A Panoramic View Of The Flood Problem In Eastern Uganda:

Lessons From Pakistan And India

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Abstract

Floods appear to be one of the most significant issues societies are currently dealing with, and they continue to have a variety of social, political, and economic effects on individuals. Both Uganda and other nations like India and Pakistan are examples of this. It's critical to understand your risk and safeguard your water supplies because floods may exacerbate the spread of water- and vector-borne diseases like typhoid fever, cholera, malaria, and yellow fever, among others. Floods are among disasters that cause widespread destruction to human lives, properties and the environment every year and occur at different places with varied scales across the globe. Flood disasters are caused by natural phenomena, but their occurrences and impacts have been intensified through human actions and inactions. The practice of flood disaster management have evolved over the years from traditional approaches of ad-hoc response measures to integrated approaches involving technologically advanced tools in flood disaster awareness, preparedness and response measures. More information is required regarding the "lived experiences" of people who have adapted to floods as well as the significance that these people attribute to their daily lives.Therefore, the only way to determine how the urban poor cope with floods is through a people-centered approach. Flooding can happen when water from water bodies, such as a river, lake, or ocean, overflows and destroys levees, allowing some of the water to escape its regular confines. It can also happen when rainwater collects on wet ground to cause an area flood. While seasonal variations in precipitation and snowmelt will affect the size of lakes and other bodies of water, these changes are unlikely to be significant unless they cause property to flood or domestic animals to drown.

KEY WORDS: Floods, Mitigation, Uganda, India, Pakistan, Vulnerability

Floods Conceptualised:

The strength, geography, and frequency of floods have all had an impact on how floods have been conceptualized around the world. The word "flood" is derived from the Old English word "fld," which is a word that is used in all Germanic languages to refer to "a flowing of water, tide, an overflowing of land by water, a deluge, mass of water, river, sea, or wave." Floods, as defined by the English language, are the result of a significant overflow of water beyond expected levels. A flood can also be of other fluids such as magma but this is rare that submerges land that is usually dry. In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flood Study is a discipline hydrology and is of significant concern in agriculture, civil engineering and public health. Different words like inundation, swamping, deluge, torrent, overflow, freshet, downpour, cloudburst, spate, outpouring, torrent, rush, stream, gush, surge, cascade, flow etc. are all used to refer to floods.

In myths and religion, legends of great civilization believe that destroying floods are widespread in many cultures. Flood events in the form of divine revenge have also been described in religious texts. The Genesis flood narrative plays a prominent role in Judaism (Legends of the Jews: The Inmates of the Ark), Christianity (Matthew 24:37-39, Luke 17:26, 1Peter 3:20, 2 Peter 2:5, 2 Peter 3:6, Hebrews 11:7) and Islam (Chapter 71 Surat Nuh/ Noah).

The Main Types Of Floods:

1. **Areal/ Pluvial floods/ surface water floods**

Areal floods can happen on flat or low-lying areas when water is supplied by rainfall or snowmelt more rapidly than it can either infiltrate or run off. The excess accumulates in place, sometimes to hazardous depths. Surface soil can become saturated, which effectively stops infiltration, where the water table is shallow, such as a floodplain, or from intense rain from one or a series of storms. Infiltration also is slow to negligible through frozen ground, rock, concrete, paving, or roofs. Areal flooding begins in flat areas like floodplains and in local depressions not connected to a stream channel, because the velocity of overland flow depends on the surface slope. Endorheic basins (interior basins) may experience areal flooding during periods when precipitation exceeds evaporation

They form in flat areas where the terrain can’t absorb the rainwater, causing puddles and ponds to appear. Pluvial flooding is similar to urban flooding, but it occurs mostly in rural areas. The agricultural activities and properties in areas where pluvial floods have occurred can be seriously affected.

2. **Riverine/ river/ Channel floods**

These are characterized by gradual riverbank overflows caused by extensive rainfall over an extended period of time. The areas covered by river floods depend on the size of the river and the amount of rainfall. River floods rarely result in loss of lives but can cause immense economic damage. They occur in all types of river and stream channels, from the smallest passing streams in humid zones to normally-dry channels in arid climates to the world's largest rivers. When overland flow occurs on tilled fields, it can result in a muddy flood where sediments are picked up by run off and carried as suspended matter or bed load. Localized flooding may be caused or worsened by drainage obstructions such as landslides, ice, debris, or work dams.

Slow-rising floods most commonly occur in large rivers with large catchment areas. The increase in flow may be the result of sustained rainfall, rapid snow melt, monsoons, or tropical cyclones. However, large rivers may have rapid flooding events in areas with dry climate, since they may have large basins but small river channels and rainfall can be very intense in smaller areas of those basins.

They include the flash floods which are fast-moving waters that sweep everything in their path. They are caused by heavy rainfall or rapid snow thaw. Floods usually cover a relatively small area and occur with little to no notice, generally less than six hours. The rapid water torrents can move large objects such as cars, rocks, and trees. Rapid flooding events, including flash floods, more often occur on smaller rivers, rivers with steep valleys, rivers that flow for much of their length over impermeable terrain, or normally-dry channels. The cause may be localized convective precipitation (intense thunderstorms) or sudden release from an upstream impoundment created behind a dam, landslide, or glacier. The deadly flood resulted from a thunderstorm over part of the drainage basin, where steep, bare rock slopes are common and the thin soil was already saturated.

Flash floods are the most common flood type in normally-dry channels in arid zones, known as arroyos in the south-west United States and many other names elsewhere. In that setting, the first flood water to arrive is depleted as it wets the sandy stream bed. The leading edge of the flood thus advances more slowly than later and higher flows. As a result, the rising limb of the hydrograph becomes ever quicker as the flood moves downstream, until the flow rate is so great that the depletion by wetting soil becomes insignificant.

3. **Estuarine and coastal floods (storm surge):**

These are brought on by storms or strong winds that approach a coast at high tide. The area is typically inundated when strong waves breach the dune or dike along the coast. The worst damaged coastal regions are those with fewest fortifications and lowest elevation. Low tide is the ideal moment to fix the breach. Large waves meeting high upstream river flows and storm surges brought on by strong winds and low barometric pressure frequently result in flooding in estuaries. Storm surges combined with high tides and strong wave events at sea, which cause waves to exceed flood barriers, or, in more catastrophic circumstances, by tsunami or tropical cyclones, may flood coastal areas. a storm surge from an extra-tropical cyclone or a tropical cyclone

4. **Urban floods:**

These occur when the drainage system in a city or town fails to absorb the water from heavy rain. The lack of natural drainage in an urban area can also contribute to flooding. Water flows out into the street, making driving very dangerous. Although water levels can be just a few inches deep, urban floods can cause significant structural damage.

Urban flooding is the inundation of land or property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers. Although sometimes triggered by events such as flash flooding or snowmelt, urban flooding is a condition, characterized by its repetitive and systemic impacts on communities that can happen regardless of whether or not affected communities are located within designated floodplains or near any body of water. Aside from potential overflow of rivers and lakes, snowmelt, storm water or water released from damaged water mains may accumulate on property and in public rights-of-way, seep through building walls and floors, or backup into buildings through culvert pipes, toilets and sinks.

5. **Catastrophic**

Catastrophic riverine flooding is usually associated with major infrastructure failures such as the collapse of a dam, but they may also be caused by drainage channel modification from a landslide, earthquake or volcanic eruption. Examples include outburst floods, Lahars, Tsunamis can cause catastrophic coastal flooding, most commonly resulting from undersea earthquakes.

Factors That Account For Floods:

Flooding occurs all over the globe for a variety of reasons. Some are human causes where as others may be natural. Here are the general causes of floods all over the world.

1. **Up slope Factors**

The amount, location, and timing of water reaching a drainage channel from natural precipitation and controlled or uncontrolled reservoir releases determines the flow at downstream locations. Some precipitation evaporates, some slowly percolates through soil, some may be temporarily confiscated as snow or ice, and some may produce rapid run-off from surfaces including rock, pavement, roofs, and saturated or frozen ground. Convective precipitation events (thunderstorms) tend to produce shorter duration storm events than orographic precipitation. Duration, intensity, and frequency of rainfall events are important to flood prediction. Short duration precipitation is more significant to flooding within small drainage basins. The most important upslope factor in determining flood magnitude is the land area of the watershed. Rainfall intensity is the second most important factor for watersheds of less than approximately 30 square miles or 80 square kilometres. The main channel slope is the third important factor for larger watersheds.

Time of Concentration is the time required for runoff from the most distant point of the upstream drainage area to reach the point of the drainage channel controlling flooding of the area of interest. The time of concentration defines the critical duration of peak rainfall for the area of interest. The critical duration of intense rainfall might be only a few minutes for roof and parking lot drainage structures, while cumulative rainfall over several days would be critical for river basins.

2. Down Slope Factors

Water flowing downhill ultimately encounters downstream conditions slowing movement. The final limitation in coastal flooding lands is often the ocean or some coastal flooding blocks which form natural lakes. In flooding low lands, elevation changes such as tidal fluctuations are significant determinants of coastal and estuarine flooding. Less predictable events like tsunamis and storm surges, melting snow and ice may also cause elevation changes in large water bodies. Elevation of flowing water is controlled by the geometry of the flow channel and, especially, by depth of channel, speed of flow and amount of sediments in it. Flow channel restrictions like bridges and canyons tend to control water elevation above the restriction. The actual control point for any given reach of the drainage may change with changing water elevation, so a closer point may control for lower water levels until a more distant point controls at higher water levels.

3. Coincidence

Extreme flood events often result from coincidence such as unusually intense, warm rainfall melting heavy snow pack, producing channel obstructions from floating ice, and releasing small impoundments like beaver dams. Coincident events may cause extensive flooding to be more frequent than anticipated from simplistic statistical prediction models considering only precipitation runoff flowing within unobstructed drainage channels. Debris modification of channel geometry is common when heavy flows move uprooted woody vegetation and flood-damaged structures and vehicles, including boats and railway equipment. Culvert fills may be converted to impoundments if the culverts become blocked by debris, and flow may be diverted along streets.

4. Climate Change

The simplest explanation for flooding is heavy rains. Increased rainfall intensity due to climate change increases risk of flooding, especially when it comes to urban flooding. Sea level rise further increases risks of coastal flooding. If sea levels rise by a further 0.15 m, 20% more people will be exposed to a 1 in a 100 year coastal flood, assuming no population growth and no further adaptation. With an extra 0.75 m, this rises to a doubling of people exposed. Similar to droughts, climate change has also been shown to have the potential to increase the frequency of bigger storm events. This increase in the frequency of large storm events would alter existing Intensity-Duration-Frequency curves (IDF curves) due to the change in frequency, but also by lifting and steepening the curves in the future.

Floods are the most frequent type of natural disaster and occur when an overflow of water submerges land that is usually dry. Floods can happen during heavy rains, when ocean waves come on shore, when snow melts, it may occur along river banks, lakes and sea coasts. Human changes to the environment often increase the intensity and frequency of flooding, for example land use changes such as deforestation and removal of wetlands, changes in waterway course or flood controls such as with levees, and larger environmental issues such as climate change and sea level rise. In particular climate change's increased rainfall and extreme weather events increases the severity of other causes for flooding, resulting in more intense floods and increased flood risk.

Flooding is increasing with extreme weather events caused by climate change which are creating rainfall events with much more rain than in the past. Cities and towns built on water bodies or with infrastructure designed around historical rainfall patterns are increasingly susceptible to urban flooding. Flooding may occur from water bodies. Flooding is a type of extreme weather. Flooding happens when there is heavy rainfall in a short amount of time.

Cyclones too that occur in low pressure zones where winds rotate inwardly. Cyclones are accompanied by storm and lead to extreme weather conditions. Overflowing Rivers. Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to homes and businesses if they are in the natural flood plains of rivers. While riverine flood damage can be eliminated by moving away from rivers and other bodies of water, people have traditionally lived and worked by rivers because the land is usually flat and fertile and because rivers provide easy travel and access to commerce and industry. Flooding can lead to secondary consequences in addition to damage to property, such as long-term displacement of residents and creating increased spread of waterborne diseases and vector-bourne disesases transmitted by mosquitoes. Global warming which is due to increased rise in global temperatures that lead to the melting of the ice on tops of mountains like the Himalayas thus causing floods in the surrounding years.

Flood Experiences From Pakistan:

Since mid-June, the National Disaster Management Authority (NDMA) has reported more than 12,800 injuries and roughly 1,700 fatalities.

The three provinces with the highest death rates were Sindh (747), Balochistan (325), and Khyber Pakhtunkhwa (307). According to reports from the Provincial Disaster Management Authorities (PDMA) of the affected provinces, more than 2 million homes have been damaged or destroyed and 7.9 million people are allegedly displaced, including over 598,000 people residing in relief camps. According to estimates, more than 7,000 schools are currently housing displaced people, and an additional 25,100 schools have suffered damage.

According to current estimates, the destruction throughout the nation has prevented more than 3.5 million pupils from finishing their schooling. Additionally, millions of rupees' worth of educational furnishings, such as books, copies, blackboards, tables, and other equipment, have all been entirely destroyed. 61 schools (26 in KPK and 35 in Balochistan) and 27,148 (58.7%) girls' learning processes have been impacted in the refugee villages. In Pakistan, unusually strong monsoon rains from mid-June to September caused flash floods, standing water, and significant infrastructure and human- and livestock-related deaths. Despite the fact that flood waters have subsided in many regions, vast portions of Sindh and eastern Balochistan are still submerged and probably always will be for time to come.

An increase of water-borne infections, filthy conditions, and rising malnutrition rates are being brought on by the standing flood water and its indirect effects. The flood-affected health system is less able to address and reduce the risk of a serious public health catastrophe at the same time that water infrastructure has sustained considerable damage. Balochistan and Sindh experienced significantly less rain during the last week as temperatures began to drop in preparation for winter. The majority of Balochistan's districts are seeing normal circumstances, while in Sindh, the Indus River is flowing regularly at the Kotri, Sukkur, and Guddu Barrages, with lower water levels at its edges. In general, water levels are dropping in Taluka Qubo Saeed Khan, Shahdadkot, Kambar, Warah, and Nasirabad's upper regions.

As of 20 September, in 18 out of 22 districts of Sindh, floodwater levels had receded at least 34 per cent, and in some districts up to 78 per cent.

Large portions of Sindh are still under water, and getting around these regions is very difficult. A major issue is the rise in water-borne and vector-borne illnesses, especially in Sindh, Balochistan, and Khyber Pakhtunkhwa, which are the most impacted. 1,900 cases of acute watery diarrhea, 200 cases of malaria, and 50 cases of dengue fever were reportedly reported by the National Institute of Health on September 20 alone in Balochistan, Khyber Pakhtunkhwa, Punjab, and Sindh. Numerous individuals reside in filthy temporary shelters with little access to essential services, increasing the likelihood of a serious public health emergency.

Pregnant women are treated in temporary camps when possible, and about 130,000 of them require immediate medical attention. Open defecation increased from 21% before the floods to 35% after, according to government-led multi-sector rapid needs assessments (RNA) undertaken in Balochistan, Sindh, and Khyber Pakhtunkhwa in September. This is likely due to destroyed water infrastructure. Latrines in 950,000 homes were either broken or inaccessible, affecting an estimated 6.3 million people. An additional issue in communities affected by flooding is malnutrition. Prior to the floods, the prevalence of Global Acute Malnutrition (GAM) was already high in Balochistan, Khyber Pakhtunkhwa, Punjab, and Sindh; 96% of children under 2 were not receiving a minimum tolerable diet, and at least 12% of children under 5 were malnourished. The current floods are expected to exacerbate food insecurity.

More recent analyses of these districts show that, according to preliminary estimates, 8.62 million people will be in crisis or emergency situations in the assessed districts between September and November 2022. This estimate includes 5.74 million people in flood-affected districts included in the assessment, with 3.82 million of them in IPC Phase 3 and 1.92 million in IPC Phase 4. According to a preliminary analysis by the UN Satellite Centre (UNOSAT), which compared satellite data from the 8th to the 14th of September to data from the 15th to the 21st, many districts in Sindh, two in Balochistan, and one in Punjab were still devastated by rising floodwaters a week ago.

In many other areas of the nation, floodwaters seem to be stagnating or decreasing, but in Sindh, increasing floodwater was once more seen in the districts of Jamshoro, Malir Karachi, Thatta, Tando Allahyar, Mirpur Khas, Umer Kot, Tharparkar, and Sujawal. Additionally, increasing floodwater was seen in the districts of Gwadar and Lasbela in Balochistan, as well as the Khusbab district in Punjab.

Since June 2022, when that month alone witnessed area-weighted rainfall 67% above average levels, Pakistan has experienced extreme monsoon conditions. Rainfall throughout the nation as of August 27 is equivalent to 2.9 times the 30-year national average. Widespread flooding and landslides resulted from this, which had detrimental effects on infrastructure, property, and human life. The Pakistani government has designated 72 areas as "calamity affected" as of this writing. The Pakistani government calculates that the country's 33 million residents are somewhat impacted by the rains, floods, and their after-effects like landslides.

Additionally impacted or at danger are the more than 421,000 refugees who reside in calamity-declared districts. About 6.4 million people were anticipated to be in need of assistance as of August 27. The NDMA reports that between 14 June and 27 August, at least 1,033 people died and 1,527 were injured, with the number of casualties rising as the rainy season continues. Over 1.7 million homes have been damaged, over 1,300 people have died, and food production has been disrupted by Pakistan's disastrous flooding. So far, more than 33 million people have been impacted. It's common knowledge that the havoc brought on by these so-called "natural disasters" is mostly unpredictable and unavoidable. Another reason given for the purported increased frequency of disasters is climate change. Years of research have shown that disasters are not brought on by the weather or other natural factors, but rather by causes of vulnerability.

Lack of capacity and resources to foresee dangers is a source of vulnerability. This includes sub par infrastructure as well as social exclusion and unfairness, which limit access to important services like education. A disaster occurs when a hazard or its effects exceed a person's capacity to deal with them using only their own resources. A hazard frequently has a negative impact on people in areas with little or insufficient resources. Flooding has always been a routine occurrence in Pakistan. Since 1950, six floods in the nation have claimed more than 1,000 lives. Numerous initiatives at flood risk management have been sparked by these catastrophes. Over 135 people lost their life in 2005 when the Shadi Kaur dam in the southern province of Balochistan broke during a period of severe rain. In the same area, eight dams have been harmed by the recent floods. Pakistan has neglected non structural risk reduction strategies in favor of large-scale infrastructure and response initiatives. As a result, many people don't have many options for dealing with their vulnerability.

Addressing Pakistan’s Vulnerability:

Vulnerability is not sufficiently addressed by Pakistan's current flood management strategies. While centralized and post-disaster procedures are being gradually phased out of flood management, progress has been slow. Pakistan must take aggressive measures to address the root causes of vulnerability right now. People should have easier access to services that can inform them of the hazards of flooding and help them make preparations. This must involve actions to ensure efficient government, promote secure land use, and enable unrestricted access to education. With obvious effects on the weather, human activity is altering the climate. Pakistan experienced devastating floods this year as a result of prolonged, heavy rain.

Despite having a very low carbon footprint, Pakistan is one of the ten nations that are most affected by extreme weather events, according to Climate Watch and the Global Climate Risk Index 2021. International cooperation is essential to effectively handle the effects of the continuing rains and floods, even while national efforts to help those impacted are already under way.

Flood Experience In India:

India is extremely susceptible to flooding. Over 40 million hectares (mha) of the 329 million hectares (mha) total geographic area are at risk of flooding. Floods are a frequent occurrence that result in significant human casualties as well as damage to property, infrastructure, and public services. The fact that flood-related damages are on the rise is cause for alarm. In the past ten years, from 1996 to 2005, the average yearly flood damage was Rs. 4745 crore, compared to Rs. 1805 crore, the corresponding average for the prior 53 years. Numerous factors, such as a sharp rise in population, fast urbanization, an increase in economic and development activity in flood plains, and global warming, might be blamed for this.

Floods affect 75 lakh hectares of land on average each year, claim 1600 lives, and cost Rs. 1805 crores in damage to public facilities, residences, and agriculture. The most lives lost (11,316) occurred in the year 1977. Major floods occur more than once every five years. The Himachal Pradesh state government reported that 27 people had died there and that six more were still missing as of Monday. It further stated that many of the fatalities were due to homes falling and other mishaps. It's the most recent in a long list of fatalities brought on by the state's severe rains since the beginning of the monsoon season at the end of June. It has been at least 244 fatalities in Himachal Pradesh since the onset of the season, according to the state report.

According to Ranjit Kumar Sinha, a representative of the State Disaster Management Authority, 12 people are still missing and five people have perished in the state of Uttarakhand. The central weather agency had forecast earlier this month that India would likely have average amounts of rain in August and September. We have used helicopters to rescue persons who have become trapped in outlying locations as a result of rain-related occurrences. The rescue effort is in full swing, according to Sinha, who was quoted by Reuters. Since August 26, 2022, flooding has reportedly devastated over 1,000 villages across 22 districts in the state, according to India's National Emergency Response Centre (NERC). As of August 29, 16,562 evacuees were staying in 386 relief camps that had been established by the authorities. According to NERC, 245,585 persons were affected as of August 31. In the recent days, the floods have claimed the lives of at least 4 persons. The Ganges was at or above Severe Flood Level as of August 31 in the districts of Ballia, Barabanki, Ghazipur, Praygraj, and Varanasi, according to the Central Water Commission of India.

The Yamuna River in the Praygraj district and the Sarda in the Kheri district were both flowing at Severe Flood Level in the days before. The Chandrawal in the Hamirpur area was above Extreme Flood Level on August 28 and 29, 2022, although it has since dropped. According to the chief minister, flooding in some areas of the state was brought on by water released from dams in Rajasthan and Madhya Pradesh. "The problem of flooding has been exacerbated by surplus water released from dams in Rajasthan and Madhya Pradesh," he stated, despite the fact that rainfall in Uttar Pradesh has been below average this time. For relief and rescue efforts, teams from the National Disaster Response Force, State Disaster Response Force, and Provincial Armed Constabulary have been sent.

Yogi Adityanath, the chief minister of Uttar Pradesh, visited flood victims in the districts of Varanasi and Gazipur on August 31, 2022, and he also did an aerial reconnaissance of the afflicted areas. On August 29, 2022, a landslide took place in the Idukki District of Kerala State in the south-east, killing several people.

Five people reportedly perished, and search and rescue efforts were complicated by persistently heavy weather. Several villages have been submerged in southern Kerala's Kottayam and Pathanamthitta Districts as a result of flash floods, rain-related flooding, and Minimala River tributary overflow. (ECHO, August 30, 2022)

On September 9 and 10, at least 13 people perished, almost 1,400 people were affected, and more than 1,200 people were evacuated throughout the States of Assam, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Uttarakhand, and Uttar Pradesh, according to the National Emergency Response Centre (NDMI). Nearly 1,800 people have perished since the start of the rainy season, 89 remain missing, more than 1,100 have been hurt, and 1,3 million have been evacuated. (9 Sep 2022, ECHO). At least 36 people died as a result of severe rain and thunderstorms that were reported in northern India on September 23–24, 2022. According to media reports, 12 more people died as a result of lightning incidents, while 24 people perished in Uttar Pradesh as a result of accidents related to severe rain. According to the National Emergency Response Centre, since June, there have been more than 1,945 fatalities across India as a result of the intense monsoon rains (NDMI). 1,260 people were injured, and over 90 people are still missing. (ECHO, Sep. 26, 2022)

In the neighboring state of Uttarakhand, a series of cloudbursts—in which extraordinarily heavy rain falls in a brief period of time—leaved four people dead and 13 missing. An employee of Uttarakhand's disaster management division, Ranjit Kumar Sinha, said: "To rescue those trapped in isolated locations as a result of rain-related occurrences, we have sent out helicopters. The rescue effort is actively underway." The Indian meteorological department predicts that the area will experience extra heavy rain during the next two days. Nearly 800,000 people in the eastern state of Odisha have been affected by floods and hundreds have been forced from their homes. Rains have also damaged highways and water and electricity infrastructure. At least six people have died in Odisha, according to Reuters, where 120,000 people have already been evacuated from the impacted districts. Landslides and floods are prevalent during the monsoon season in India's Himalayan north, and scientists assert that they are growing more frequent as glaciers melt due to global warming.

River Systems and Associated Flood Problems

The rivers in India can be broadly divided into the following four regions for a study of flood problem.

(1) Brahmaputra Region;

(2) Ganga Region;

(3) North West Region ; and

(4) Central India and Deccan region.

Brahmaputra River Region:

The Brahmaputra and Barak rivers, as well as their tributaries, are what make up this region, which spans seven states: Assam, Arunachal Pradesh, Meghalaya, Mozoram, Northern West Bengal, Manipur, Tripura, and Nagaland. The catchments of these rivers experience extremely significant precipitation, ranging from 110 cm to 635 cm annually and predominantly occurring from May/June to September. Because of this, there are severe and frequent floods in this area. Additionally, the unstable and easily eroded rocks of the highlands from which these rivers flow contribute to the extraordinarily high silt charge in the rivers. Additionally, the area experiences strong, frequent earthquakes, which frequently result in landslides in the hills and disturb the flow of the rivers.

Ganga River Region: This river region is made up of the Ganga and all of its tributaries, with the Yamuna, Sone, Ghaghra, Gandak, Kosi, and Mahananda being among the most significant. It includes the ten states of Uttaranchal, Uttar Pradesh in its basin, Jharkand, Bihar, South and Central West Bengal, portions of Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, and Delhi. It also includes parts of Himachal Pradesh and sections of Madhya Pradesh. In this area, the average annual rainfall ranges from 60 cm to 190 cm, with the south west monsoon accounting for more than 80% of the total. From West to East and from South to North, there is an increase in rainfall.

Flooding mostly affects the areas near the Ganga river's northern bank. The Ganga's northern tributaries flow over their banks and alter their pathways, causing devastation. Even though the

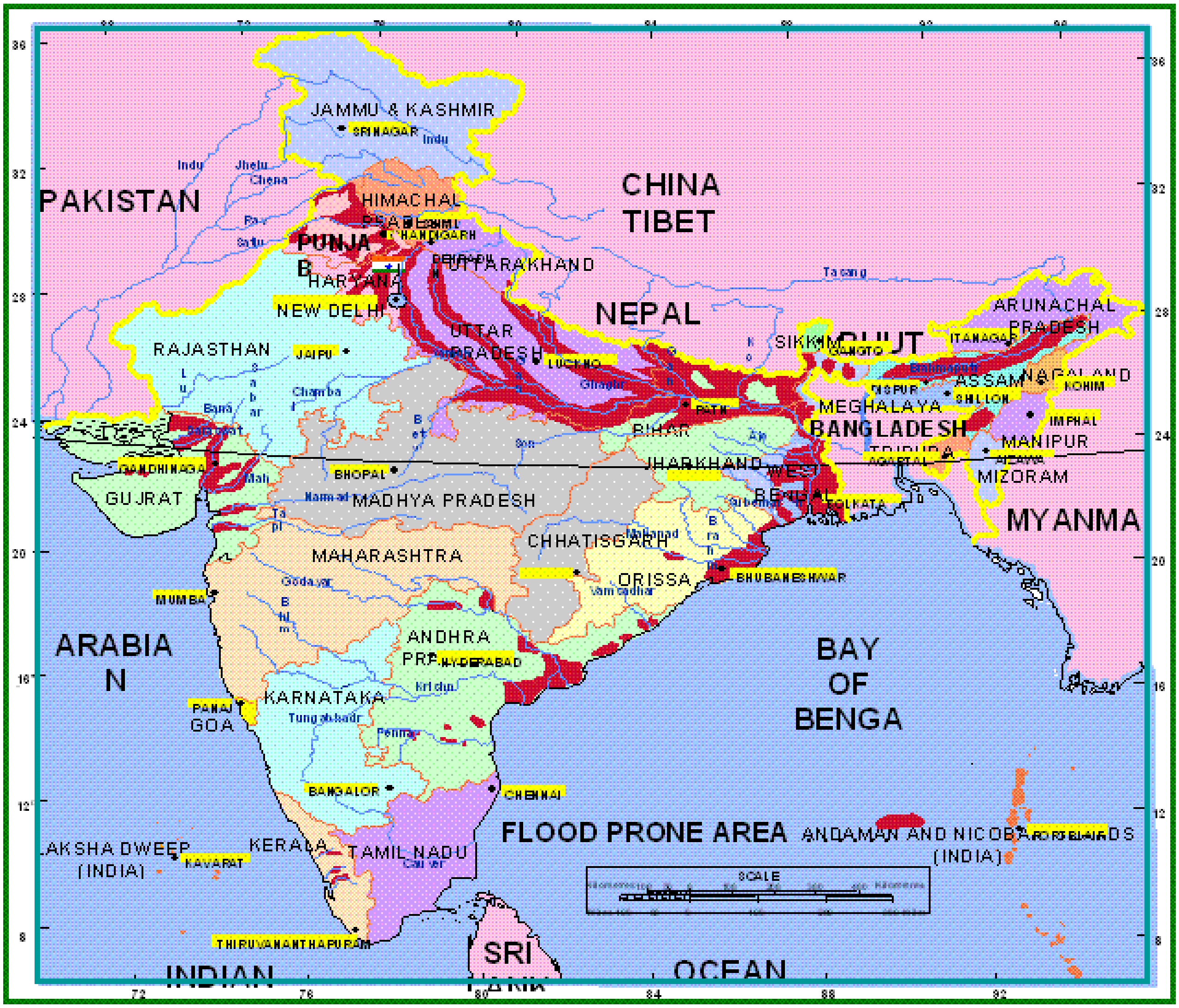
Ganga is a powerful river with enormous discharges of 57,000 to 85,000 cumec (2 to 3 million cusec), the erosion and inundation issues are only present in a small number of locations. In the States located downstream, there is a severe problem with erosion and flooding. Heavy floods have also occurred in recent years in some States that weren't often prone to them.

North West River Region: The Sutlej, Beas, Ravi, Chenab, and Jhelum are the principal rivers in this area. They are all tributaries of the Indus and originate in the Himalayas. These carry a lot of sediment and quite a bit of discharge during the monsoon. They frequently alter their route, leaving sand-filled trash in their wake. The state of Jammu & Kashmir, Punjab, and portions of Himachal Pradesh, Haryana, and Rajasthan are included in the region. Flooding is less of an issue here than it is in the Ganga and Brahmaputra river basins. The main issue is poor surface drainage, which results in flooding and water logging across considerable regions.

Central India and Deccan Region: The Narmada, Tapi, Mahanadi, Godavari, Krishna, and Cauvery are some of the significant rivers in this area. The majority of these rivers have clearly defined, dependable channels. With the exception of the delta area, the natural banks have sufficient capacity to carry the flood runoff. The East Coast's major rivers' lower reaches have been embanked, essentially solving the flooding issue.

The overall flood-prone area in the nation was estimated by the National Flood Commission (RBA) in 1980 to be 40 m.ha, of which 33.516 m ha were unprotected flood areas and the remaining were protected areas. The country's flood-prone territory was estimated by the Working Groups on Flood Management for the X and XI Plans to be 45.64 million ha.

This is seen by the map below:



Government’s Initiatives And Policies On Floods

After the unprecedented floods of 1954, the Government of India took several initiatives and constituted a number of Committees to study the problem of floods in the country.

Recommendations Of Expert Committees On Flood Management

A brief account of the recommendations of some of the important expert committees are as follows.

Policy Statement - 1954

The Union Minister for Planning, Irrigation and Power presented two remarks to the Parliament on September 3, 1954, titled "Floods in India - Problems and Solutions" and "The Floods in the country," in response to the severe floods of 1954. Unmistakably stated in the policy pronouncements was the goal of ridding the nation of the threat of floods through the containment and management of floods and so finding a solution to the issue. The above upbeat note was slightly modified in the supplemental statement presented to the Parliament on July 27, 1956, to read, "We shall, however, be able to curb and confine the floods, more and more, and do all that is possible to save ourselves from the harm and the devastation that they bring."

High Level Committee On Floods – 1957 & Policy Statement of 1958

The Central Flood Control Board evaluated the report from the High Level Committee on Floods, which had submitted it in December 1957, during its seventh meeting in May 1958.

Some of their key recommendations include

(i) It is technically impossible for known flood control techniques to provide complete or permanent protection from flood damage.

Therefore, it is important to give flood plain zoning, flood forecasting and warning, and similar measures the attention they deserve, especially because they don't call for a significant financial outlay.

(ii) To the degree practical, flood control strategies should integrate with other water-related measures.

(iii) Future multi-purpose projects should simultaneously take into account flood control issues.

National Water Policy (1987 / 2002/2012)

The National Water Policy of India reflects the Government of India's strong emphasis on managing floods during the policy-making process as follows:

In order to improve flood management, it was advised, among other things, that "sufficient flood cushion should be given in water storage projects wherever practicable" in the National Water Policy (1987) adopted by the National Water Resources Council. While acknowledging that "physical flood protection works, such as embankments and dykes, will continue to be necessary," it placed a strong emphasis on the adoption of non-structural measures for the minimization of losses, such as flood forecasting and warning, flood plain zoning, and other similar practices.

The National Water Resources Council suggested the following guiding principles in its 2002 National Water Policy, among other things:

(i) Each flood-prone basin needs to have a master plan for flood control and management.

(ii) Wherever possible, adequate flood protection should be included in water storage facilities to aid in improved flood management.

Flood control should be given top priority in reservoir rules in highly susceptible areas, even at the expense of any irrigation or power benefits.

Possible Causes Of Floods In Eastern Uganda

Uganda is one of the countries that has consistently faced floods in several years especially in areas surrounding mountainous areas of Rwenzori and Elgon. According to the Uganda Red Cross Society September 2022, Homes were damaged or destroyed and several lives lost after heavy rain in the Western Region of Uganda caused flash floods and landslides. Landslides buried homes in Kisoro, Uganda. Uganda Red Cross reported heavy rain on 02 September 2022 triggered landslides in villages near Rubuguri in Kisoro District. At least 8 houses were destroyed or damaged, displacing or affecting 37 people. Red Cross teams were carrying out further damage assessments. As of 04 September, no fatalities were reported.

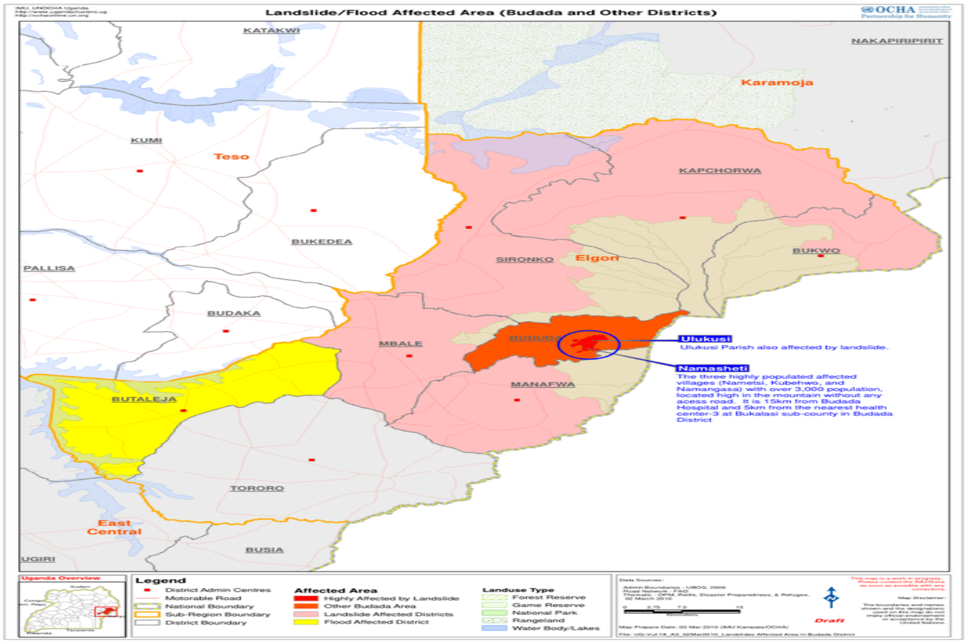
Meanwhile heavy rain has also taken its toll in Bundibugyo District, where several people including children were reported missing after severe flooding struck in villages near Ntandi town on 02 September. Uganda Red Cross said around 10 homes were filled with mud and the belongings of the residents destroyed or swept away.

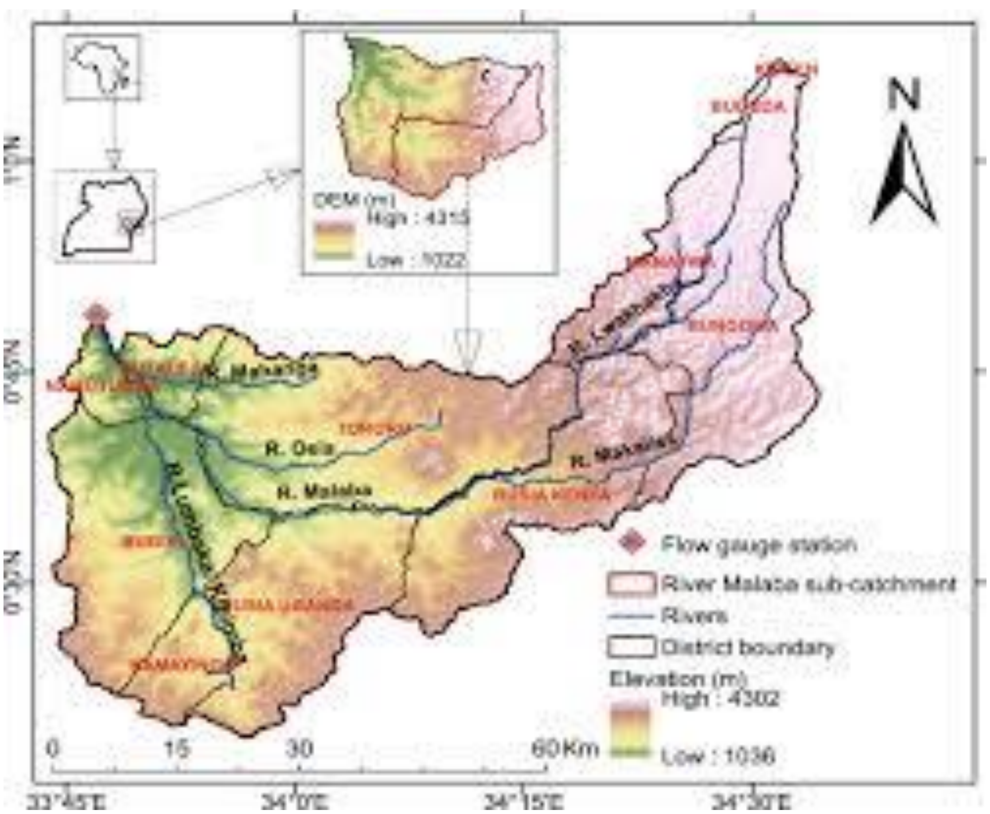
"Our Bundibugyo branch Red Cross volunteers are working with the local authorities to dig up the mud in search of the bodies of the children," Irene Nakasiita, Red Cross spokesperson said.

As of 03 September, Red Cross reported the body of one of those missing had been found. Local media reported a further 2 bodies were recovered later in the day. Uganda Red Cross and Uganda National Meteorology Authority (UNMA) also reported high levels of the River Nyamwamba in Kasese district in Western Region. Parts of the country's Eastern Region saw massive flooding from late July this year. Catastrophic flooding and landslides in the Eastern Region of Uganda left at least 10 dead and hundreds homeless after heavy rain caused rivers to overflow. Uganda Police Force said flooding and landslides struck following heavy rain on the slopes of Mount Elgon late on 30 July 2022. Areas of Mbale, Kapchorwa and Sironko Districts in Eastern Region have all been severely affected. Houses were submerged and crops and roads wiped out.

Uganda Red Cross said several rivers including the Nabuyonga and Namatala overflowed in Mbale District. According to Uganda Police Force, the floods caused extensive property damage, especially in areas of Namakwekwe and areas of Mbale City where several vehicles and an unknown number of occupants were swept away. As of 31 July, Uganda Red Cross reported 7 fatalities in Mbale and 3 in Kapchorwa. More are feared missing and the death toll is likely to rise. Teams from the Red Cross are working with the community and district disaster management committees of the affected areas to support the victims. However, Red Cross said rescue efforts in some of the areas are useless since the roads are impassable.

Below is a sketch map of part of eastern Uganda showing the major areas affected with floods





Rescue efforts have been hindered by rainfall, with a number of areas still inaccessible.

“The situation is very serious,” said Edward Simiyu, of Mercy Corps Uganda. “A lot of medical teams are needed on the ground. Dead bodies are being recovered, and more and more people are injured.”

Three health centres in Mbale were damaged and many people have had to travel up to 60 miles (100km) to find the closest hospital. The government has deployed emergency supplies and is working with humanitarian aid agencies to provide temporary shelters, but teams on the ground said they were stretched.

“Many have lost everything and have had barely anything to eat over the last few days. There are small children who don’t have a change of clothes and many families are still looking for their loved ones,” said Joseph Ssenkumba, of the Association of Ambulance Professionals Uganda.

Simiyu said the flooding was unprecedented. “We believe that this is being fuelled by climate change because we’ve had heavy rains before but not to this scale,” he said. Hundreds of people have lost their lives or livelihoods to floods in the hilly area of Mbale over the past five years. The impact of extreme weather events has been worsened by the clearing of land for farms and homes. The Uganda National Meteorological Authority has predicted more rain in east Uganda over the next month. Authorities have advised people to evacuate the Mbale area and have been working to relocate those from areas around Mount Elgon. Only about 2,500 people out of a target of 100,000 have so far been relocated.

The Head Of Communications at the office of the prime minister, Julius Mucunguzi, said: “The long-term solution is to protect the environment, stay clear of wetlands, riverbanks and avoid destroying river pathways. Climate change is evident. You can no longer predict when the rains will come and how intense they will be.”

About 300km north of Mbale, the Karamoja region has experienced severe drought over the last few months. A World Bank report predicts that at least 86 million Africans will migrate within their own countries by 2050 as a result of climate change.

These floods have been attributed to:

Heavy rains

This is one of the meteorological factors which over a long period of time has led to floods. This is because the systems that are created to move rainwater into the appropriate basins and reservoirs sometimes become overwhelmed, back up and the water levels rise towards the places regardless of homesteads.

Cloud bursts are another factor for floods in eastern Uganda. This is due to intense precipitation in a short duration which can be accompanied by hail and storm and thus floods. This is common at the mountain slopes where water runs down towards the plains causing floods.

Over Flowing Rivers

This also happens so much during the heavy rains where the authorities that are concerned with dam operations and management take tough decisions about the dams themselves and floods become a result of negligence or delay. This goes hand in hand with improper planning of the drainage systemin an area which can cause excess water due to heavy rains to get stuck and cause floods. Two rivers burst their banks after heavy rainfall swept through the city of Mbale over the weekend, submerging homes, shops and roads, and uprooting water pipes. About 400,000 people have been left without clean water, and more than 2,000 hectares (5,000 acres) of crops have been destroyed.

Broken Dams

Most of the infrastructure in Uganda was built long time ago and therefore happen to be old enough. Therefore when rain water comes levees fail to hold the torrent but rather makes it worse to act as the alluvial material

Urban Drainage Basins

These are geographically known as the catchment areas. Most of the sinkholes in urban areas are made of concrete and therefore live no room for water to sink into thus pushing it to flooding in low lying areas. Lakes and rivers themselves have been filled with waste that block the waters from reaching their destinations.

Channels with Steep Sides

Most of the fast run-off of the eastern Uganda region are located on steep slopes. It normally worsens when there's no vegetation.

Deforestation as one of the major human cause of flooding. Mount Elgon itself had forests at its peak. These trees are cut down for several reasons by the inhabitants. This gives way to the rain water to run towards the river valleys and as a result floods occur.

Improper Agricultural Practices

If farmers are not cautious about the effects of any methods of farming applied in their area for example continuous tilling of the soft soils on the slopes of mountain Elgon. These soils later become strained and lose their erodibility powers and thus become susceptible to floods.

Engineering /Structural Measures

The flood control engineering techniques that provide relief to flood-prone areas by reducing flood flows and, as a result, the flood levels include:

(a) a man-made reservoir behind a dam across a river

(b) a natural depression that has been appropriately improved and controlled, if necessary, or by diverting a portion of the peak flow to a different river or basin where it would not significantly harm the environment.

(d) by building a parallel channel that passes a certain town or flood-prone river stretch.

The following are some flood protection engineering techniques that lessen spills but do not decrease flood flow:

In order to keep flood water contained within the river banks and prevent spilling, there are two main methods:

(a) embankments that artificially elevate the effective river bank.
(b) (b) channel and drainage improvement projects that artificially lower the flood water level.

Reservoirs

Reservoirs can moderate the time and intensity of the impending flood. In order to be prepared for the following wave, rivers that discharge the most water do so by holding it back until the critical high flow condition has passed. The capacity of the reservoirs at the moment for absorbing storm run off and their closeness to the predicted damage center would determine how effective they are in reducing floods. They are run according to a meticulously designed schedule of regulations that considers both the safety of the dam and its connected structures and the safe carrying capacity of the river's lower reaches in their current state.

Embankments

Embankments (such as ring bunds and town protection works) contain flood flows and stop them from spilling, which lessens damage. These have typically been built in large numbers in the past and are the most effective, rapid, and affordable way of flood protection. Particularly in the lower portions of big rivers, these are said to have provided significant protection at comparably moderate expenditures. Embankments may be the only practical way to prevent flooding in many locations.

Channelisation of Rivers

In order to address the vast wandering issues of the rivers, activate navigational channels, and retrain these rivers into their natural routes, certain states are contemplating channelization of rivers, at least in particular portions.

Channel Improvement

Desilting, dredging, lining, and other hydraulic improvements to the river channels to improve their hydraulic conditions and allow the river to carry its discharges at lower levels or within its banks have been frequently advocated but have only been adopted to a very limited extent due to their high cost and other issues. If it is technologically and economically feasible, dredging may be considered as part of a package of actions for improving the channel to stop river bank erosion. When navigation is involved, it might be economically justified as a channel improvement technique.

Drainage Improvement

Damages result from surface water drainage congestion brought on by inadequate natural or man-made drainage channels for carrying storm water discharge in a timely manner. Differentiating between instances of drainage congestion and flooding is frequently challenging. Andhra Pradesh, Bihar, Haryana, Punjab, Orissa, Uttar Pradesh, Assam, West Bengal, J&K, Gujarat, and Tamilnadu are among the states with the most severe cases of this issue.

Flood Plain Zoning

Flood plain management revolves around the idea of flood-plain zoning. This idea acknowledges the fundamental truth that a river's flood plain is fundamentally its domain and that any development or encroachment into that area must respect the river's "right of way." In order to limit the damage caused by floods when they do occur, if not prevent them altogether, flood-plain zoning measures aim to demarcate zones or areas that are likely to be affected by floods of different magnitudes, frequencies, and probability levels. They also specify the types of developments that are permitted in these zones. Unfortunately, despite the fact that this strategy is largely supported in theory, it receives less attention in real practice, which increases flood damages.

Flood Proofing

A few settlements were raised above predetermined flood levels and connected to neighboring roads or high lands as flood proofing techniques in India in the past. In the 1950s, thousands of villages were built in Uttar Pradesh because to this scheme. Land-fills were also attempted in West Bengal and Assam to protect homes above flood levels.

All the above can be applied in the areas that are affected with severe floods in Uganda

APPENDIX

Villagers try to retrieve bodies from a minibus partly submerged in the Nabuyonga River in Namakwekwe, eastern Uganda as adopted from photographs by Badru Katumba/AFP/Getty Images/2021

Students in Mbale dry books and papers on the roof of their school as adopted fromPhotograph: Badru Katumba/AFP/Getty Images/2021

The following is a photographic representation of the flood system in the eastern part of Uganda.

In conclusion therefore, The majority of the deaths and destruction created by floods are largely preventable. A great deal can be done to lessen the impact of a disaster. First, though, the general public as well as engineers, planners, politicians and others need to understand the nature of the hazard. Based on that understanding, a decision and a commitment need to be made to implement mitigation measures to reduce flood damage. Reducing the harmful effects of a flood requires actions on three fronts: reducing the vulnerability of the physical settlements and structures in which people live; reducing the vulnerability of the economy; and strengthening the social structure of a community so that coping mechanisms can help absorb the impact of a disaster and promote rapid recovery. The first step in vulnerability reduction for human settlements is to identify the high-risk areas. This is done by relating a natural hazard such as a flood to the terrain and to the probability that such an event will occur. This activity is known as risk mapping. Flood risk mapping, for example, would indicate the areas likely to be covered by water during floods of given magnitude. The second step in vulnerability reduction is to identify those communities that are particularly susceptible to damage or destruction. This is done by relating risk to human settlements and their structures.

The third step is selection of a vulnerability reduction strategy. Specific mitigation activities may include:

- Development of extensive public awareness programs to inform the public about flood hazards and illustrate what can be done to prevent a disaster;
- Land-use zoning to control development;
- Construction of protective works, such as embankments, to protect from flooding;
- Restrictive development regulations to ensure that any development meets certain standards that take into consideration the threat to the site;
- Land swaps, which would provide alternatives to development of the site;
- Establishment of incentives to encourage future development on safer sites and safer methods of construction (such as favorable taxation, loans or subsidies to those qualifying in terms of building methods or sites);
- Diversification of agricultural production; identification and planting of flood resistant crops or adjustment of planting season, if possible, to avoid coinciding with the flood season;

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