CHAPTER 2
LITERATURE REVIEW

1.5. Definition of a flood disaster

Flooding is the overflow of previously or normally dry land, and flood disaster refers to the damage related to these events (Tabari, 2020). Coastal areas, where sea water meets the land, consist of dynamic hydrological and fluvial environments. These areas are particularly vulnerable to extreme weather events such as hurricanes and tides, which can cause catastrophic consequences for coastal infrastructure (Taherkhani et al., 2020).

Flood disasters are often categorized into several types 1(Tariq et al., 2020):

- Coastal flooding occurs when the sea breaches inwards onto land due to extreme weather or tides (United States Geological Survey, 2023).
- Sea level rise is expected to cause an increase in this type of flooding (United States Geological Survey, 2023).
- River flooding occurs when river swell, extreme weather, and other events cause river water to flood (Sofia & Nikolopoulos, 2020).
- Groundwater flooding occurs when the soil becomes oversaturated and is expected to happen gradually (Taherkhani et al., 2020).
- Flash floods are sudden floods caused by extreme weather or other events (Khajehei et al., 2020; United States Geological Survey, 2023).
- Pluvial flooding occurs when heavy rainfall overwhelms drainage systems and causes water to pool on the surface (Rentschler et al., 2022).
- Sewage or drainage flooding occurs when natural or manmade effluents become obstructed.

In Suriname the flood disasters consists of heavy rain events that exceeds the soil capacity (pluvial flooding) with lesser occurrences of sea water intrusion in the coastline (Nijbroek, 2014).

1.6. Flooding in Suriname

The recurring flood disasters in the Republic of Suriname have become a pressing socioeconomic issue for the country. The rise in affected residential areas, particularly during the rainy season, has exacerbated the situation. In recent years, Suriname has experienced multiple instances of widespread flooding, causing damage to communities and posing difficulties in accessing affected areas. For instance, in 2021, heavy rainfall led to flooding in numerous communities, including in the districts of Paramaribo, Nickerie, Coronie, Saramacca, Marowijne, Sipaliwini, and Commewijne.

Mangrove deforestation and receding mud banks exposes the coastal inland to inundation and likelihood of reaching (infrastructural) urban development. This would affect any previous advantages in cost and time to prepare ahead for major underlying environmental concerns such as climate change projections such sea level rise (SLR) (Anthony et al., 2010). Whilst global temperature increase has more frequently been represented as greenhouse gas emissions in the atmosphere, the increase of exposed surface vegetation loss to logging has shown to greatly influence temperature changes and contributing as much to climate change (Pielke et al., 2002). Therefore, vegetation coverage is significant for preventing regional temperature changes.

Globally, the sea level is rising with many researches pointing out to anthropogenic climate change (Dismukes & Narra, 2018; FitzGerald et al., 2008; Lichter & Felsenstein, 2012), which is also acknowledged by the Intergovernmental Panel on Climate Change (IPCC) (Church et al., 2013). Recent projections for sea level rise, also indicated as SLR, evidently will result in severe damage to coastal ecosystems, in particular, the mangrove forests and large expanse of arable lands (Alongi, 2015; Ángela Andrade Pérez, 2010; Haage et al., 2018a; Nijbroek, 2014).

1.7. The nation's capacity

At the time of writing, Suriname is in a difficult financial position after the previous government has left the nation bankrupt (Bouterse, 2016; The World Bank, 2023). The new Cabinet which took office after the democratic elections of May 2020 faced a difficult situation with high inflation, low international reserves

, a large fiscal deficit and a huge financial need (Martoredjo, 2021). Acknowledging the vulnerability, the World Bank has ranked Suriname the 2nd of the coastal formation, the damages that are already progressing. Given its low national budget, the republic of Suriname took initiatives to seek financial support for its environmental mitigation efforts (Berrenstein and Gompers-Small, 2016). Noticeable activities have already been initiated in the country, including : infrastructure projects to control sediment flow in favor of depositing ashore, mangrove reforestation, including climate change factors in its legislation, controlling development and exploration around vulnerable zones, which are indicated as Multiple-Use Management Area (MUMA).

Areas are prioritized and targeted on the basis of (high) population density within the districts such as Nickerie, Coronie, Paramaribo and Wanica (Berrenstein, Haydi. J and Gompers-Small, 2016; Republic of Suriname, 2015; United Nations Development Programme in Suriname, 2016). The majority of initiatives focusses on the conservation and rehabilitation of mangrove forests that offer ecological and environmental advantages along the shore (Godoy & Lacerda, 2015; Toorman et al., 2018). But this also accounts for the socio-economic importance, for example for the locals who use the aerial roots to their advantages for catching fish, hunting and beekeepers have been using these wetland forests for honey production (United Nations Development Programme in Suriname, 2016). As such, MUMA's have social-economic importance for the surrounding residents, but there exist a lack of general knowledge about the significance for maintaining these natural barriers, and has resulted in the community interfering in coastal adaptation activities (Nijbroek, 2014).

To gain a better knowledge on how to address these environmental factors, the Anton de Kom University of Suriname (AdeKUS) in collaboration with research bodies of the region and expertise of universities of Netherlands have done research through observations and projections of the coastal zones (Berrenstein, Haydi. J and Gompers-Small, 2016).

The projects involving MUMA's will require observation over a period time or even to be carried out continuously over the scoped areas as there is no established track record for monitoring (United Nations Development Programme in Suriname, 2016). The Bigi Pan MUMA, a brackish water wetland internationally listed in the RAMSAR convention, has a conservation and rehabilitation project component which needed to include maintaining and tracking of the Bigi Pan environment (*Bigi Pan Management Plan 2013-2023*, 2013). Suriname is among the 188 countries that is coping with flood disasters as a developing nation with low lying coasts and high poverty occurrence (Rentschler et al., 2022).

1.8. Flood mapping

The tracking of vulnerability of settlement areas to flood is the main focus for this research because it shifts the attention towards flood events in correlation to human activity, which is an important variable by which the human behavior being relatively unpredictable, consequently considering these factors into any adaptation planning. With its small national budget and resources, it would be best appropriate to use the already available tools and concepts so that it can be easily comprehended and integrated within the general assessment of the coast.

1.9. State of the art

Academic documentation for flood vulnerability mapping are generally poorly represented in/ for Suriname, and not represented among flood mapping in development countries (Membele et al., 2022). Although some attentions are given within project reports from multilateral and non-governmental organizations (NGOs), the literature results are susceptible to research bias, with academic papers pointing towards reappearing lead researchers. More relevant studies are found within project reports and direct funded research. The following Table 1 highlights research found as of writing, which are relevant to flood disaster assessment by a vulnerability indices model.

Table 1. List of recent relevant researches.

#	Citation	Title	Method	Context relevance	Difference
1	(Guzman et al., 2017)	Paramaribo Strategic Flood Risk Assessment Final Report.	Mix method.	Thorough assessment of flooding in Paramaribo that includes infrastructural mismanagement and already suggested off-the-shelf systems such as Deltares.	General approach and limited to Greater Paramaribo, and flood relief for public infrastructure.
2	(Allafta & Opp, 2021)	GIS-based multi-criteria analysis for flood prone areas mapping in the trans-boundary Shatt Al-Arab basin, Iraq-Iran	GIS multi-criteria analysis.	Flood analysis accentuating remote sensed data and AHP through expert opinion.	Trans-boundary case of Iraq- Iran, flood assessment model by remote sensing/ GIS and addition of traditional data.
3	(Padhan & Madheswaran, 2023)	An integrated assessment of vulnerability to floods in coastal Odisha: a district-level analysis.	Indicators relying on secondary data and normalized indices using the Iyengar & Sudarshan (1982) method.	Flood Vulnerability Index (FVI) derived from IPCC 2007 reporting. FVI Indicators of socioeconomic , physical and environmental components are used to rank the up to district level; ranked high globally as a vulnerable coastal region	It's a case study of Odisha, India where there are other calamitous natural disasters and FVI indicators have a larger extent, especially in the demographics.
4	(Tempa, 2022)	District flood vulnerability assessment using analytic hierarchy process (AHP) with historical flood events in Bhutan	Analytic hierarchy process (AHP) type MCDM.	Flood vulnerability assessment at district level, the use of AHP method for scoring and weighing each variable	Case study in Bhutan, Extensive historic flood event analysis and different flood vulnerability model structure, use of MCDM.