3rd Conference on Sustainability in Civil Engineering (CSCE'21)
Department of Civil Engineering
Capital University of Science and Technology, Islamabad Pakistan

An Overview on the Causes and Impacts of Floods on Building Construction

Umair Abbas

Department of Civil Engineering, Lahore Leads University,umair.u4u@gmail.com

Abstract- This paper reviews the causes of Floods, Effects of floods on Buildings and Infrastructure, and socioeconomic disruption due to flood effects. Different researcher investigate different causes for floods, like Massive rainfall, Climate changes, urbanization, and deforestation, etc., and effects of floods on buildings are Buildings are partially destroyed or destroyed and due to flood effects on different areas social and economic losses like deaths, migration of residents from one place to another Infrastructure (Residential Buildings, Commercial Buildings, Road network's, etc.) are completely or partially destroyed. The Paper Concludes the causes of floods, effects of the flood on building construction, and socioeconomic disruption due to flood.

Keywords- Floods, Rainfall, Urbanization, Deforestation.

1 Introduction

Flooding is the most catastrophic event worldwide and one of the costliest. Depend upon the area, key flood-creating cycles can incorporate fluvial, precipitation, pluvial, seaside, bursting of dams, and snowmelt, which are examples. The cycles creating flooding for some random districts are meteorological systems (for example environmental streams, hurricanes, air flows) that can shift essentially starting with one area then onto the next [1]. Flooding is a situation where typically dry land gets lowered in the water. These phenomena can be caused normally by unnecessary precipitation and expanded surface water stream. It could likewise be human-made because of dam spillage, poor construction of drainage system and defective establishment of local area water conveyance pipes among others.

2 Causes of Floods

There is solid proof that the key systems creating flooding are as of now changing and will keep on changing with additional an Earth-wide temperature boost. Outrageous precipitation at various times (from sub-hourly through to many days)s is expanding and is projected to keep expanding in many areas all around the world with brief span precipitation bound to show more prominent increments, and also Climate change is one of the main reasons of compound floods [1]. Massive precipitation can have intense societal effects. These indirectly contribute to high streamflow and fluvial flooding and, all the more straightforwardly, pluvial flooding. Weighty precipitation can likewise trigger landslides. Flooding across Kenya is due to long rain periods in 2018 caused the dislodging of 0.3 million individuals instantly followed by the periods of ‘‘short rains" from October to December season flooding of 2019.[2].Because of an earlier than-regular beginning of the South China Sea summer monsoon and an all the more toward the north. The drawn-out Meiyu framework with oddly heavy precipitation expands numerous streams caused Flash flooding, Urban flooding, and landslides, Causing devastation across huge spaces of China, especially in the River basin of Yangtze[3]. Heavy rainstorm precipitation desolated an enormous area of East Asia in summer 2020. Extreme flooding in the river of Yangtze dislodged a huge number of occupants amidst a notable general wellbeing emergency. This extreme stormy season was not expected from El Niño conditions[4]. The term El Niño alludes to a warming of the ocean surface (or better than anticipated sea surface temperatures) in the central and eastern tropical Pacific Ocean. El Niño occasions can

upset ordinary climate designs in the United States and universally [5]. The study presents, the historical backdrop of floods is viewed as centering in antiquated Greece since the early Bronze Age. The progressing urbanization and deforestation during that time have prompted an expanding and unmanageable flood hazard. Greece experiences today flood varieties. Because of urbanization and deforestation, flood issues are more extreme these days than in the past. It is noted that the recurrence and event of outrageous flood occasions are expected to increment because of the progressions in the segments of the hydrological cycle that will be influenced by environmental change. Figure 2: shows the historical floods that affected the areas of Greece due to heavy rainfall [6].

Figure 2: Historical Flood is Greece [6]

From the hydrological viewpoint of flood characterization, flood types are dictated by the irregularity or sizes of hydrological drivers (e.g., precipitation, snowmelt, catchment wetness). Waterway flooding makes seriously harms human culture. Climate/Environmental change may additionally intensify flood risks. Past examinations distinguish the different patterns of flood extents and frequencies dependent on long-haul stream flow perceptions at a worldwide scale. Rainfall is the most predominant driver and one of the main reasons for floods [7]. Utilizing the information gathered from two rounds of public overviews (n = 903) across six Colorado people group overwhelmed in 2013, this investigation improves our comprehension of the variables that drive our belief about expected reasons for floods, focusing on environmental change. Thus, these convictions about environmental change are decidedly connected with the view of the dangers of future flooding. At last, belief about climate/environmental change was discovered to be an imperceptibly huge indicator of seen future flood hazard [8]. The characteristic reasons for yearly flood sources have been very much read and summed up the United States for different states; shockingly, evaluation of the normal reasons for outrageous (e.g., return time of at any rate 10 years) flood varieties is often restricted to the event and provincial scale examinations. For instance, investigations of this kind have analyzed the June 2008 flood varieties in Iowa, The basin of the river Ohio Southwestern USA sources of floods are return period of more than 10 years, specifically; focus on atmospheric cycles leading to substantial precipitation, which is a significant factor of the flood [9].

3 Effect of Floods on Buildings

Steady precipitation toward the end of 2002 due to this flood situation appeared in the catchment of Thames and caused flooding. The railroad lines were disturbed, 128 residential properties were affected, and the schools are destroyed due to flood, and making interruption in the everyday life of the town. Meetings recommend that for a gathering of town inhabitants. Flood in 2013 not just striking hydrological properties yet additionally in light of the institutional reaction to the crisis. Due to flood-restricted admittance to many parts of the town, immersing houses, and confining individual's

admittance to fundamental assets, the neighborhood discernment was that flood specialists demonstrated unequipped for dealing with the actual crisis.[10]. The study intends to break down the impact of environmental changes on flood harm focusing on the Wonjucheon basin, which is a metropolitan stream flowing the city. In fast expansion in high causalities and property harm in metropolitan territories caused by urban flooding. In Korea, the Wonjucheon basin which was a metropolitan stream flowing through the downtown area was chosen as the objective basin. The Wonjucheon basin was a district where urban inundation happened much of the time because of the stream flooding in the past as shown in figure 3 which caused a lot of flood harm. The stream was flooded in 2006, 2010, 2011, and 2012 because of substantial rainfall. The affected /damaged area which includes Residential, Agriculture, and industrial (buildings and lands) show in figure 4, and flood damage/affected assets shown in table 1 [11].

Table 1- Flood Damage/affected Assets [11]

Asset Type	Assets
Residential	Residential properties, Home Supplies
Industrial	Facilities of Production
Agricultural	Agricultural land

Figure 3: Past stream flooding [11]

Figure 4: Flood Damage Area [11]

The examination applies the use of primary and secondary source of data collection for examination, the discoveries uncovered that the flooding happened because of heavy precipitation that kept going around four hours which made the inland water rise. The subsequent impact was that buildings and different properties were affected and mostly destroyed; individuals were displaced while a few groups lost their lives. All in all, huge damages to properties and loss of lives were recorded and emphasized on viable mitigation measures were made to decrease the impacts of the flood. As a result of a flood, buildings are partially and destroyed which are shown in Figures 5 a & b, below [12].

Figure 5 a: Partial Collapsed of Building [12]

Figure 5 b: Completely Destroyed Building [12]

Flooding overall can't be eliminated yet can be decreased. The examination in Suleja L.G.A.(Local Government area) uncovered that the area of structures near the stream not more than five meters while a few structures are found less than a meter from the waterway. A few structures built on the flood plain were destroyed alongside lives and properties[12]. The study centers around the assessment of direct harms brought about by 3 flood situations with various return periods of Trotuș River. The harm for three land use is residential properties, infrastructure, and Farmland. The outcomes showed that the major damages are registered for the private structure/residential. The flood events that occurred in the previous years fundamentally affect this territory, both on the people as well as on residential properties, destroyed infrastructure, and major impacts on the environment. The effect of flooding in this area is critical because of the presence of houses, about 1.200 structures being experienced in the 3 towns examined in this study, 95% of the structures which are residential properties. The flood events caused by the Trotus River and its tributaries since July 2005, huge damages to houses/residential and infrastructure was recorded. Table 2 shows the damages caused by two flood events (2005 and 2010)[13].

Table 2- 2005 and 2010 Flood Damages [13]

Affected Elements	**Year 2005 Amount Affected**	**Year 2010 Amount Affected**
Damaged Houses	116	86
Residential Property Destroyed	2	-
Provincial Roads	5.5 km	7.09 km
Roads of Village	-	1.17 km
Highways	-	0.9 km
Demolished Culverts	3	4
Agriculture Land	35 hectare	1 hectare

The study territory is situated on the shoreline of Tuscany in the region of Livorno of central Italy (Fig. 6 "b"). In September 2017, the precipitation event hit numerous little catchments nearby with the significant losses caused by the immersions of Rio Maggiore and Ardenza. The immersed region about 1.15 kilometers square, and the population affected is around 4 thousand, 4 people die and only one property in the Rio Maggiore catchment, and 4 deaths in the Ardenza catchment. Flood damages many buildings, foundations, retaining walls, interior flooring of buildings and plastering, etc. Authorities gathered 302 remuneration structures filled by the affected residents around there shown (Figure: 6, a, c), Floods damages to structures including buildings, foundations of the buildings, retaining walls at different places, interior flooring of buildings and plastering, etc.[14]

Figure 6: Rio Maggiore Area (a) region of Livorno (b) Damages (c) Affected buildings and residents [14]

The examination territory is situated along in south Quebec of, Canada. The Richelieu River takes source from the Lake Champlain at the US line and streams toward the north into the St. Lawrence River. The latest event happened between the 5th of June and 4th of August, 2011, bringing about more than US dollar of 88 Million damages to around 3,000 affected residential buildings. The majority of damages were noticed south of the Saint-Jean-sur-Richelieu. The examination territory considered in the investigations contains 8 hundred residential buildings. [15].Changes Environmental conditions raising the number of outrageous events, like extreme floods, have expanded the consideration of their impacts on the metropolitan system. Urban floods create significant hydrodynamic loads on the building. The investigation is done with experimental tests replicating masonry buildings with a scale of 1/10, while the impact of the flow hitting the building has been acquired by moving the structure/Building in the water. [16].

4 Socioeconomic Disruptions Due to Effects of Flood

Thailand has been experiencing repeating flood events and was most which are seriously influenced during the 2011 floods. Floods in 2011 during the long periods of October 2011 to December 2011, was one of the most ruinous floods as far as financial losses, social damages in ongoing many years. The 2011 floods were among the high-cost calamities in Thailand the financial losses were raised to over Trillions, 1.4 trillion in Thailand currency "Thai Baht" equal to forty-two Billion united states dollar and an extra recovery costs of over Forty-five Billion United States Dollar which are equal to 1.5 Trillion Thai Baht since the 2011 floods. A few territories including Ayutthaya and Pathumthani were seriously influenced because of the quality of the huge number of business endeavors that were immersed in over 2.5 meters of rising water. The Thai Small and medium enterprises accommodate 70% of the work and contribute forty-five percent "US $ 215 billion" towards the absolute of Thai National Gross Domestic Product (GDP) and international trade [17]. Due to the double influence of tropical storm Rumbia and Yagi, on August 18, 2018, Weifang city, Shandong Province, was hit by a progression of substantial rainfall, bringing about extraordinary precipitation and a potential flood hazard in the Mihe River basins. A few towns were flooded, and an enormous number of Residential Properties,

agricultural land, and vegetable nurseries were destroyed. As indicated by insights, the catastrophe caused 26 people died, and one lack seventy thousand individuals were migrated, 14,130 residential buildings were collapsed, more than 2 lack nurseries were damaged and monetary/economics losses arrived at 22.292 billion Chinese yuan, including 14.658 billion Chinese yuan for horticultural damaged[18].In this paper, Flood damages in the Muzaffargarh region were analyzed. The investigation territory major flood influenced areas by floods before. Essential information was gained through surveys, The investigation shows that the flood was created by a heavy precipitation event in July 2010 in River Indus at the upper catchment spaces. This created the ever most elevated release in the River. The greater part of the land region was immersed. Additionally, the investigation showed that the immersion caused absolute assessed financial loss of about US $9.85 million Out of aggregate, the greatest harms of US Dollar 4.45 million were accounted for from farming area followed by infrastructure US Dollar 3.5 million[19].A comparative case study investigation was directed in 3 unique areas in the City of Hampton, The Hampton Roads space of Southeast Virginia is a level, flowing district with the most noteworthy estimated pace of the City of Hampton includes more than two hundred twenty-seven miles of shoreline along lakes, waterways, and the Chesapeake Bay, just as one hundred twenty-four miles of navigable waterfront making it exceptionally vulnerable to flowing flooding The city administration collected there were 938 losses in the repetition of floods inside the City of Hampton [20].In South China, 634 rivers flooded and almost 64000000 million individuals were influenced. The loss of life is almost 219 and more than 54 thousand properties were demolished as of 2020 August. During a dam-break flood, over 100 thousand individuals in Uzbekistan and Kazakhstan were cleared. About 81 thousand individuals were evacuated in Somali and Ethiopia and 78,000 in Congo during floods due to substantial precipitation. Numerous individuals influenced by the flood were inclosed during evacuation.A major flood in both Uzbekistan and Kazakhstan is due to the failure of the dam which is in Uzbekistan. Substantial rainfall and high breezes destroyed the dam wall, flooding enormous land territories in both adjoining nations. Many houses in both Countries were destroyed. In Uzbekistan, around 70 thousand individuals from 3 districts were cleared. 2 child deaths were recorded. In Kazakhstan, more than 31 thousand individuals from a district in the southern area, which is near the border of Uzbekistan, were cleared. Flooding in Yangtze river china demolished almost 400000 houses and damaged 5000000 hectares of agricultural land. it is assessed that immediate economic losses due to floods surpass 25 billion dollars [21]. Flooding essentially affects the socio-economic lives of occupants of the floodable regions in the chose networks and Adamawa State when all is said in done. Infrastructure and administrations like public and private structures or buildings, Road Networks, and Electricity supply offices are destroyed by flooding. In the aftermath of the 2019 floods in Adamawa State, an expected 381 houses were destroyed, 493 houses are partially destroyed, with more than 365 water and sanitation offices damaged influencing more than 12,000 people.The greater part of farmlands having crops was demolished and animals lost and an expected figure of around 12,000 people was evacuated from the selected communities[22].The investigation region is Draa Basin, and of Tafilalet basin of Morocco, Tafilalet basin on the November 5th, 1965, a flood Destruct the Ziz valley, due to this 25,000 individual's homeless. In Merzouga, the recent significant flood was recorded on May 26th, 2006 after extreme precipitation for three hours. The flood destroyed 140 residential houses and hotels, the disintegration of Taouz Merzouga Roads, Streets, destroyed the water distribution supply line of Merzouga and Taouz towns show in figure:7 A & B below [23]

Figure 7 A & B: Destroyed Houses, Roads and water Supply lines [23]

Draa basin the brutality of flood caused water disintegration which lessens the fertility of rural land. Photograph in Figure 8 A & B shows the floods in 2009 that disconnected a few towns of Beni Zouli from the public street N9, and afterward the stop of provisioning administrations/Services for15 days [24].

Figure 8 A & B: Draa Valley 2009 Flood [23]

This examination was led in four urban communities of Iran in 2017–2018. Ajabshir province and Azarshahr province are urban areas of Azerbaijan East territory situated on the west side of Iran. The two urban communities were badly affected by the magnificent huge flood in 2017. Specifically, Ajabshir province has 40 towns, of these, 3 towns were flooded, and due to flood-hit the towns, 20 people died because of the flood in the town of Chenar, yet no demise happened in the other 2 towns. The province of Azarsahhr was likewise affected due to the flood alongside the town of Chenar around there (Both are urban areas are near one another); in Azarshahr, around 22 individuals deaths were reported.[24].Floods are arranged into direct damages due to flood and indirect damages due to floods. Direct damages happen because of the actual contact of rising Flood with peoples, properties, or other components, and indirect damages are initiated by the immediate effects of the direct impact of the flood. These are additionally characterized into tangible damages and intangible damages depend upon regardless of whether these damages can be surveyed in money-related qualities [25].

5 Conclusions

The current study Present the causes of floods, Effects of flood on buildings, and socioeconomic disruptions due to flood effects.
The following conclusions are made:

- The major causes of floods are heavy rainfall in a particular area, many other causes will discuss in the above-reviewed paper-like climate change, urbanization, deforestation, return period, etc.
- Flood effects on buildings are also reviewed, due to floods buildings are partially or destroyed depends upon the nature of the flood, if the flood discharge is minimum it affect not catastrophic but partially affects the buildings if the flood discharge is maximum it will destroy the buildings.
- Residential Property Damages is in hundreds depends upon the amount of discharge enter residential areas.
- Flood disasters in a particular area create social and economic disruptions i.e. Deaths, Migration from that area, Infrastructure destruction, destroy agricultural lands, and Disturbed Transmission services, it will impact on country's economy.
- The deaths and affected people due to flood are in thousands, and the monetary losses are in million $ due to flood.

6 Acknowledgment

The author would like to thank Engr. Dr.Usman Farooqi, Assistant Professor, Department of civil engineering, Capital University of Science and Technology who helped throughout the work, with his constructive suggestions. I am very thankful to anonymous reviewers for their careful review and constructive suggestions.

7 References

[1] Westra S, Nathan R, Orr HG, Villarini G, Villalobos Herrera R,Fowler HJ Wasko C, "Incorporating climate change in flood estimation guidance.," *The Royal Society Publishing*, 2021.

[2] RUTGER DANKERS, RICHARD GRAHAM, KISWENDSIDA GUIGMA, LUKE JENKINS,MARTIN C. TODD, AUGUSTINE KIPTUM, MARY KILAVI, ANDREW NJOGU,AND EMMAH MWANGI DAVID A MACLEOD, "rivers and Subseasonal Predictability of Heavy Rainfall in Equatorial East Africa and Relationship with Flood Risk," *Journal of Hydrometeorology*, 2021.

[3] Xiaomeng LI, Guy J.-P. SCHUMANN, Lorenzo ALFIERI, Yun CHEN, Hui XU, Zhifang WU, Hong LU, Yamin HU, Qiang ZHU, Zhijun HUANG , Weitian CHEN, and Ying HU Huan WU, "From China's heavy precipitation in 2020 to a "glocal " hydrometeorological solution for flood risk prediction," *Advances in Atmospheric Sciences* , vol. volume 38, 2021.

[4] Shang-Ping Xie , and Renhe ZhangHistoric Zhen-Qiang Zhou, "Yangtze flooding of 2020 tied to extreme Indian Ocean conditions," *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, 2020.

[5] https://www.usgs.gov/faqs/what-el-ni-o-and-what-are-its-effects?qt news_science_products=0#qtnews_science_products.

[6] G. Antoniou · K. Voudouris · N. Kazakis · N. Dalezios5 · N. Dercas N. Angelakis, "History of foods in Greece: causes and measures for protection," *Natural Hazards*, 2020.

[7] Hanbo Yanga, Dawen Yang Wencong Yanga, "Classifying floods by quantifying driver contributions in the Eastern Monsoon Region of China," *Journal of Hydrology*, 2020.

[8] Elizab et hAAl brigh t & Deserai Crow, "Beliefs about climate change in the aftermath of extreme flooding," *Climatic Change*, 2019.

[9] Hamid Moradkhani & Upmanu Lall Katherine e. schlef, "Associated with extreme United States Floods Identifed via Machine Learning," *Scientific Reports*, 2019.

[10] Daniel H. de Vries Kseniia Puzyreva, "A low and watery place': A case study of flod history and sustainable community engagement in flod risk management in the County of Berkshire, England," *International Journal of Disaster Risk Reduction*, 2021.

[11] Dong-Ho Nam , Se-Jin Jeung and Byung-Sik Kim Dong-Ho Kang, "Impact Assessment of Flood Damage in Urban Areas Using RCP 8.5 Climate Change Scenarios and Building Inventory," *Water*, 2021.

[12] Kigun P.A., Alfred Y.B., Majidadi ST., Surajo L.A Birmah M.N., "Flood Assessment in Suleja Local Government Area, Niger State, Nigeria," *International Journal of Research Publication and Reviews*, 2021.

[13] José Luis Zêzereb , Iulia Crăciunc , Gabriel Lazăr , Iuliana Lazăr Roxana Țîncua, "Quantitative micro scale flood risk assessment in a section of the Trotuș River, Romania," *Land Use Policy*, 2020.

[14] Bernardo Mazzanti, Francesco Pistone, Fabio Castelli, Chiara Arrighi, "Empirical fash food vulnerability functions for residential building," *SN Applied Sciences*, 2020.

[15] Karem Chokmani, Miroslav Nastev, Rachid Lhissou and Anas Elalem]Khalid Oubennaceur, "Flood risk mapping for direct damage to residential buildings in Quebec,Canada," *International Journal of Disaster Risk Reduction*, 2019.

[16] Gianluca Zitti , Ersilia Giordano , Francesco Clementi , Giovanna Darvini , Stefano Lenci Matteo Postacchini, "Flood impact on masonry buildings: The effect of flow characteristics and incidence angle," *Journal of Fluids and Structures*, 2019.

[17] Shubham Pathak and Jorge Chica Olmo, "Analysing spatial interdependence among the 2011 Thailandflood-affected small and medium enterprises for reduction of disaster recovery time period," *Geoenvironmental Disasters*, 2021.

[18] Qi Zhou , Mingjie Li, Dianxing Song , Yanjun Wen Shuolin Geng, "Spatial–temporal diferences in disaster perception and response among new media users and the influence factors: a case study of the Shouguang Flood in Shandong province," *Natural Hazards*, 2021.

[19] S., Sajjad, A. & Rahman, Au. Mahmood, "Cause and damage analysis of 2010 flood disaster in district Muzaffar Garh, Pakistan. ," *Natural Hazards*, 2021.

[20] Aishwarya Borate,Shereen Hughes,Ross Weaver, David Imburgia, William A.Stiles Jr Anamaria Bukvic, "Exploring neighborhood-level resilience to floo ding: Why the context and scale matter," *Journal of Flood Risk Management*, 2021.

[21] Zbigniew W. Kundzewicz,Nigel Wright Slobodan P. Simonovic, "Floods and the COVID -19 pandemic A new double hazard problem," *WIREs Water*, 2020.

[22] B., Umar, H., Barde, M. M. and Adamu, S Abubakar,". Socio-economic Impact of Flooding on the Riverine Communities of River Benue in Adamawa State, Nigeria," *FUTY Journal of the Environment* , vol. 4, 2020.

[23] Ahmed Karmaoui & Balica Stefania, "A New Flood Vulnerability Index Adapted for the Pre-Saharan Region," *International Journal of River Basin Management*, 2019.

[24] Ali Ardalana, Abbas Ostadtaghizadeha, Yadolah Zarezadeh, Mohsen Souf Boubakran, Farzam Bidarpoorc, Abbas Rahimiforoushani Arezoo Yaria, "Underlying factors affcting death due to flood in Iran: A qualitative content analysis," *International Journal of Disaster Risk Reduction*, 2019.

[25] Luca Locatelli,María Guerrero, Beniamino Russo and Montse Martínez Eduardo Martínez-Gomariz, Socio-Economic Potential Impacts Due to Urban Pluvial Floods in Badalona in a Context of Climate Change," *Water*, 2019.