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Assessing the Performance of Kot Diji Fort against Flood Hazards a Lesson from Expected and Unforeseen Events

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Abstract

Floods and climate change have caused severe damage to Pakistan's Sindh province, endangering the region's cultural heritage. In addition to examining the effects of climate change on the cultural heritage of the region, this abstract provides a thorough evaluation of disaster response tactics as they affect to Sindh's history. This study explores the overlaps and inconsistencies between disaster management and efforts to preserve cultural heritage using an interdisciplinary approach that includes historical analysis, policy evaluation, and environmental science.

The results highlight how urgent it is to incorporate climate change considerations into strategies for protecting cultural assets and dealing with natural disasters. This calls for proactive risk analysis, flexible planning, and sustainable management of cultural resources. The study highlights the value of knowledge exchange and capacity building among stakeholders, encouraging a group effort to protect Sindh's cultural legacy in the face of shifting environmental conditions.

This case study makes a contribution to bridging the gap between disaster response, climate resilience, and heritage conservation through a comprehensive framework. In order to preserve Sindh's distinctive identity and promote long-term sustainability, it promotes the acknowledgment of cultural heritage as an essential element of comprehensive disaster management plans. This research presents suggestions for developing an integrated paradigm that safeguards both tangible and intangible heritage treasures for future generations as Sindh navigates the difficult difficulties brought on by floods and climate change.

Keywords: Heritage destruction, Architectural Heritage, Pakistan Heritage, Kot Diji Fort, Sindh Floods

Introduction

Climate change is one of the biggest issues faced by the world nowadays, either its, fire, monsoon, snow, floods or rain due to climate change these things have reached the next level and of course we really need to do something about it. From wildlife fire to extreme rainfall, this climate change has affected the whole world. From North America to Europe, Africa to Australia, Asia to South America and Antarctica every continent of the world is at the urge to find some effective solutions regarding climate change (Gössling & Scott, 2025).

Asia has also faced a lot of issues regarding climate change, specially those countries who are still under development states, Pakistan is one of them for sure. In Punjab there has been increase in temperature causing prolong heatwaves, the rate of precipitation has also been increased from 100 to 300mm annually. In Baluchistan's plain areas there has been recorded higher temperatures in summers and the amount of precipitation has been at lower level, which is causing droughts in different regions of the province. In Khyber Pakhtunkhwa, temperature has gone bit higher causing glaciers melting. In Gilgit Baltistan and Azad Jammu and Kashmir there has been some changings in the pattern of snowfall and rainfall. And lastly in Sindh it is observed that there has been increment in

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heatwave, particularly in the region of Karachi and there has been increment in rainfall in the province 30 to 60mm annually(Ullah et al., 2024).

In Upper Sindh there is Khairpur district and it has been affected by recent Sindh floods 2022. Infrastructure, countryside areas, and people of the region has been affected. In this list Khairpur's heritage also got damaged. The Kot Diji Fort has been affected badly by those heavy monsoon rainfall in 2022.

Kot Diji Fort is located in Khairpur district, Sindh Pakistan it's a notable form of heritage, this fort is also called Ahmedabad fort. This for was made by Talpur family in 18th century. The fort is situated on a mountain which is located opposite side of an archeological site called Mound of Diji which was civilization of pre-Harappa era the data should the time was somewhere between 2600 to 2800 BCE. Mir Sohrab Talpur formed this fort in 1785 to 1795. The fort is built on a 110-foot-high mountain overseeing the Kot Diji city. The fort has 30 ft. high walls. It has 50 ft. tall towers built on the fort too. The total area which fort covers is 6.4 acres. The fort walls are made from bricks where as the foundation of the fort is built from stones. As the surrounding of the fort is concerned, the fort is located on Old National Highway, Khairpur. At the north side of the fort there is an archeological site called Mound of Kot Diji. At the south side is Kot Diji city. From the east side there is cultivated land and from the west side there are few villages near Kot Diji city as show in figure below.

Figure 1.1

The fort has experienced various heavy rainfalls too. Which has caused some serious threats to the conservation of the fort. In broader sense we can say that the climate change has caused some serious threats to the fort's conservation. This research paper deals with the fort's current situation due to climate change specifically after the monsoon season of 2022 which caused Sindh flood 2022. It may seems that the fort is standing firm on the mountain but the actual things is that it has been damaged a lot after monsoon 2022.

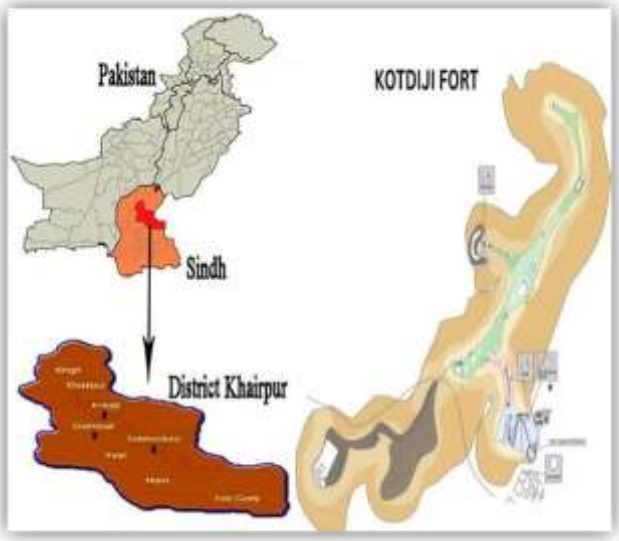


Figure 1.2

This figure shows the location of Kot Diji fort in the Map. It shows that there are various provinces in Pakistan and among those provinces there is Sindh Province which is located in Southern part pf the country and in that province there is a district named Khairpur.

Research Question

There has been different research on different historical sites in Pakistan, but as this research paper is about Kot Diji Fort and Floods hazards so here three factors are going to be discussed as research gap in the Fort.

Disaster response it one, as there has been a lot of rains recently in the region of Khairpur, it is observed that the fort is getting damaged from these unforeseen events, which are increasing year by year as it's the matter of climate change. Now the thing is that how the fort will response to these heavy rains or flash floods.

On number second, we have Climate resilience. Can this fort or the current structure of the fort hold this much rains in present times? Is the heritage of the fort is conserved well enough to protect it from the rains? Are enough funds provided to the fort for its projection against these heavy rains?

Third is conserving the heritage. How this remarkable ancient building is being protected? Is there any kind of shelter provided to the fort, or those fragile parts of the fort as its standing on a rock 24/7 especially during the day time when the heat is on its peak?

Literature Review

The Kot Diji fort is located in Kot Diji city in Khairpur district in Sindh province, Pakistan. The fort is km away from Khairpur city. In Kot Diji city, there are few other historical sites of Talpur's family some of them being used for tourism purpose and some are still under the supervision of the Talpur's family. Khairpur has different various cities, towns and villages there. Kot Diji is a town where this Kot Diji fort is located (Ahmed, 2014). The Kot Diji fort is clearly visible from old national highway, Khairpur but the entrance of the fort is from the city center, which is approximately at the distance of 1 km from old national highway. Khairpur district is surrounded by some other district too like Sukkur, Larkana, Shikarpur, Sanghar, Nawabshah and Noushehro Feroz. After the completion of Multan to Sukkur motorway tourist are even coming from south Punjab to visit the fort (Rengel, 2003). But this remarkable heritage site is getting damaged by floods due to heavy rains.

The climate change has impact around us is getting more evident. The increment in temperature is a global thing such as humidity adverse, hurricanes, tornados, floods and heavy rains. Since these past years rains and floods have increased, so it is high time to understand how to protect our heritage from water either in the form of floods or in the form of rain (Momčilović Petronijević & Petronijević, 2022). The Cultural heritage can be affected by floods resulting various issues like tangible, intangible and mixed issues when it comes to damaging of site(Arrighi et al., 2023). In many substantial cost for the perk of restoration is necessary and the worst case scenario is irreversible destruction of unique assets that has cultural significance(De Lucia et al., 2024).

Damages on cultural sites around the world.

In Germany 19% out of 538 archeological sites got damaged, most of them were destroyed by the power of water. The deeper causes were erosion, floating debris, and mortar washouts(Schmidt et al., 2024). In Seoul South Korea a study took place in which 1620 heritage sites were studied which results that after 10, 30 and 50 years the extreme precipitation scenario repeats (Kim & Sung, 2024).

In recent years world heritage sites have got damaged worldwide for example various cultural sites at the coastline of Sri Lanka has got damaged due to earthquake. In 2015 in Kathmandu, Nepal due to earth quack one of a remarkable site in the city got damaged. A cultural heritage site in France Notre Dame, Cathedral caught fire (Brandano et al., 2025).

One of a researches also shows, various sites in Europe were studied and resulted that they were still in good condition though the exposure to sun and water were way too high but the sites were designed in a way that they were resilient and to these factors and after sometime sites recover by itself causing minor damages(Cacciotti et al., 2024).

Impact on tourism

Either it's a natural heritage site or a built heritage site, people living around these sites have a feeling of belonging or a socio-economic importance, these people also runs their small businesses around these sites. The restoration and management of these sites can impact their businesses and disturb the stockholders (Fatima et al., 2023; Ginzarly et al., 2024). World heritage sites can be categorized into

i) Natural heritage ii) Cultural heritage and iii) mixed heritage but these all site have a great impact on the businesses running around and because of these site their business runs(Li, 2024).

It is obvious that cultural heritage site takes long to restore and when it is also related to economy of the people living round those sites then it became a big challenge for the authorities to work and complete it within the time frame(Ali & Joshiraj, 2025).

In china a tourism community was hit by an earthquake when study carried out it resulted that the GDP of the region and tourism activities decreases as the sites got damaged and it was not getting more visitors as the site was closed due to restoration and maintenance (Carone et al., 2025).

Research Methodology

The research Methodology which is used in this research is qualitative research methodology. This kind of research provides research in depth and has meaningful analysis.

Sampling Techniques

Moreover two research techniques were used to collect the data snowball technique and convenient technique. Snowball was used as one person was suggesting the other person and through this way data was collected via various people. Convenient technique was also used as easily approachable people were selected to collect the data from the site and surroundings.

Data Collection

Data was collected via different people of different organizations public and private, people living near by the site of Kot Diji Fort and concerned department.

Sampling Size:

Data was collected via semi-structured process, in which detailed open-ended interviews were carried out from people face to face and through telephone etc. The sampling size was 30 respondents.

Data Analysis:

Data was analyzed by Content analysis. Content analysis is mostly done there where the data is collected wither in verbal form or in visual form. It actually assists to categorize the meaning of the material which has been assembled during data collection process. The performance of the fort was assessed by various ways like, structural stability, how much water was exposed to the fort during past floods events.

Findings

Following are the finding which have been carried out from the data collection for this research paper.

Gaps	Categories	Sub-categories	Impact
Disaster Response	Threaten historical sites	Historical Sites at Risk	Environmental
	Causes structural damage and affects preservation objects with their bare hands Damage materials like brick and stone	Protecting Vulnerable Sites	
	Leads to site destruction or alteration.	Structural Damage	
	Different natural disasters and their impact on historical sites	Instant steps for protection heritage	
Climate Resilience	Cultural heritage sites can generate significant income from tourism	Tourism Revenue	Economical
	strengthens community bonds and unity	Local Economies	
	Funding is required for preservation efforts.	Heritage Conservation Costs	
	Balancing tourism for economic benefits with heritage conservation.	Sustainable Tourism	
Heritage Conservation	Cultural heritage shapes individual and group identities, fostering a sense of belonging.	Identity and Belonging	Social
	Sites are exposed to sun and the rain without any kind of shelter.	Community Cohesion	
	Workers normally have to work for long shifts of 10–12 h a day which causes social damage in to their life.	Storytelling and Memory And Cultural Expression	

This table shows that what kind of research gaps are there in Kot Diji Fort in terms of Disaster response, Climate resilience and Heritage conservation.

In Disaster response the structure of the site is getting damaged as there are more disaster coming day by day. There are more earth quacks more storms and more rain in the region. This actually threatens the historical sites and in result these ancient sites are at high risk every time. Structural damaged is also one of the biggest problem when it comes to the how fort Reponses when there is disasters, moreover there are brick all-around the fort basically edge of the fort is made up of bricks so these bricks are also at the high risk at the time of these catastrophic events, so there should be a well maintenance of these brick and the whole structure of the fort. It basically results the destruction of these historical sites. Not only rains but the sun during the summers is too harsh on these sites so there must some kind of protection to the fort especially to the fragile part of the fort which should protect the fort from rains and scorching sun. This discussion on disaster response shows that these sites really needs protection and these sites are at huge risks, instant steps should be taken by the authorities to protect these site immediately.

Climate resilient is also one of the biggest factor to consider, if these sites are maintained well so these could be climate resilient and can bear heavy rains and sun too, that means if there is a good take care of these sites, so these can face climate change also it a good way. This is not only about the protection the site but when sites are being protected well, there will be more tourism and where there is more tourism there will be more generated income at the sites of course. It encourages local people and communities to run their businesses near the site and they can generated a good amount of income through the tourism. No doubt for increasing the tourism at the site, the sites should be first preserved well, and for preservation the fort really needs a good amount of money for it. So higher authorities must provide funds for protecting the site. Heritage tourism is not only about visiting various sites and enjoy there but it actually supports the local people and generates sufficient economy for the region. So tourism also supports economic growth of a region.

Heritage conservation is the third factor to discuss here. As heritage shows the sense of belongings with the site, so the heritage will be preserved well when these sites will be maintained well. People who live around the fort they says that this site is being damaged by these heavy rains and sun, so there must be some kind of protection provided to the fort. People working on the fort has their own issues they are working for long shifts as there are less worked on the fort specifically guides and cleaners and gate keepers. They are working 10 to 12 hours per day so it effects their social life as from morning to the dusk they are present on the fort. This shift of workers should not be more than 8 hours per day.

Results and Discussions

In 2022, Sindh faced devastating flesh floods. These were among worst floods in Pakistan. Hundreds of people were killed, thousands got injured and 10 million people were displaced. Various villages and different areas were badly affected. Cultivated land got damaged also including dates and mangos fields. Floods not only affected people or cultivated land, it also hit the infrastructure of the district. Many diseases like malaria and dengue got worse due to stagnant water in the country side as shown in the figure below.

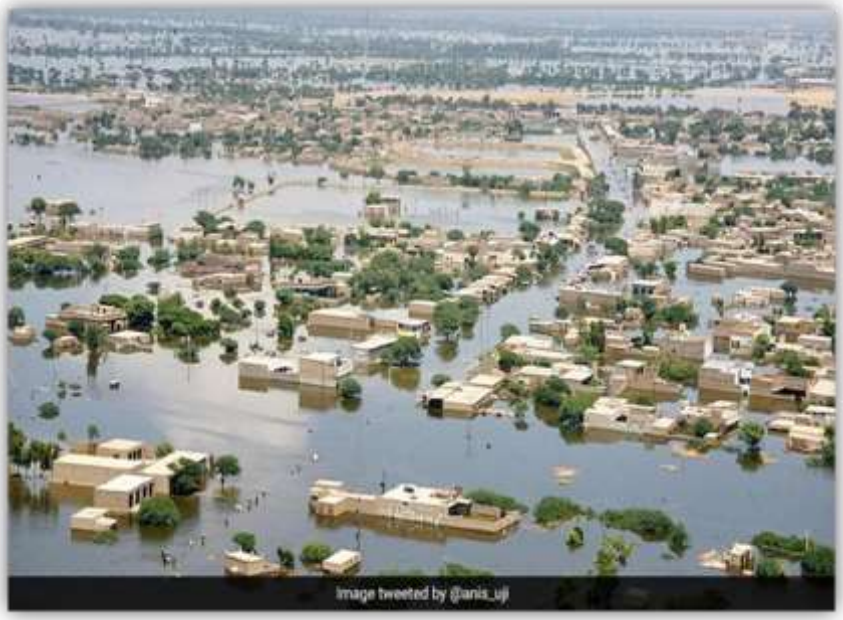


Figure 1.3

Not only these, but heritage was damaged too. Kot Diji fort has been affected by these heavy rains in Khairpur. Due to these heavy rains and flash floods the fort got closed for the visitors several days even after rains.

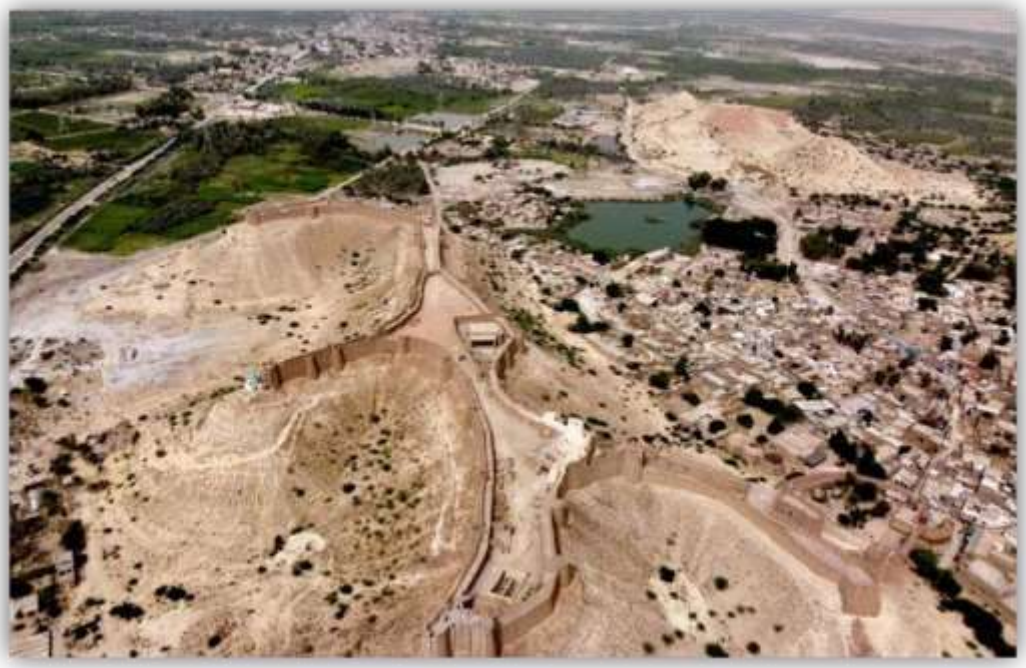
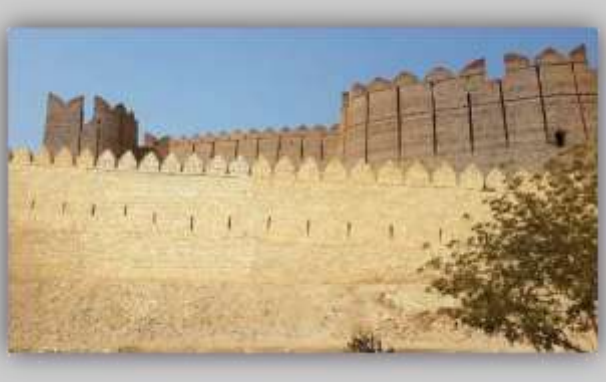
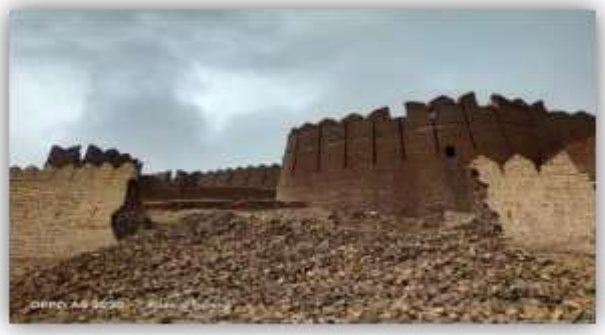
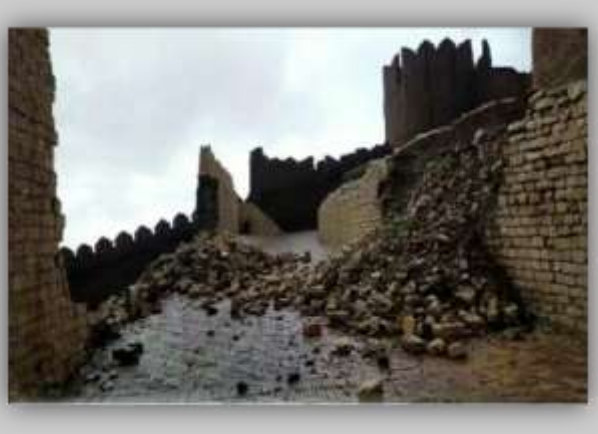


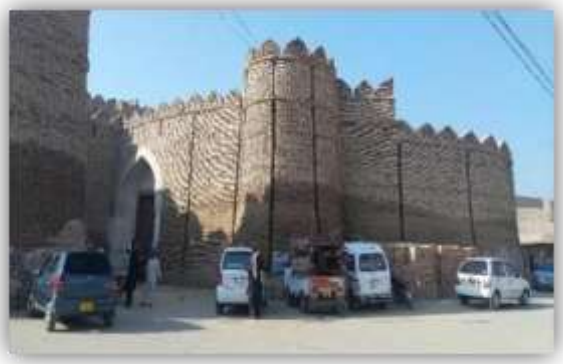
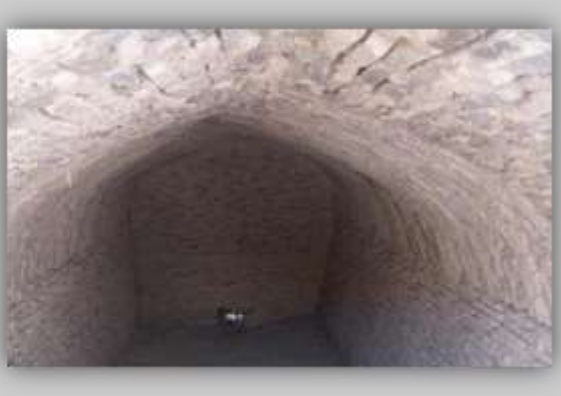
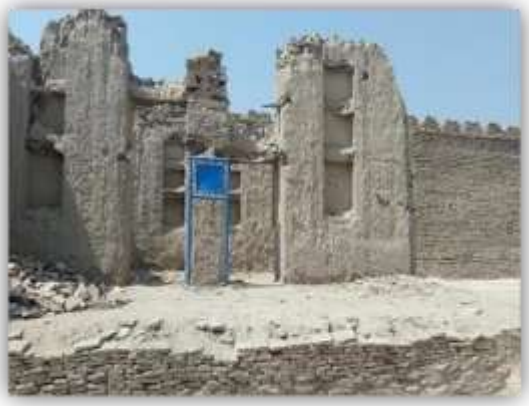
Figure 1.4

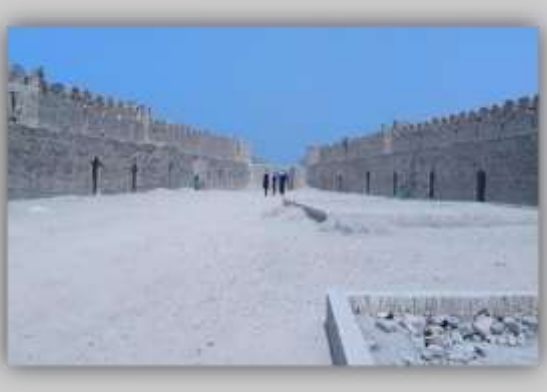
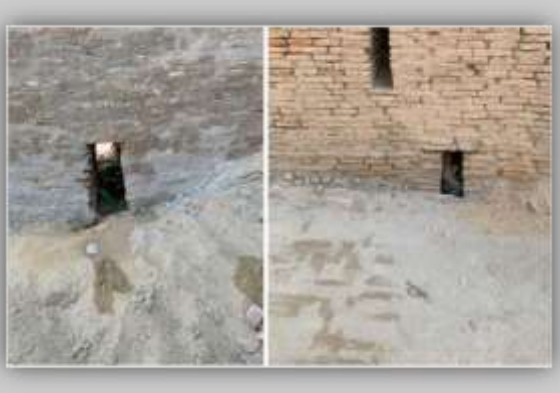
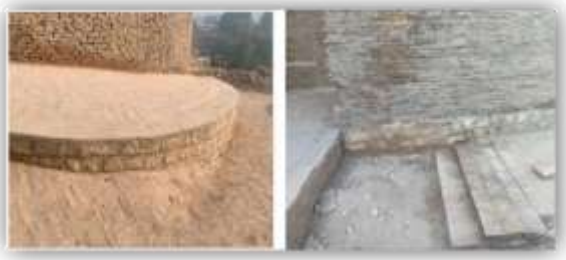
This is view of Kot Diji Fort from above. This is the third level of the fort. From right side there is Kot Diji city located and from left side of the fort old national highway is located.

Following is the table which shows the results and discussing results on the other side of the table.

Results	**Discussions**

 **Figure 1.5**	This is the wall at the ground level of the fort as the fort is divided into three levels. This picture shows condition of the wall before the flood, it stood firm on the ground. Basically the ground is inclined and going to the other levels of the fort. Behind that wall is a slope which leads towards other levels of the fort.
 **Figure 1.6**	This picture shows condition of the wall after floods as there were flesh floods in the region. The wall which lead to other levels of the fort was destroyed due to heavy rains. It is visible in the picture the stones and bricks are laid on ground and both sides of the wall.
 **Figure 1.7**	Not only the front wall but the wall on the other side of the slope has also got destructed due to rains. It is also visible in this picture that both walls have been affected.
 **Figure 1.8**	The man in the left sides picture telling the level of stagnant water level during floods and in the right sided image man is pointing that in the city this was the level of water during Sindh flood 2022.

 **Fiqure 1.9**	This is the condition of the city in the Kot Diji where the fort is located. As there were flesh floods in the region so the water stood in the streets for about 5 to 6 days in the city. This not only destroyed the infrastructure of the city but it also affected the fort too as Kot Diji fort is located in the city.
 **Figure 1.10**	The mortar and bricks of the fort has been very much affected as the fort in an ancient building and the wall were already weakened but these flesh floods even stimulated the already worsen condition of the walls of the fort. The water during floods was also standing on the outside of the fort.
 **Figure 1.11**	The deterioration of the fort especially where there are crawling spaces has increased due to heavy rain, it causes dampness on the walls and it actually increased the process of deterioration. Water, humidity and moisture affected the fort very much.
 **Figure 1.12**	Already damaged residence of the king in the fort got more damaged during rains. As it is visible that the wall is made up of clay and burnt bricks, bricks section is standing there but the mud and adobe wall has been affected very much.

 **Figure 1.13**	These both are the outer wall of the fort at 3rd level. It also got damaged during heavy rains in 2022. The mortar and bricks from the top of the wall got damaged a lot.
 **Figure 1.14**	The walls of the fort has this kind of arched shaped design all over the fort. Bricks stood in a satisfactory condition but the mortar inside the brick got damage. This thing also got damaged in the heavy rains as there was continuously raining in the region.
 **Figure 1.15**	These are the drainage holes inside the fort. During floods water was drained out of the fort from these drains but at the first level or ground level water stayed there for days and damaged the structure of the fort.
 **Figure 1.16**	This is the ongoing maintenance and restoration work at the fort.

Conclusion

Kot Diji Fort is located in Khairpur District. It is almost 200 year old fort. As the fort is an ancient property, there are higher chances of the fort getting destroyed at various areas. Recent flesh floods in 2022 have actually affected the fort very much. On this behalf research was conducted via various ways. The data method used in this paper is qualitative research methodology. Snowball and convenience techniques were used to collect the data. Data was collected from different government and private organizations, people live around the fort and concerned department. During finding we found that how the fort will react if there is any disastrous event which will be due to the environmental impact. The fort should be conserved in a way that it should be climate resilient every time, this will happen if ta handsome funds are given to the fort and the fort will get economically stable. As the fort is part of heritage conservation it has a deep roots with society and people live around the fort.

Due to heavy rains the inner boundary wall at first level which leads to other levels of the fort got damaged. Not only this but observers observed that on the pathways inside the fort also got damaged and it created cavity in the fort due to lose of mud/mortar from the bricks. Slopes in the fort also got erosion at some points. It is important to remove the wreckage from the drains of the fort and create some more drains to drain out the water more easily form the fort. Lost bricks should be installed again in the wall with mortar covering it in way that in coming rains it should not come out. Strengthening the walls of the fort all around. Drainage should be made in a way that it should not harm the fort and neither should it decrease the beauty of the fort.

In a short note, due to flash floods in 2022 this remarkable heritage got damaged from various parts. The biggest hit was at the internal wall of the fort at first level. The zones were also got damaged due to heavy rains like walls of upper level, outer boundary of the fort, price's residence on the upper level and entrance door of the fort at level first. These all areas were hit in a very worst way by the flesh floods during Sindh floods 2022. If the authorities want that there should be more tourism and the heritage should be conserved well then some major percussions must be taken before it's too late.

The key lesson which we understand from this research is, never leave heritage site on its own when there is come unexpected climatic issue. Either its hurricane, tornado, heavy rain or snowfall, it's the duty of the authorities to take actions from protecting the site from the disastrous events. Heritage belongs to us, and we people are there who has to take measures to protect it, if not then who will? So either it Kot Diji Fort or any other heritage site, that should be protected well no doubt.

Recommendations

Not only Kot Diji Fort but various site around the fort and around the district are also been affected by the rain during Sindh floods 2022. Here are some recommended sites which also be under observation and maintenance too when these kind of events takes place.

1. Sheesh Mahal located in Kot Diji city afew kilometers from the Fort.
2. Mound of Diji located at the opposite side of the fort at old national highway.
3. Faiz Mahal located in Khairpur city, at 25 kilometer distance from the Kot Diji Fort.
4. Tomb of Sultan Badshah in located on the top of Rohri hills located 17 kilometer from Kot Diji Fort.
5. Tomb of Shadi Shaheed located at the 23 kilometer from the Kot Diji fort.

These are site are present near the fort with the distance of half hour driving from the Kot Diji fort. Beside this there are a lot of site located in Sukkur region who's take care in terms of conservation and preservation.

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