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AspectsofUrbanFlooding:AStateofArtofReview

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Abstract:

Urbanfloodingistheinundationoflandinabuiltenvironment,mostnotablyinheavilypopulated areas. It occurs when rainfall or other events exceed the capacity of drainage systems.It is a complex whole that deals with the factors ranging from geology like low relief up toanthropocentric facets like urbanization, faulty drainage, and unscientific waste management.This is a kind of flood which is mostly man-made in nature. Going through literature those havecome up with various factors of urban flooding is important for understanding the nature of theflooding and where it is occurring like whether it is coastal city or a hill city or a city in theplains. This paper provides a current literature overview on flood impact assessment in urbanenvironments,includingtheirapplicationandlimitations.

Keywords:UrbanFlood, climatechange,urbandrainage,urbanization,review.

1. Introduction:

Flooding is the most prevalent natural disaster that causes enormous devastation. (Jha et al.,2011) Although floods may occur everywhere, from rural Indus River villages to urban areassuch as Sendai, Brisbane, New York, Bangkok, Jakarta, and Karachi, the most damage happensin cities because to the larger concentration of property as well as individuals. (Hammond et al.,2015) Urban floods are becoming increasingly widespread in all major cities, particularly inAsian cities, which previously experienced significant water logging andare now confrontedwith the urban flooding issue. It is the influx of a tremendous amount of water induced bytorrential rainfall, as the name implies. It is occasionally accompanied with catastrophic eventssuchascyclones,butthe fundamental cause ofurbanareaisunplanned urbangrowth,anexcessive pace of concretization, slum clustering, development beyond the natural flood barrier,and so on. If trend on the climate of the South-East Asian cities is followed then it can besummarizedas:

a. Therewillbeanincreaseinthenumberofclimaticextremeevents.

b. CitiesinAsia'slow-lyingdeltawillbeincreasingly affectedbyclimatechange.

c. Peoplelivinginslumsandshantieswillbedisproportionatelyaffectedbyclimatechange.[Point:1-3-(Svensson&Whitehead,2021)]

Ifdifferentauthenticdefinitionsofurbanfloodingismentioned,

- '*Urbanfloodingissignificantlydifferentfromruralfloodingasurbanizationleadstodeveloped catchments, which increases the flood peaks from 1.8 to 8 times and flood volumesby up to 6 times. Consequently, flooding occurs very quickly due to faster flow times (in amatterofminutes).*'-(NationalDisasterManagementAuthority,2017)

- *'Urban flooding is not just"flooding that happens in an urban area." This isn't whathappens when a river overflows its banks or when a hurricane drives a storm surge across acoastal neighborhood. Instead, it's caused by excessive runoff in developed areas where thewater doesn't have anywhere to go. Urban flooding can be linked to a major disaster, likeHurricane Harvey and its 33 trillion gallons of rainfall. But more often it happens duringmore routine circumstances, appearing in the form of wet basements and sewer backups.Even small amounts of rain can overwhelm the deteriorated or inadequate infrastructurefoundinmanyneighborhoods,especiallyinImpoverished,neglected,and/orsocioeconomicallyisolatedurbancommunities.'*(Weber,2019)
- *'Urban flooding is defined as the inundation of land or property in the built environmentwhen storm water management systems, like storm sewers, fail.Climate change is bringingincreasinglyheavyrains.Combiningthiswiththeincreaseinrunofffromcontinueddevelopment, we find that outdated municipal drainage systems are unable to keep up.Theresult is more frequent and intense local flooding, destroying homes and personal propertyand forcing businesses to close'.*(FEMA (Federal Emergency Managing Authority), 2020)Fromthedefinitionsthefactorshavecomeupinthefollowingmanner:

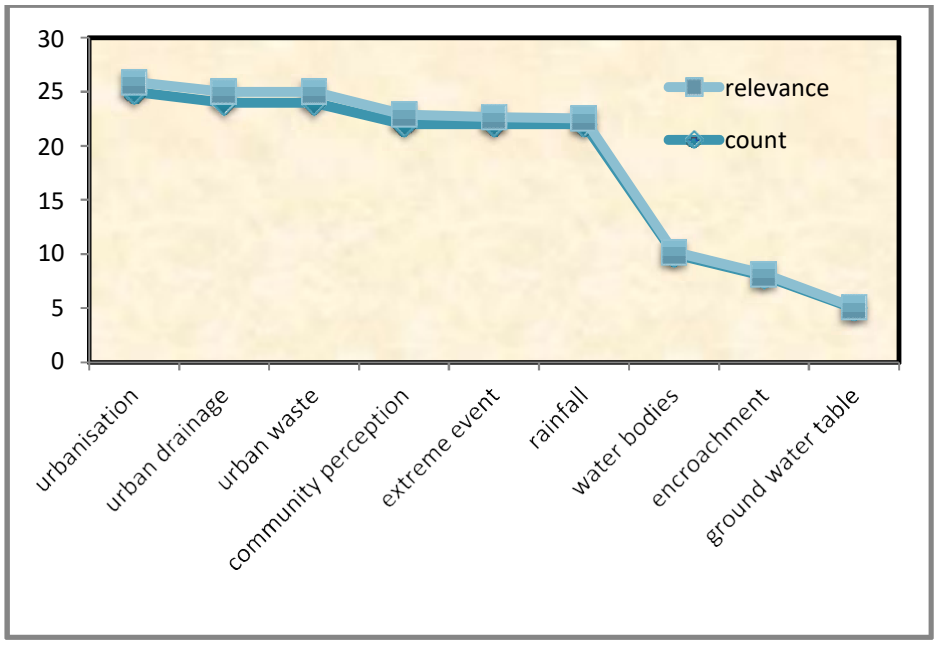

Fig.1,2.Wordcloudonthefactorsof urban floodingand theoccurrencesofthefactorsintermsofrelevance

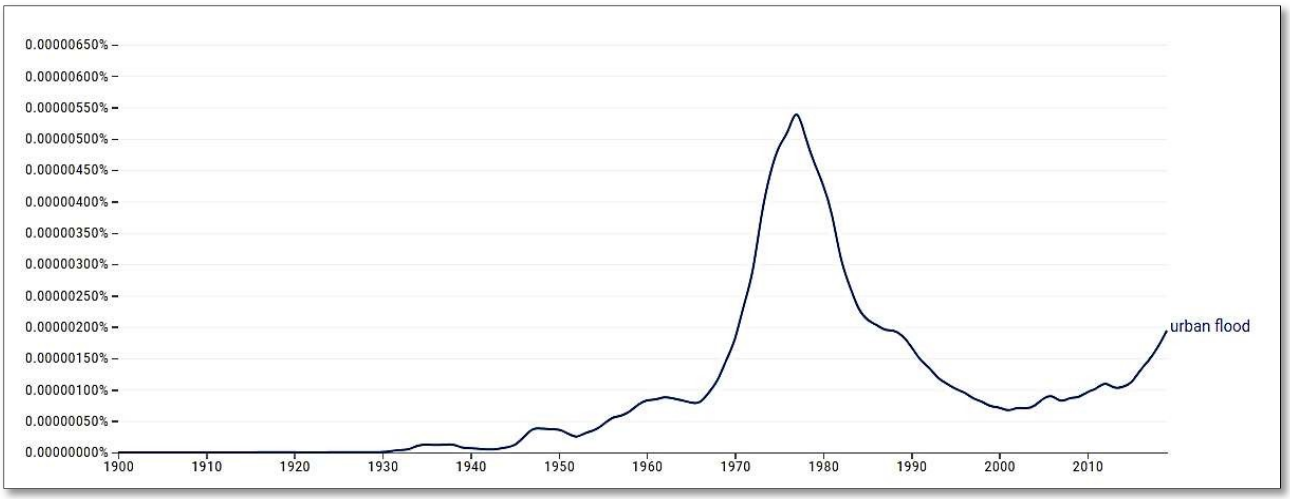

Fig.3 Showing the trend of researches on urban flood.[*Google* Books *Ngram Viewer where X-axisshows the year and Y-axis shows the percentages of the occurrences of the books comprising the key word'urbanflood management'morethan 40times ina specifiedcorpus..(Josund, 2017)*

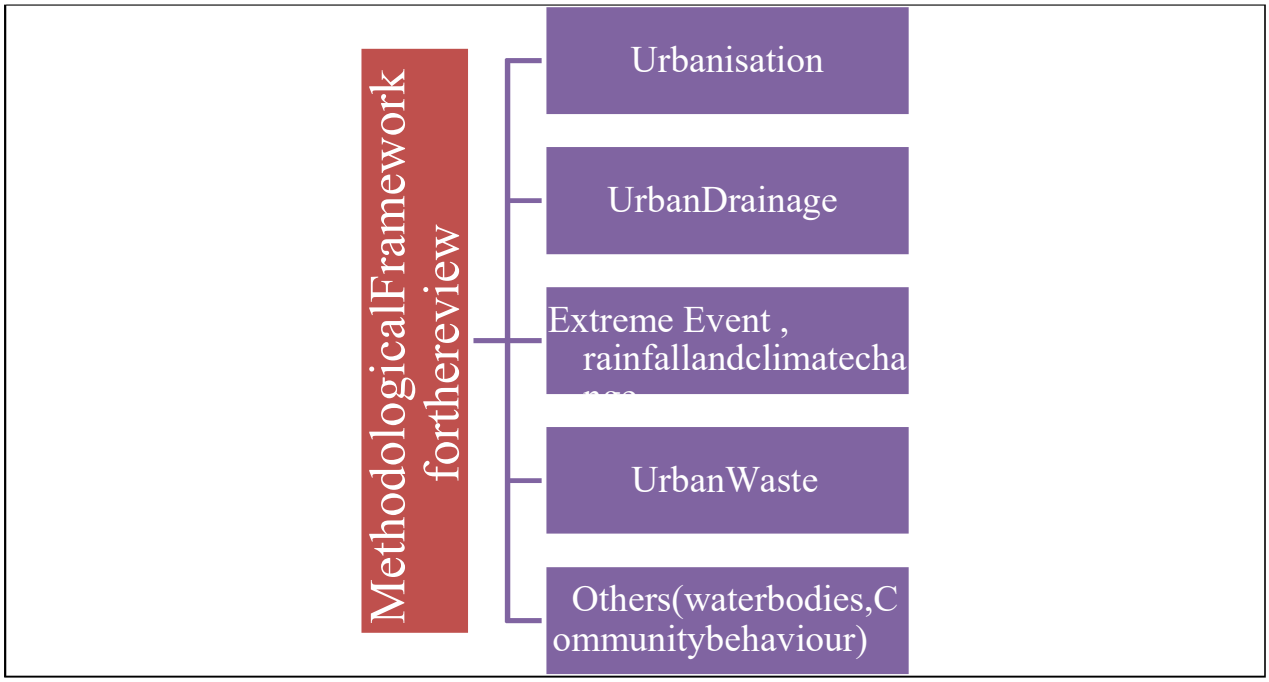

Fig.4TheMethodologicalFrameworkfor Literature Review

2. FactorsofUrbanFlooding:

2.A.Urbanization:

Floods have become increasingly dangerous in many places, causing damage a rising number ofpeople each year. (Zambrano et al., 2018) If the global examples are studied, in case of DonValley watershed, the mechanism for urban flood is perceived as - the rainwater transport andstorageatthegroundsurfacewithinaparticularwatershedaredrasticallyaffectedduringurbanizatio nduetochangesinlandscapefromnaturaltoman-made.Builtimpermeablematerials prevent natural water penetration, lowering the rate of surface infiltration. When theprecipitation rate exceeds the maximum rate of infiltration, extra precipitation will travel swiftlyasoverlandflowintoastreamchannelandcontributetoshort-termstreamresponse,potentially resultinginsoilerosionandfloodslikeinthecaseofthe.(Fengetal.,2021)Thatiswhy,agood understandingoffloodresponsesinlocationswithvaryingdegreesandexpansionsof urbanizationarecriticalforregionalurbanplanning.(Duetal.,2019)Groundconditionsandthe builtenvironment,whichisconstantlybeingupdatedandreshapedbyhumanactions,havea considerableimpactonurbanfloodriskasexperiencedinthreeareasonAccra'sexpanding outskirts.(Andreasenetal.,2022)Ontheotherhand,TheUnitedStateshasbecomeamore urbansocietyoverthe lastcentury.Flooding isaffectedbychangesinlanduselinkedwith urban developmentinavarietyofways.Increasingflowtostreamsfromrainfallandsnowmeltby removing vegetation andsoil,grading thelandsurface,andconstructing drainage networks.As a result,themaximumdischarge,volume,andfrequencyoffloodsinsurroundingstreamsrise. Streamchannelchangescausedbyurbanexpansioncanreducetheircapacitytotransmit floodwaters.Asnewconstructionoccurs,roadsandstructuresinflood-proneareasfacerising floodthreatssuchasfloodinganderosion.Informationregardingstreamflowandhowlanduse

affects it can assist communities in reducing their current and future vulnerability to flooding.(Konrad,2003)Despitetremendouseconomicandtechnologicaldevelopmentthathassignificantly enhanced the quality of human life in recent decades, flooding continues to be themost common natural disaster, affecting a large population worldwide every year.(Ma et al.,2022) Coming to the developing countries like India, in case of population influx, migration playsa huge role within the cities. This Increase in Population which results into more inappropriateurbanization, imperviousarea,and generates less infiltration and greater surface flow.(N &Kumar, 2020)Here,urban flooding doesn't only occur intheurban areasbutalso theprimecause to it is the faulty urbanization in the flood plain cities.(R. Samal et al., 2014) Like Sarmahand Das have mentioned urban floods are more manmade in character, with fast and uncontrolledurbanization filling up water bodies, blocking water courses, causing deforestation, and so on.This urban expansion can lead to both local climate change and formation of urban heat island,which are some other important factors for flooding in the cities. The quantification of urbansprawl through land Use and Land Cover Dynamics, Gradient analysis and urban spatial metricscan be done. Based on the result, and with the input of Digital Elevation Model, a proper floodzonation map can be figured out, like it has been shown in the case study of Delhi. (Gaurav et al.,2018)The degree of Urban Sprawl can also be equated with the various entropy indices andparametric and non-parametric tests too.(Jain et al., 2016) These measures would help to managethis irrational growth calling for a proper and scientific urban planning is needed which wouldtakeaccountintothedesignofurbangrowth,itscausesandsolutions.(Rojasetal.,2017)

2.B.ClimateChangeandIncreasedRainfall:

Global growth in urbanization, as well as the increased frequency and intensity of extremeweathereventscausedbyclimatechange,poseseriouschallengesforurbanfloods.(Yangetal.,

2021)Furthermore, they have resulted in tremendous casualties and economic losses. Climatevariability has contributed to precipitation uncertainty in many parts of the world, consequentlyurbanflooding.(Thanvisitthponetal.,2018)Climatechangeisanticipatedtoincreasethes everity and frequency of heavy rainfall events in Europe, which is a driving force behind urbanpluvialflooding.Surprisingly,theriskof pluvial floodsisexpectedtoriseevenfurther aswintersgetwarmerandwetter,withmorerainandlesssnow.This,togetherwithrisingurbanization and population, will almost certainly result in greatly increased urban pluvial flooddanger. What is certain is that there is already a significant danger of flooding, and that risk isgoing to increase further as a result of climate and demographic change. It is critical to increaseactivities aimed at addressing each component of urban pluvial flood: risk, the exposure, andsusceptibility. (Ochoa-Rodríguez et al., 2010) For example, on 20 July 2020, a severe downpourhit Henan Province, China, with a maximum hourly rainfall of 201.9 mm and a maximum 24-hour rainfall of 645.6 mm, killing over 300 people. A continuous rainfall struck western Japan inJuly 2018, killing more than 200 deaths, making it Japan's worst rainstorm disaster since theNagasakifloodinJuly1982.(Yangetal.,2021)

Hydrometeorologicalimplicationsofurbanizationarealwaysanoverlycomplexfactor,increasing the risk and size of floods in small and urban catchments, wreaking havoc on citizensand infrastructure. The nature of the flooding is also dependent whether it is a flash flooding orpluvial flooding, or riverine or coastal floods those inundates the cities. Flooding is directlyrelated to high precipitation; however, climate change, fast urbanization, and uncontrolled urbangrowth function as catalysts by altering the catchment's hydrological response. (Singh et al.,2018)Climate change has increased the likelihood of higher precipitation both in terms of higherproportion,intensityandoccurrencesinthetwenty-firstcenturybymorethan90percent.

(Ramachandraiah,2011).Theexactforecastingofrainfall,beithighintensityormoderateintensity is needed to deal with the city's vulnerability. The accurate modeling and prediction ofrainfall can also capture the reverse-flow phenomenon which is usually found in the urban areasdue to heavy storm.(Wang et al., 2019) Extreme precipitation (as in Mumbai in 2005 and theGujarat flood disasters of 2005 and 2006) is projected to increase significantly over a vast regionof the west coast and central India. This will necessitate a considerable overhaul of urban designtechniques in order to incorporate flood mitigation and adaptation strategies as well as climatechangemitigationandadaptationmeasures.(Ramachandraiah,2011)

2.C.Urban Drainage:

Urban floodsare produced byan increaseinpopulationdensity,the constructionofurbaninfrastructure withoutproper regard for drainage issues, andan increase in paved surfaces.(Rangari&SaiPrashanth, 2018)The following processes of the urban hydrological cycle havebeen influenced by urbanization: (a) expanding impervious surfaces, such as sidewalks

andconstructions,mayincreasetheamountofsurfacerunoffandreducerechargeofgroundwater;

(b) lowering surface roughness by reducing vegetation distribution and flattening the surfacecould speed up the surface runoff process; (c) stiffening river bottoms may accelerate the riverconfluence process. Using Handan City as an example, it showed urban floods under varied landuseanddrainagesystemconditionsandcharacterizedtheprocessofhistoricalground-undergroundbuildinganditsinfluenceonspatialdifferencesinwaterlogging.(Liuetal.,2022)The design of urban drainage plays an important role like the presence and the layout of themajor drainage system (Open nallah, natural surface drains) and minor (network of undergroundpipesandcanals)drainagesystemandalsotheircompetencetochannelizetheexcessstorm

water.(Butler&Davies,2020)InBurdwanMunicipalityurbandrainagesystemsgenerally perform poorly, mostly as a result increased population and haphazardurbanization. Solid garbage (such as plastic, packages, and aluminum cans) clogsthe majority of open surface drains. Therefore, regular flow is severely hindered. Inthe monsoon season, this stagnant liquid waste causes foul odors, pathogens, andurbanfloods (Dutta&Mistri,2016).

2.D.UrbanWaste:

Another important factor is - Conservancy services, by a Municipal body or a Town meansconservation of urban environment in a sustainable clean manner by including the services likerubbish pickup and removal, road cleaning and sweeping, tree trimming and cutting, dead animallifting, and so on. In one simple sentence, it is the services that make city garbage free.(Kumar &Goel, 2009) The major portion of this city conservancy services is performed by the removal andmanagement ofMunicipal Solid Waste (MSW). Most of thecities of today are growing at amuchfaster rate than floodriskcontroltechniquesandinfrastructurearebeingdeveloped.Furthermore, existing systems are ill-equipped todealwith changing andexpanding runoffpatternscausedbyclimatechangeandincreased impervious surfaces.These stresses are feltmostacutelyintheinformalsettlementsofdevelopingcities,whereimpromptubuildingscommonly spread into flood-prone, low-lying zones or existing drainage systems Meanwhile,industrialization increases and diversifies waste production per capita, resulting in a waste outputrate that exceeds actual urbanization Municipal and residential trash are likely the most abundantoftheseurbanwastegroupsYetthat,onlyabout30%ofurbangarbageinunderdeveloped

countries is collected. Due to a lack of waste collection services and an understanding of healthand sanitary concerns, residents turn to dumping these wastes into nearby drains, streams, andopen areas. Inside drains, open dumpsites (Mokuolu et al., 2022) During a flood, trash and othermaterial gathered by floodwaters can cause additional property damage and result in higher floodlosses following a flood, waste deposition can impede access and serve as a source of toxins anda breeding ground for disease. Floods can also disrupt waste management systems, causingcontaminants to leak into groundwater (Lamond et al., 2012) On the other hand, towns and citiesin the developing nations are acting as hubs of solid waste generation as an outcome of immensepopulationgrowthandhaphazardurbanization.Poorsolidwastemanagement(SWM)hasbecome a burden for governments in developing Asia and Africa, as it is critical to public health,safety,andtheenvironment.Uncollectedrubbishpilesinthestreets,obstructeddrainagechannels, or deposited in watercourses constitute a significant public health risk, and unmanageddisposal of waste can harm water supplies and pose serious environmental health risks to peoplewho live nearby. Workers in solid waste and rubbish collection confront severe occupationalhealth and safety risks. (Ferronato&Torretta, 2019)Thus, solid waste must be handled in a waythatminimizesenvironmentalandhumanhealthconcerns,whichhasconsequencesforitsstorage, collection, and safe disposal. The National Action Plan for Municipal Solid WasteManagement Act 2000 and Solid waste management rules,2016 (India) both put an emphasis theduty of an Urban local body to deal with the municipal solid waste management starting from itsgenerationtoitsrecyclingprocesses.(Ministryof EnvironmentForestandClimateChange,2016)

2. E.OtherFactors:

Floodsinvariouscities,includingMumbai,Hyderabad,Surat,andBangalore,suggestencroachment and loss of water sources, the cities which were once endowed with water bodies.(Chigurupati, 2008) Also, there has been a scarcity of research on community resilience to urbanfloods, particularlyamong transient people, therefore more empirical investigations are neededtoincreaseourunderstandingandfindeffectivetreatments.(Xuetal.,2020)

3. Conclusions:

The gap between disaster occurrence and precaution is always filled with casualties and the onestakeholder that is always first to suffer is the community or the local people.. While numerousclimate change prevention and adaptation methods have been implemented in recent years, manyhave progressively come to the conclusion that developing community resilience is critical whenresponding to climate change, particularly urban flooding. Floods in metropolitan settings are theresultofacomplexsocio-ecosystemprocesswithnumerousfactors,somicro-levelurbanwatershedplanningincludingthelocalcitizensisthemostconvenientstepatthishour.

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