And then we come to the Ayutthaya which is has been an ancient kingdom as I said to you it also reflects some stories about the Rama the birthplace of Rama and Ayutthaya. But in Thai it has been founded in 1351 by King U Thong who went there to escape a smallpox outbreak in Lop Buri and proclaimed it the capital of his kingdom, and this is often referred as Ayutthaya kingdom or Siam.

So that is where the Ayutthaya has became the second Siamese capital of the Sukhothai, Sukhothai which I showed you earlier. So this has become more of the second capital, and this city is located at the junction of Chao Phraya and Lopburi and Pasak rivers, so it is almost a kind of delta kind of thing.

So this particular historic city has some religious meanings and the historical understanding to it. And there is a cultural significance and cultural integrity and as a cultural context which actually frames this historical city. And this has been 17th century it has been destroyed by the Burmese military and then later on it has been converted as a Ayutthaya historical park when it has been recognized as in a school world heritage site, and this is where it has reflected with its outstanding universal value where we talk about OUV.

I am going to refer about mainly two to three important documents and this particular paper Which talks about the disaster aspect of it where the flood risk assessment in the areas of cultural heritage and how it has been applied in the Ayutthaya.

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ORIGINAL PAPER

Holistic approach to flood risk assessment in areas with cultural heritage: a practical application in Ayutthaya, Thailand

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So this is a group of authors which worked that has been published in natural hazards and Zoran Vojinnovic, and Michael Hammond, Daria Golub, Sianee Hirunsalee, and others you know they have actually published is a very recent document.

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Flood risk assessment (FRA) is a key tool in the traditional approach to understanding and managing flood risk.

However, FRAs commonly focus on those impacts that can be quantified in financial terms, such as the cost of damage to property and business disruption. These readily quantifiable impacts do not reflect the entire effects of flooding, and those impacts that are difficult (or impossible) to express in non-monetary terms, such as the loss of life or the loss of cultural heritage, are often neglected

So first they talk about what is a flood risk assessment you know because that is FRA, we call it as flood risk assessment that is a very basic key tool as a traditional approach in the traditional approach to understand and managing the flood risk. So and if you look at FRA techniques much of the work has been mostly focused on the quantitative aspects or the target based on how much has been impacted or the cause of them.

And the cost of damage to the property and the business description and you know either it may be quantified in financial terms. And when it talks about these quantifiable impacts, do not reflect the entire effects of flooding you know that like, for instance, there is not only about the monetary aspects, there is a physical aspect, and there is also to do with the non-monetary aspects of the intangible aspects of it. So this is where the loss and life, loss of cultural heritage which has been often neglected in the FRA tools.

So when we say about the hazard assessment of any floods that is where the hydrologist they talk about many hydrological models when it is a 1d model the 2d models and which actually talks about the represent the process by which rainfall is converted into the surface runoff. So you know so how much water volume of water and how much surface runoff is carried out, so this is all about the quantitative aspect of it and the modeling and the simulation aspect of it.

Whereas in the vulnerability assessment it actually has to it is often assessed using the site-specific indicators or measurements, and this is where the multiple aspects which has to be combined by multi-criteria methods.

There is also the qualitative aspects, there is also the financial aspect, there is a livestock, there is livelihood, there is human loss, there is a property damage, there is a infrastructural damage. So it is a different sets of impact situations which we considered varies from site to site but in this kind of conditions we need to look at the culture as an important cultural vulnerability. So there is two approaches when the authors they try to relate with the traditional approach.

Where we call about R=risk=hazard when vulnerability adds on to it that is where the risk component comes to it and this is the risk perception approach how people how the communities percept this approach you know the risk.

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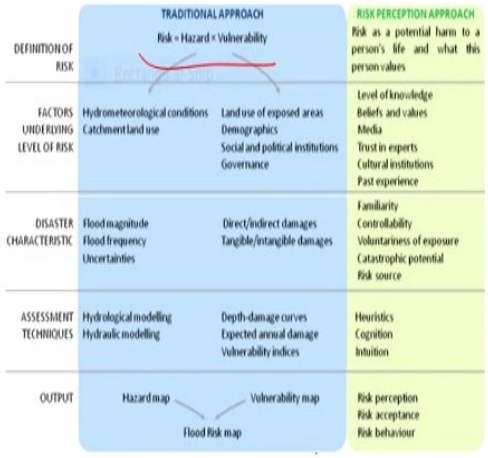

Fig. 1 Comparison of the two approaches to flood risk assessment (traditional or quantitative, and risk perception or qualitative, approach)

Like, that is where they try to compare, like in the factors underlying the level of risk here the Hydrometeorological conditions and the catchment the land use areas and what are the land use of exposed demographic social and political institutions and the governance. Whereas here when we talk about the perception aspects of it the level of knowledge the beliefs and values the media and the trust in the expert's cultural institutions, and the past experience what they have understood what they have experienced.

Disaster characteristics: this is where the flood magnitude, flood frequency, and uncertainties. Whereas the direct and indirect damages the tangible and as well as intangible damages so this is where again the perception brings about the familiarity, controllability, voluntariness of exposure, catastrophic potential.

And assessment techniques: Maximum they might narrow down to hydrological and hydraulic modeling. And depth-damage curves except inundation maps and all this. Whereas here they talk about the heuristics, cognition, and intuitions. And what is the output out of it it takes us a hazard map, and the vulnerability map, and that is how a flood tisk map regeneration. But there is also the risk perception, risk acceptance as risk to whom then how do they prepare for it how do they accept it risk behaviour so this is again this whole thing comes from the social and community.

It is very community-specific, it is also society specific how they look at it how they see it how they behave to it.

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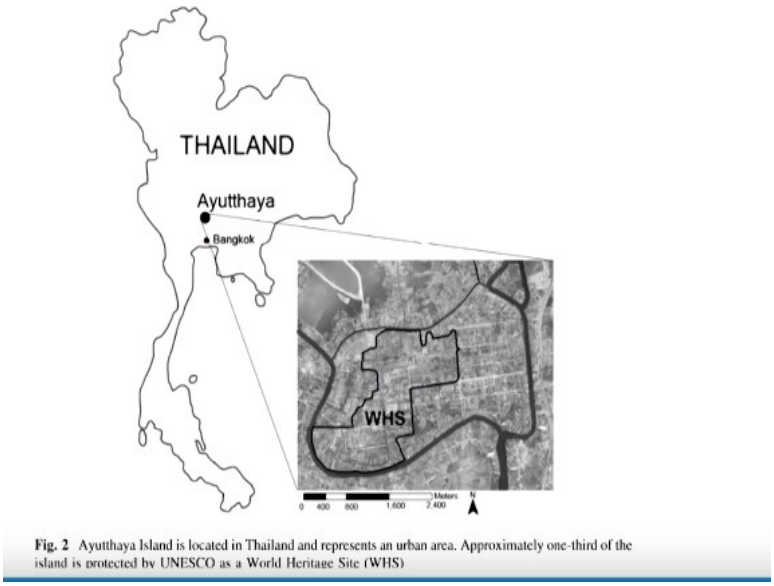

Fig. 2 Ayutthaya Island is located in Thailand and represents an urban area. Approximately one-third of the island is protected by UNESCO as a World Heritage Site (WHS)

So now when you look at the Ayutthaya island which is located in the urban area. So almost one-third of this island is under the world heritage site. So and you can see that the river process the kind of the whole island is set up in the river bases.

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A 1D model of a 52-km stretch of the Chao Phraya River is developed, which consists of the channel data for the Chao Phraya River and a number of tributaries that include the Lopburi and Pasak Rivers which meet at Ayutthaya.

Rainfall data from four raingauges and observed river stages are used as initial conditions. Second, a shorter section of this 1D model is coupled with a 2D model of the urban area, to investigate the propagation of excess floodwater from the 1D river system of the Pasak, Lopburi, and Chao Phraya Rivers into the urban area, using the DHI MIKE FLOOD software.

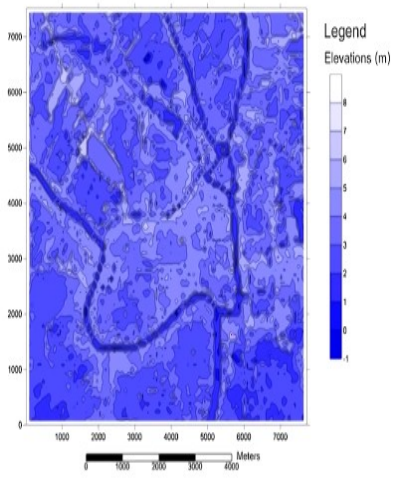

Fig. 3 Contour topography of Ayutthaya Island derived from 2-m grid scale resolution data

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The two lands coming and what this authors have tried to do they tried to club both the methods of both, one is the scientific approach of it, and second is the social approach to it, and the perception of it. And see how they are actually relating to it. Like it is about a 1D model this is a

1D model of 52 kilometer stretch of Chao Phraya river and which has a number of tributaries that include Lopburi, Pasak rivers which actually meet at Ayutthaya.

But they also collected lot of rainfall data and 4 rain gauges and then this 1D model is coupled with a 2D model of the urban area to investigate the propagation of excess flood offered that is where how much an inundation is created. And from the 1d river system of Pasak, Lopburi and Chao Phraya rivers into the using and they use the software of DHI MIKE flood software.

So here is what you can see is that the intensities, this is you know about they develop this contour topography of Ayutthaya land derived from 2 meter grid-scale resolution from the satellite data and how it can actually create the inundated areas.

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Physical vulnerability :
To assess physical vulnerability, four different classes of the built environment are identified: residential buildings, cultural properties, critical infrastructure, and roads. Within each group, individual asset types are categorised as exhibiting low, medium, or high vulnerabilities

	BUILT ENVIRONMENT			
VULNERABILITY CLASS	Residential buildings	Cultural properties	Critical infrastructure	Roads
Low	Pillar house	Restored		Asphalt roads
Medium	Two-storey house	Archeological remains	Hospitals, police stations, water supply, ATM	Gravel roads
High	One-storey house	Not restored		Unpaved roads

Fig. 4 Categorisation of build environment into three vulnerability classes

Then the physical vulnerability so there is a for assessing the physical vulnerability 4 different classes of the built environment or identified. Residential buildings, cultural properties, and the critical infrastructure, and the roads and the connectivity. And within each group they also categorize the vulnerability part of it low, medium, and high. So if you look at it the pillared house in the residential buildings there a subjected the medium.

But whereas in the high, which is a one-storey house which is based on and they are subjected mostly to the high risk. Similarly, in the cultural properties which has been submerged they are