each of the ESC aspects, the measure of the dependency upon the property and the capacity to adapt in the face of loss of WH values due to projected climate change were evaluated. Dependency reflects the extent to which the loss of WH values will affect ESC indicators in the future (considering ca. 2040, as for the OUV Vulnerability analysis). These effects can be positive or negative (assessed on an eight-point scale, high-negative to minimal-negative then minimal-positive to high-positive); e.g., some business types may experience an increase in economic value. Separate assessments for economic, social and cultural dependency were combined to give an overall ESC dependency. Adaptive capacity reflects the currently-existing level of capacity within each component to adapt in the face of loss of WH values due to key climate stressors, and only

has a positive directionality (four-point scale, minimal to high). Whilst adaptive capacity may be further developed in the future (potentially in response to opportunities identified through the CVI process), any such strategies cannot be considered in the assessment. As for dependency, separate assessments for economic, social and cultural adaptive capacity were combined to give an overall ESC adaptive capacity.

Analysis of the Economic components considered eight primary business types related to the RKK and RSM WH property: Site rehabilitation; Government and non-government organisations; Research; Fishing; Transportation; Boat making; Craftwork; and Tourism. Assessments of the potential change to these with the threat of climate impacts to the WH values produced polarised results – those related to conservation and management were perceived to experience a future increase in economic activity resulting from a predicted increase to impacts, while those linked to tourism and services would be negatively affected by a loss of values. Based on the participants' view that conservation-related activities are of greater market value, the overall economic dependency was assessed to be low-positive (Table 4.3). All business types were considered to have a moderate or high (the two highest categories) level of economic adaptive capacity, noting that the service-related activities have persisted for a long time and are not reliant upon the property values and that conservation-related sectors are inherently adaptive. Overall, the economic adaptive capacity was assessed to be Moderate.

Social activities are characterised by interactions with the property by members of the three people groups (locals, domestic visitors and international tourists). Participants described how life activities are linked to the property and its values. In the event of a loss of WH values, participants

indicated a negative effect on social interactions would occur. Examples given included impacts on ritual activities, religious undertakings (including pilgrimage) and on societal fabric (e.g., the typical gathering of women around wells would be lost if wells were to run dry). The social dependency was assessed as moderate-negative for locals and domestic visitors (Table 4.3). Considering international tourists, the assessment was high-negative, reflecting that WH designation is a key aspect of promoting the region that is not on a noted tourist pathway. As there are other similar coastal fortifications in the region and along the tourist pathway (e.g., Fort Jesus, Mombasa in Kenya), the social adaptive capacity for international tourists was evaluated to be at a moderate level. However, the adaptive capacity for locals and domestic visitors was assessed to be low, noting, for example, that pilgrims often want to draw from a specific teacher or prophet and so are linked to the specific location. As locals were considered to be the predominant group for consideration of effects on social interactions, the participants selected those categorisations for the final assessments (moderate-negative social dependency; low social adaptive capacity).

Cultural aspects reflect the identity of local, national and international people groups and can be considered through indicators of individual and community identity, through connection with the environment and in opportunities for pleasure associated with the property. As for social dependency, participants indicated that a loss of property values would result in a negative effect on cultural connections. For locals, this effect would be at the highest level due to their greater attachment to the site; for other nationals and internationals, a moderate-negative influence would result, noting that other locations may provide a similar cultural connection. The adaptive capacity was assessed as minimal (the lowest category) for locals, noting there exists a

multi-generational attachment to the RKK and RSM WH property. Adaptive capacity for other nationals (low) and internationals (moderate) reflect that these people groups have alternative locations from which they can derive cultural benefits. Participants considered all people groups in determining the final assessments for cultural dependency (moderate-negative) and adaptive capacity (low).

Combining the economic, social and cultural assessments for dependency resulted in an overall low-negative ESC dependency, which when combined with the moderate OUV Vulnerability indicated a low potential impact on the community. Incorporating this with the overall assessment of ESC adaptive capacity (low), led to the Community Vulnerability being determined as Low.

4.6 CVI summary

From the CVI Consult assessment, the RKK and RSM WH property was assessed to have a Moderate level of OUV Vulnerability and a Low level of Community Vulnerability (each on a three-point 'traffic light' scale from Low to High). This outcome was with respect to the ca. 2040 under a high-emission scenario (RCP8.5) and considered the three key climate stressors identified by the participants: Intense precipitation events, Sea level rise (trend) and Coastal erosion. From these climate stressors, there is potential for moderate-to-extreme impacts from climate change upon the WH values, which may be mitigated by traditional and/or contemporary management strategies, as noted in the adaptive capacity assessment. Impacts on the community resulting from a climate-related loss of WH values are likely to be greater on social and cultural aspects than on economic connections with the property; each of these would be exacerbated should mitigation of impacts on the property not be successful.

5

NEXT STEPS



5.1 Possible further application of the CVI process for the Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage property

The CVI for the RKK and RSM WH property applied the CVI Consult delivery mode (Figure 1.2). This was due to two related reasons. Firstly, facilitator travel was not possible due to travel restrictions caused by the global Covid-19 pandemic. This meant that strong internet was necessary for remote facilitation resulting in a smaller workshop away from the property in Dar es Salaam. The Consult mode provided a rapid and high-level assessment of climate vulnerability from a small group of participants including site managers and community members and was facilitated remotely using a hybrid process with the majority of participants physically present, while the facilitators and other stakeholders joined remotely. Preparatory webinars on value-mapping were held to provide added value to the CVI Consult model allowing participants to join remotely. While still valuable and beneficial, the Consult mode was necessarily less detailed than a full CVI Workshop.

A full CVI Workshop would include a more diverse array of representatives of management, policy, academic, business and community representatives, in which different perspectives are brought together. In addition, the broader CVI Workshop mode uses breakout groups (each

with a diverse make-up) to foster input from across all areas of expertise for inclusion in the analysis, which also provides the potential for a range of responses that are discussed in plenary synthesis sessions. Finally, there are additional assessments of ‘modifiers’ to the exposure and sensitivity analyses that are incorporated when a full CVI workshop is conducted. There can be little doubt that a full CVI Workshop at the RKK and RSM WH property would hear from a wider range of stakeholders and provide more data to assess site vulnerability; however, its cost-benefit may be minimal given the outcome of the Consult model run during the project. Notwithstanding some advantages, there would be various logistical and practical challenges if a full CVI Workshop were to be undertaken, given that the RKK and RSM WH property is a relatively isolated location. Issues with travel and access were a challenge for the workshop; however, these challenges are shared by many WH properties, particularly in developing countries. Conversely, climate impacts and the need for vulnerability assessment at these sites are often greater than for more-accessible properties. While a more complete CVI Workshop at RKK and RSM property may provide valuable lessons for future CVI workshops, the experiences and lessons learnt from the current Consult model are already very valuable.

The CVI process explores the vulnerability of a site to the three most likely stressors over an



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agreed period of time based on a single emissions scenario. These factors are decided for each site by workshop participants. A major concern is the synergistic or combined impacts of multiple stressors, climate or other, that are expected to be greater than the impacts of individual stressors for all WH properties. Processes that cause extreme events often interact and are spatially and/or temporally dependent. While traditional risk assessment methods typically only consider one climate stressor and/or hazard at a time, the full CVI Workshop incorporates the potential for these via the compounding effects modifier to the Sensitivity assessments. However, the magnitude of synergistic effects may be greater than is accounted for within the CVI process and, if considered relevant, should be further examined.

5.2 Possible wider application in Africa

Addressing climate change is not just something to be addressed at the local scale by property managers; more than ever there is a need for planning and appropriate responses at regional and national scales whilst also taking greater action to reduce greenhouse gas emissions and atmospheric concentrations responsible for climate change.

In conjunction with another African WH property assessed as part of the CVI-Africa project (Sukur Cultural Landscape, Nigeria), the potential application of the CVI methodology to other African WH properties is now being considered.

Given the accessibility and travel issues caused by the Covid-19 pandemic, both workshops had to be facilitated remotely and were delivered differently with hybrid in-person/remote elements. For the RKK and RSM CVI Consult, these adaptations had both benefits and pitfalls. They facilitated wider access throughout the process but they also reduced the amount of time available and the number of stakeholders present for the workshop itself. This resulted in a less detailed outcome.

The lessons learned throughout the CVI Consult were invaluable when considering the wider application of CVI in Africa. The accessibility issues and challenges experienced during the workshop are not unique to the RKK and RSM. Even without Covid-19 restrictions, many WH properties in the developing world are inaccessible and lack strong internet connectivity, illustrating the importance of local and national capacities. There is an urgent need to strengthen capacities within African heritage sectors in African countries to run values-based and science-led vulnerability assessments. This urgency was part of the CVI-Africa project, which provided foundational training in climate change effects on heritage and the CVI methodology to six African professionals from Cabo Verde, Kenya, Nigeria, Tanzania, Tunisia and Uganda.

5.3 The importance of local knowledge and experience

The RKK and RSM property has a long conservation history. Coastal erosion and issues with building maintenance and conservation (amongst other things) resulted in its inscription on the List of WH in Danger in 2004. Following a substantial national and international response, it was removed from the list in 2014. This response included the construction of protective walls, consolidating structures, and the planting of mangroves along the coast to protect against wave action. The CVI Consult concluded that there was a moderate level of OUV Vulnerability; however, this was contingent upon the implementation of the identified adaptive capacity strategies. In the absence of these, the property would likely be subject to the full effect of the assessed potential impact, which (when considered across the three key stressors) was at the second-highest level (High). The conservation process has also had a positive impact on the local community who experience the economic benefits of both conservation and research projects. As such, it is a good example of climate adaptation contributing to both site preservation and community sustainable development. This conservation experience, institutional knowledge, inclusive community engagement and capacities at RKK and RSM are of considerable value to other sites facing similar climate-related stressors both in Africa and internationally.

ACKNOWLEDGEMENTS



Various people and organisations contributed to the success of the CVI Consult for RKK and RSM WH property including:

- The workshop participants (Appendix 3) who provided their time and expertise from a diverse range of perspectives.
- Background information and presentations (Appendix 2) prior to, and during the workshop, were provided by:
 - o Mr. Evarest M. Abraham (Sokoine University of Agriculture, Tanzania)
 - o Dr. Noah M. Pauline (University of Dar es Salaam, Tanzania)
 - o Dr Brenda Ekwurzel (Union of Concerned Scientists, USA)
 - o Mr Adam Markham (Union of Concerned Scientists, USA)
 - o Dr Noel Lwonga (Director, National Museum of Tanzania)
 - o Dr. Donatius M. Kamamba (Ministry of Natural Resources & Tourism, Tanzania)
 - o Dr. Pastory M. Bushozi (University of Dar es Salaam, Tanzania)
 - o Dr Edward Pollard (The Discovery Programme Centre for Archaeology and Innovation, Ireland)
 - o Dr Matthew D. Richmond (Consultant, Portugal)
 - o Dr Elgidius B. Ichumbaki (University of Dar es Salaam, Tanzania)
 - o Mr Stephen E. Madenge (Tanzania Wildlife Management Authority)
- The Steering Committee formed for the workshop (indicated in Appendix 3) provided oversight and arrangements to ensure success in applying the CVI process.
- This CVI Consult would not have occurred without the efforts and coordination of Dr Will Megarry, (Principal Investigator, CVI-Africa Project, Queen's University, Belfast). Support from Dr Albino Jopela (African World Heritage Fund) was also appreciated.
- Proofreading was provided by Dr Ewan Hyslop (Historic Environment Scotland)

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GLOSSARY

Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Anthropogenic	Resulting from or produced by human activities
Climate	The composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years.
Climate change	A change in the pattern of weather, and related changes in oceans and land surfaces, occurring over time scales of decades or longer.
Climate projection	A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models.
Exposure	A measure of the contact between a system (whether physical or social) and a stressor.
Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate variability or change.
Extreme weather event	A weather event that is rare at a particular place and time of year. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed probability.
IPCC (Intergovernmental Panel on Climate Change)	The United Nations body, established in 1988, for assessing the science related to climate change; it was created to provide policymakers with regular scientific assessments on climate change, its implications, and potential future risks, as well as to put forward adaptation and mitigation options. The IPCC is the most authoritative international body on climate science and is an essential component of the world's response to climate change.
Mitigation (of climate change)	A human intervention to reduce emissions or enhance the sinks of greenhouse gases (GHGs). Mitigation measures in climate policy are technologies, processes or practices that contribute to mitigation, for example renewable energy technologies, waste minimisation processes, public transport commuting practices, etc.
Restoration (in an environmental context)	Involves human interventions to assist the recovery of an ecosystem that has been previously degraded, damaged, or destroyed.
Weather	The state of the atmosphere—its temperature, humidity, wind, rainfall and so on—over hours to weeks.

APPENDICES



APPENDIX 1:

Statement of Outstanding Universal Value (SOUV)

Ruins of Kilwa Kisiwani and Ruins of Songo Mnara

Brief synthesis

Located on two islands close to each other just off the Tanzanian coast about 300km south of Dar es Salaam are the remains of two port cities, Kilwa Kisiwani and Songo Mnara. The larger, Kilwa Kisiwani, was occupied from the 9th to the 19th century and reached its peak of prosperity in the 13th and 14th centuries. In 1331-1332, the great traveller, Ibn Battouta made a stop here and described Kilwa as one of the most beautiful cities of the world.

Kilwa Kisiwani and Songo Mnara were Swahili trading cities and their prosperity was based on control of Indian Ocean trade with Arabia, India and China, particularly between the 13th and 16th centuries, when gold and ivory from the hinterland was traded for silver, carnelians, perfumes, Persian faience and Chinese porcelain. Kilwa Kisiwani minted its own currency in the 11th to 14th centuries. In the 16th century, the Portuguese established a fort on Kilwa Kisiwani and the decline of the two islands began.

The remains of Kilwa Kisiwani cover much of the island with many parts of the city still unexcavated. The substantial standing ruins, built of coral and lime mortar, include the Great Mosque constructed in the 11th century and considerably enlarged in the 13th century, and roofed entirely with domes and vaults, some decorated with embedded Chinese porcelain; the palace Husuni Kubwa built between c1310 and 1333 with its large octagonal bathing pool; Husuni Ndogo, numerous mosques, the Gereza Fort constructed

on the ruins of the Portuguese fort and an entire urban complex with houses, public squares, burial grounds, etc.

The ruins of Songo Mnara, at the northern end of the island, consist of the remains of five mosques, a palace complex, and some thirty-three domestic dwellings constructed of coral stones and wood within enclosing walls. The islands of Kilwa Kisiwani and Songo Mnara bear exceptional testimony to the expansion of Swahili coastal culture, the Islamisation of East Africa and the extraordinarily extensive and prosperous Indian Ocean trade from the medieval period up to the modern era.

Criterion (iii): Kilwa Kisiwani and Songo Mnara provide exceptional architectural, archaeological and documentary evidence for the growth of Swahili culture and commerce along the East African coast from the 9th to the 19th centuries, offering important insights regarding economic, social and political dynamics in this region.

The Great Mosque of Kilwa Kisiwani is the oldest standing mosque on the East African coast and, with its sixteen domed and vaulted bays, has a unique plan. Its true great dome dating from the 13th was the largest dome in East Africa until the 19th century.

Integrity

The key attributes conveying outstanding universal value are found on the islands of Kilwa Kisiwani and Songo Mnara. However, two associated groups of attributes at Kilwa Kivinje, a mainly 19th century trading town, and Sanje Ya Kati, an island to the south of Kilwa where there are ruins covering 400 acres, including houses and a mosque that date to the 10th century or even earlier, are not included within the boundaries of the property.

The property is subject to invasion by vegetation and inundation by the sea, and vulnerable to encroachment by new buildings and agriculture activities that threaten the buried archaeological resources. The continued deterioration and decay of the property leading to collapse of the historical and archaeological structures for which the property was inscribed, resulted in the property being placed on the List of World Heritage in Danger in 2004.

Authenticity

The ability of the islands to continue to express truthfully their values has been maintained in terms of design and materials due to limited consolidation of the structures using coral stone and other appropriate materials, but is vulnerable, particularly on Kilwa Kisiwani to urban encroachment and coastal damage as these threaten the ability to understand the overall layout of the mediaeval port city. The ability of the sites to retain their authenticity depends on implementation of an ongoing conservation programme that addresses all the corrective measures necessary to achieve removal of the property from the List of World Heritage in Danger.

Protection and management requirements

The sites comprising the property are legally protected through the existing cultural resource policy (2008), Antiquities Law (the Antiquities Act of 1964 and its Amendment of 1979) and established Rules and Regulations. Both the Antiquities laws and regulations are currently being reviewed.

The property is administered under the authority of the Antiquities Division. A site Manager and Assistant Conservators are responsible for the management of the sites. A Management Plan

was established in 2004 and is currently under revision. Key management issues include climate change impact due to increased wave action and beach erosion; encroachment on the site by humans and animals (cattle and goats); an inadequate conservation programme for all the monuments, and inadequate community participation and awareness of associated benefits.

Long term major threats to the site will be addressed and mechanisms for involvement of the community and other stakeholders will be employed to ensure the sustainable conservation and continuity of the site. There is a need for better zoning of the property for planning in order to ensure development and agricultural uses do not impact adversely on the structures and buried archaeology.

APPENDIX 2:

Preparatory webinars prior to the CVI workshop

CVI Kilwa Kisiwani **Webinar 1: Climate Science** Monday 23rd August @ 13.00 (Tanzania Time)

Time	Speaker	Theme
13.00	Dr Noel Lwoga and Mr Revocatus Bugumba	Welcome
13.05	Dr Will Megarry	Introduction and webinar structure
13.10	Dr Scott Heron	Brief introduction to the CVI methodology
13.20	Mr Adam Markham	Climate Impacts on Cultural Heritage
13.35	Dr Brenda Ekwurzel	Regional climate impacts: Africa
14.00	Mr Evarest Abraham	Climate Models for Kilwa Kisiwani
14.20	Dr Donatius Kamamba	Climate Impacts and Responses at Kilwa Kisiwani
14.40	All	Q&A and Discussion
14.55	Ms. Mercy Mbogelah	Concluding thoughts and thanks

CVI Kilwa Kisiwani **Webinar 2: Heritage Values** Monday 13th September @ 13.00 (Tanzania Time)

Time	Speaker	Theme
13.00	Dr Noel Biseko Lwoga	Welcome
13.05	Dr Will Megarry	Introduction and webinar structure
13.10	Dr Jon Day	Site Values: OUV and Key Property Values
13.20	Dr Pastory Magayane Bushozi	Cultural heritage values
13.35	Dr Edward Pollard	Cultural heritage values
14.00	Dr Matthew Richmond	Natural heritage values
14.25	All	Q&A and Discussion
14.55	Mr Revocatus Bugumba	Concluding thoughts and thanks

CVI Kilwa Kisiwani **Webinar 3: Socio-economic values** Monday 4th October @ 13.00 (Tanzania Time)

Time	Speaker	Theme
13.00	Ms. Mercy Mbogelah	Welcome
13.05	Dr Will Megarry	Introduction and webinar structure
13.10	Dr Scott Heron	Site values: Socioeconomic property values
13.25	Dr Noel Biseko Lwoga	Socioeconomic Values Presentation
13.45	Dr Elgidius B. Ichumbaki	Socioeconomic Values Presentation
14.05	Mr Stephen E. Madenge	Socioeconomic Values Presentation
14.25	All	Q&A and Discussion
14.40	Mr Revocatus Bugumba	Concluding thoughts and thanks

APPENDIX 3:

List of participants for the CVI Consult workshop for the Ruins of Kilwa Kisiwani and Ruins of Songo Mnara

(Online and in-person, 19th & 20th October 2021)

(Steering Committee shown **)

Participant	Position/Organisation	Location for workshop
Mr Revocatus Bugumba**	National Museum of Tanzania	Dar es Salaam
Ms. Mercy Mbogelah**	Tanzania Wildlife Management Authority	Dar es Salaam
Mr Mohamed Bakari Sadi	Chairman of the Ruins Committee	Dar es Salaam
Mzee Said Khamis	Member of the Ruins Committee	Dar es Salaam
Mr Sanjo Bakari Mafuru	Workshop translator	Dar es Salaam
Mr Evarest Abraham	Sokoine University of Agriculture (SUA)	Morogoro, Tanzania (remote)
Dr Noel Biseko Lwoga	Director, National Museum of Tanzania	Dar es Salaam (remote)
Ms Nengai Nairouwa	CVI-Africa Trainee	Dar es Salaam (remote)
Dr Scott Heron**	CVI Developer and workshop facilitator, James Cook University	Townsville, Australia (remote)
Dr Jon Day**	CVI Developer and workshop facilitator, James Cook University	Townsville, Australia (remote)
Dr Will Megarry**	CVI-Africa & Queens University, Belfast	Belfast, Ireland (remote)

APPENDIX 4:

Full list of other significant property values (SPV) for the Ruins of Kilwa Kisiwani and Ruins of Songo Mnara World Heritage Site, as identified during the CVI process

Broad groupings of SPVs	Key SPVs	Additional justification
Biological diversity <i>(e.g., other flora, fauna, or habitats of significance not in the SOUV)</i>	The site is rich in terrestrial natural assets which are important to the community.	The terrestrial forest and mangroves have been identified to have more than 100 species of bird. The mangrove forests and huge baobab trees in Songo Mnara are the source of attraction.
		Baobab are long-living trees, valued for shelter and food, and mark many areas of ruins by growing amongst them. Other species are important in the fish trap making, boat and house building such as the mangroves and casuarina.
	Rich in marine natural assets which are important to visitors and the community	The marine resource in Kilwa attracts divers and spot fishing lovers
Aesthetic values or phenomena <i>(e.g., any special scenic qualities or phenomena that are significant)</i>	The combination of cultural and natural scenery has aesthetic value	Wave-cut platforms, notches, caves, stacks, euphorbia and casuarina, and islets with sandy beaches on the east coast form interesting scenery. Mvinje Island Mosque is associated with a cave and overlooks the causeways so must be a key location.
	The role and significance of beads in the contemporary Kilwa community	Beads are an understudied means of communication between the local community. These have both aesthetic and social values and messages.
Economic values <i>(e.g., provide income or employment opportunities through tourism, fishing, or other commercial activities, etc.)</i>	Fishing opportunities	Net, line and spear fishing as well as deep-sea diving for lobster and the collection of shellfish. There is a secondary industry in smoking and drying fish.
	Agricultural opportunities	This is small scale and involves keeping animals (goats, chickens and cows) and growing a small number of plants (cassava, banana trees, vegetables, etc.)
	Trade and commerce opportunities	Small-scale internal trade and also to tourists and site visitors, including food and drinks and other crafts. Examples include the Kilwa Bonanza where local women are able to generate income at the site.
	Value for those offering transport	Local transportation as well as tourist activities including sea-sports, wildlife watching,
	Tourism development and research funding	Aside from direct revenue from tourism, development and research projects provide economic support for the local communities (Ichumbaki 2020)
	Local knowledge of fishing and boat building	The local maritime knowledge of fishing grounds and boat building skills can be used for tourism and transport

Broad groupings of SPVs	Key SPVs	Additional justification
	Salt production	Within the estuary tidal sand flats have value in the salt work industry
	Building materials	The site has long provided building and construction material for the local communities; however, most of this destructive activity has now ceased
	Employment in research and conservation activities	Locals work off-season on conservation of the site, or sell products to those working on conservation projects.
Recreational values <i>(e.g., provide for recreational activities like hiking, camping, wildlife viewing, etc.)</i>	The natural amenities offer great recreational opportunities	The landing places and ports used around the estuary are often sandy beach locations and have value to hotel building and swimming.
		These sand flat areas can also be used for games or exercise.
	Cultural places are used for gatherings	Wells are places of congregation, particularly for women in the community
Historic/cultural values <i>(e.g., features or locations that represent history or enable traditions or ways of life to continue, etc.)</i>	Archaeological evidence from other important periods	There is a long history of occupation prior to that already recorded in the Outstanding Universal Value (OUV), from the Middle Stone Age to Late Stone Age into the Iron Age. These periods remain understudied (Kirkman 1964).
		The waterfront at the port of Kilwa Kisiwani has an eroding stratigraphic sequence of occupation and port use in the cliff.
	Archaeological evidence along the coast near the WH site	There is a unique series of intertidal infrastructure along the east coast. These consist of reef coral causeways and platforms on the lagoons and reef crest but also include islets, caves, mosques and promontories have value for navigation, access across the intertidal zone for fishers and shell gatherers, storage of reef coral for lime making (Chami 1994).
		The intertidal reef crest has ballast and Persian pottery from 9th- to 10th-century shipwrecks on the intertidal zone.
		The medieval water management system can be traced from abandoned wells and cisterns around the islands. These have evidence of different climatic events, and wealthier periods supporting a larger population
	The significance of bead culture at Kilwa Kisiwani	There is a long history of bead manufacture at Kilwa. This tradition continues to the present day. The historical and archaeological aspects of this culture remain understudied (Chami 1999).
	Intangible traditions and oral histories	There is a long tradition of oral history and Kilwa and these histories have not been recorded. They relate to the history of the site and how it has changed.

Broad groupings of SPVs	Key SPVs	Additional justification
Learning/ Scientific values <i>(e.g., opportunities for scientific research, nature interpretation, etc.)</i>	Traditional crafts and local knowledge	This includes boat making and craft work which are still practiced at the site. There is an opportunity to help preserve this knowledge by training others at the sites.
	Affords unique educational opportunities	The heritage here is of educational value to train people in Tanzania and from abroad in underwater and terrestrial archaeological skills.
	Intangible knowledge associated with the site	The narratives include types of fish they are allowed/disallowed to fish, heroes of the ocean and many others. The folklore regarding the nature of life in the ancient times as well as the other intangible heritage associated with daily activities such as navigation, farming, fishing, medication, etc.
Spiritual/ Philosophical fulfilment <i>(e.g., areas that are sacred, religious, or spiritually significant, etc.)</i>	International value for religious visitors	The two domed mosques testify to the history of the Islamic faith on the Island and attract many Muslims to learn and hear narratives about the incoming of Islamic religion in Africa.
	The ruins have huge spiritual value to the local community	The ruins are often a place for reading or learning such as Koran readers from the local Islamic school.
	Mythical or folklore related value	Shipwrecks are known in local folklore of limestone wave-cut islets and a stone anchor is also recognised though being remembered as the Sultan's bedpost losing its maritime function.
	Location of traditional activities	The ruins are a focal point for festivals and social rituals like weddings, etc. These continue to happen at the site and attract people to it. Graves are focal points for rituals, as are natural features like baobab trees.
Health/ therapeutic values <i>(e.g., areas that enable people to feel better physically or mentally, etc.)</i>	Oral histories about the site	These record the medicinal aspects of plants and places
	The value of bead culture	Bead culture at Kilwa reflects medicinal or health-related concerns including fertility and curative properties when beads and plants are used together to cure specific ailments.



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