Lecture 8
Floods in the Humid Tropics (II): Impacts of Fluvial Floods on Places

KEY QUESTION:

✓ *Why do fluvial floods affect places and people differently?*

With the completion of this lecture, attached readings and tutorial, you should be able to understand the:

- Impacts of fluvial floods on places
- Variations in the effects of fluvial floods on places
- Variations in effects of fluvial floods experienced by different groups of people due to differences in their vulnerability to fluvial floods

Lecture Outline

8.1 Introduction: Impacts of Fluvial Floods

8.2 Positive Impacts

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8.2.2 Recharge ground water storage

8.3 Negative Impacts

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8.3.1 Property damages and economic losses

Environmental

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8.3.5 Diseases

8.4 Different Groups of People, Different Vulnerabilities

8.1 Introduction: Impacts of Fluvial Floods

- Fluvial floods, often triggered by heavy rainfall and snowmelt, have profound and multifaceted impacts on both natural environments and human communities.
- The consequences of fluvial floods encompass a wide spectrum, ranging from immediate and devastating damage to infrastructure, property, and livelihoods, to more intricate ecological effects such as soil erosion, sediment deposition, and alterations to aquatic ecosystems.
- As the frequency and intensity of extreme weather events continue to rise due to climate change, understanding and mitigating the impacts of fluvial floods have become essential endeavors for sustainable development and disaster resilience.

8.2 Positive impacts

- Fluvial floods, though often associated with destruction and disruption, can also bring about a range of positive impacts that contribute to the ecological health and vitality of river systems and surrounding landscapes.

8.2.1 Increase soil fertility

- Perhaps, one of the most recognised benefits of flooding is that it makes the soil fertile.
  - As the flood water eventually recedes, it leaves behind fine sand, clay, silt and organic matter. Floodwaters transport nutrients and sediments to floodplains, which nourish the soil. This aids in the distribution and deposition of river sediments across broad floodplains.
  - The nutrients in the topsoil are replenished by these river sediments, making agriculture more productive. Since recurrent flooding resulted in fertile, productive farmland, many ancient civilisations thrived on the banks of the Euphrates, Ganges, Nile (**Fig. 1**), Tigris and Yangtze. Even today, many agricultural systems on floodplains are in harmony with low-magnitude, high frequency floods.

Fig. 1 A view of the Nile River.

For thousands of years, the lower reaches of the Nile flooded annually during August and September. This resulted from heavy rainfall in the Ethiopian Highlands in the Blue Nile's upper course in July and June.

Each year as the river flooded it deposited fertile silt on the floodplain, vital to farmers. This was particularly important in the Nile delta, which has some of Africa's most productive farmland.

In addition, the Nile is important for transport and as a source of water for domestic and industrial uses.

8.2.2 Recharge ground water storage

- Flooding is important for recharging underground water sources. Both extreme, rare floods and small floods occurring seasonally lead to increased water volume in groundwater stores (recall **Lect 5**).
- Recharge that results from flooding is especially beneficial during dry seasons when groundwater is the main source of freshwater and baseflow to rivers in areas that experience pronounced wet and dry seasons.
    - An example is Cambodia in the lower Mekong River basin, where 85% of its precipitation falls during the wet southwest monsoon season. Flood control which reduces the area of inundation in the Mekong River basin in Cambodia in turn results in a reduction of groundwater resources in the area. In 1998, a 44% reduction in inundation areas led to a 42% reduction in groundwater storage.

8.3 Negative impacts

- Human inhabitation of floodplain locations, including higher risk areas, has increased in the 20th century. This is due to urban development, population pressure, and more road and rail routes. Thus, people have increasingly become exposed to the flood risk and the hazard has increased in relative importance without an actual increase in flood events.
    - Impacts can be severe at **all levels** of economic development. However, flood impacts follow the pattern of other hazards, with developing countries suffering the most deaths and developed countries the highest economic loss.
    - Research suggests that developed countries suffer only 5% of fatalities from floods, but 75% of the costs from natural hazards, whereas the developing countries suffer 95% of the deaths and 25% of the costs.

Economic

8.3.1 Property damages and economic losses

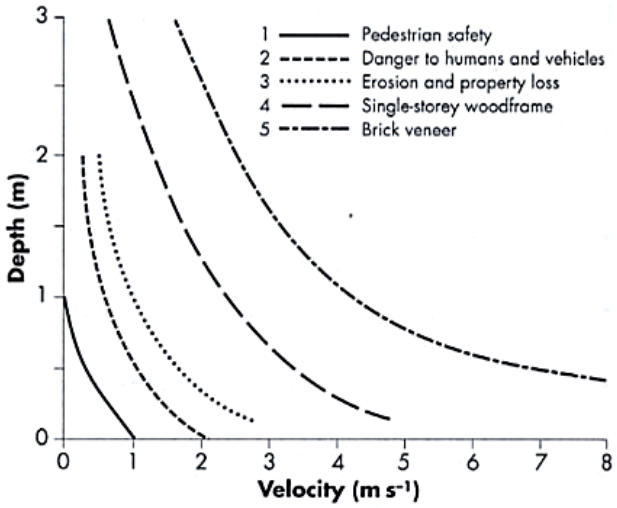

Fig. 2

- The degree of flood hazard is dependent on factors such as the depth and velocity of the water, the duration of the flood and the load carried. **Fig. 2** shows some approximate thresholds for depth and velocity.

- People and cars can be washed away in about 0.5 m of fast-flowing water. Buildings, and other obstructions, create turbulent scour effects and many buildings start to fail at velocities 2 m/s.

- The physical stresses on structures are greatly increased when rapidly flowing water contains debris such as rock, sediment or ice. The consequent collapse of the sewerage systems and storage facilities for products like oil or chemicals means that flood waters create pollution and other hazards.
- The high energy floodwaters can undercut and erode the foundation of buildings, bridges structures and levees, causing their collapse or leaving them in need of substantial repair. The destruction of houses would lead to homelessness.
- When the floodwaters retreat, velocity is generally much lower and sediment is deposited. After the retreat, everything is usually covered with a thick layer of stream deposited mud, including the interior of buildings. This damages buildings and incurs a huge cost of cleaning and repair.
- The impacts of flooding on property and lives can be seen in these examples:
  - In the 2016 Colombo floods, the Kelani Ganga River basin (**Fig. 3**) received 350 mm of total rainfall within 3 days across the whole river basin (equal to one month's precipitation) which caused the following damages:
    - Approximately 2,343 sq. km. of land went under water.
    - Flood have displaced more than 300,000 people across the island with at least 58 left dead and a further 130 missing.
    - Houses in the localities were submerged 6 to 10 feet under water. More than 125,000 houses were damaged or destroyed.
    - Major damage occurred to roads, plantations and crop lands.
    - Colombo floods expected to cost at least $1.5 billion.

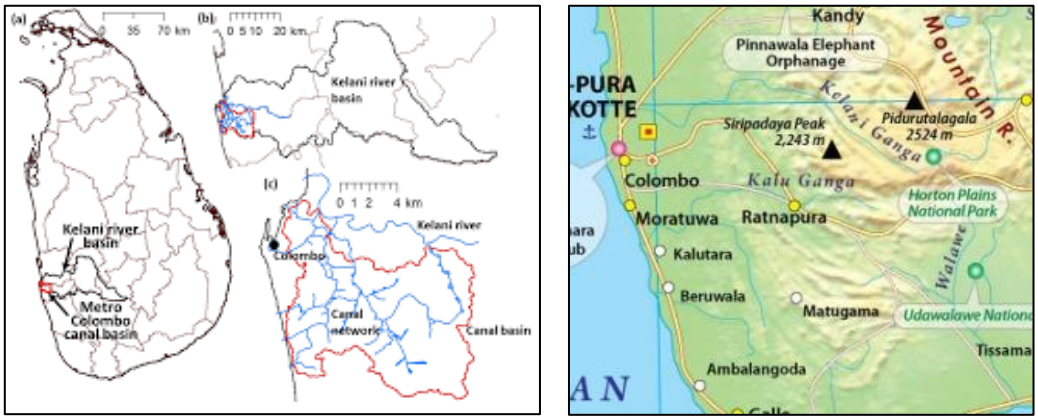

Fig. 3 Kelani Ganga River Basin

  - In August 2022, extreme monsoon rains (5-7 times more than normal) submerged vast areas of Pakistan. From **Lect 7 Reading 1**, in the initial stages, it was already estimated that:
    - A million homes have been destroyed or badly damaged
    - 33 million people have been directly affected
    - Total flood damage estimates exceed £8.7 billion
    - Sindh, with a population of 50 million, has been hardest hit, receiving 466% more rain than the 30-year average

Environmental

8.3.2 Extreme floods cause erosion

- As it is, extreme flooding events can wipe away significant amounts of sediment. This can eventually lead to bank erosion, collapse or even landslides where the terrain is steep.
    - For example, monsoon flooding causes severe erosion in the state of Assam, India. Bank erosion by the rivers has been a serious issue since last six decades as more than 4.27 Lakh Hectares of land was already eroded away by the river Brahmaputra and its tributaries since 1950, which is 7.40 % of area of the state. As assessed, the annual average loss of land is nearly 8000 Ha. The width of the Brahmaputra River has increased by 15 km because of bank erosion by flood.

Environmental and Economic

8.3.3 Destruction of agricultural land

- Sediments deposited by flooding may destroy agricultural land. The use of floodplains to grow agricultural product considerably increases this risk. Losses in the agriculture sector by floods usually include drowning of crops and livestock and damage to agricultural infrastructure. This severely affects the livelihoods of farmers.
- Countries with large agrarian economies like Bangladesh and Pakistan would be heavily impacted by floods.
    - In Bangladesh, agriculture comprises about 20% of the country's GDP and employs about 45% of the total labour force. The whole mushroom industry, for instance, was seriously affected by the floods of 1998 and 2007, causing a huge loss of income for farmers.
    - In 2010 Pakistan floods, an estimated 7 million ha of the most fertile arable land was obliterated. In the province of Punjab, Pakistan's breadbasket, the flooding of crops and loss of grain stores caused shortages which led to the doubling or tripling of food prices. By the end of August, the cost to agriculture was put at US$2 billion.
- A long-term negative impact on agriculture is the erosion of the topsoil by high magnitude floods. The topsoil is where decomposition and nutrient cycling take place and it hence provides nutrients to crops. The erosion of topsoil would result in reduced productivity of the land and possibly eventual abandonment.

Social

8.3.4 Loss of lives, and post-trauma stress

- When caught unaware, floods can kill thousands to millions of people at one go. This is also true where majority of the population live on or close to floodplains.
    - In August 2022, more than one-third of Pakistan is under water due to unprecedented levels of flooding. Estimates suggest that 1,265 people have been killed, with 6,000+ injured. The scale of the tragedy is already being compared to the devastating floods of 2010 when more than 2,000 people were killed, marking the event as the deadliest in Pakistan's history.
- Even after the floods, survivors suffer different health problems, including psychological disorders. A study of 392 low-income parents exposed to Hurricane Katrina found that rates of

mental and physical illness rose sharply among participants and remained elevated for at least one year following Hurricane Katrina. The prevalence of probable serious mental illness doubled after the disaster, and nearly half of the respondents exhibited probable post-traumatic stress disorder (PTSD).

8.3.5 Diseases

- In addition to deaths from drowning, flood-related mortality includes disease epidemics.
- Gastro-intestinal diseases regularly break out in developing countries where sanitation standards are low or when sewerage systems are damaged.
- In tropical countries the increased incidence of water-related diseases, such as typhoid or malaria, can double the mortality rate.
- Drinking water supplies may become polluted, especially if the sewerage treatment plants are flooded. This may result in disease and other health effects, particularly in developing countries (see **Fig. 4**).
    - In 2010 Pakistan floods, the first cases of cholera were confirmed in the Swat valley in the province of Khyber Pakhtunkhwa (KPK), where 600,000 people had been cut off during the initial flooding.
- Developed countries are not immune to the negative impacts due to flooding. When flood management measures fail, there could also be a severe loss of lives.
    - Hurricane Katrina (2005) killed nearly 2,000 people in New Orleans, United States, due to the failure of levees (see **Lect 9**) to contain floodwaters. Poor households were hardest hit as they did not own a car and were unable to evacuate in time.

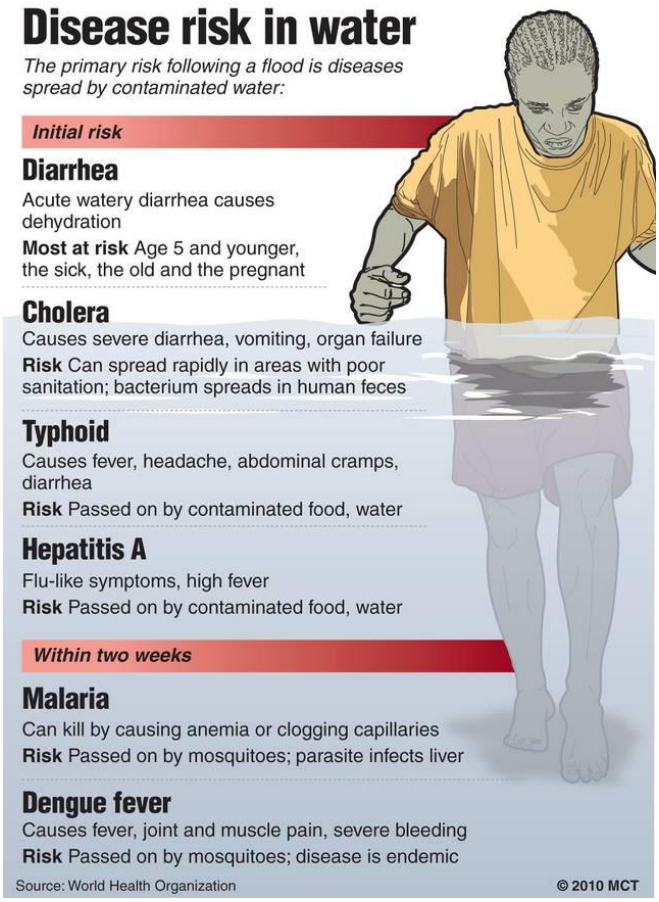

Fig. 4

8.4 Different Groups of People, Different Vulnerabilities

- The impacts of fluvial flooding seem to be *geographically uneven*, on people and places.
  - People: Impacts of fluvial flooding could also vary because of different communities and their respective *vulnerabilities*. Vulnerability is concerned with the ability of a community to withstand exposure to, and risks from, impacts of fluvial flooding.
  - Places: Impacts of fluvial flood could vary *geographically* due to regional differences in the severity of the flood, the geography of the area, the local infrastructure, and the preparedness and response measures in place.

- Variations in the effects of fluvial floods on different people and places can be seen when we compare using categories such as **developed *vs* developing countries, urban *vs* rural, low-lying *vs* places of higher altitudes; etc.** For example:
  - *People who settle around water bodies and fertile flat land are inevitably exposed to storm-induced floods.* Elevation and distance from water bodies are variables that contribute to exposure to the flood hazard.
  - The *type of housing* can determine vulnerability too as there are some construction materials that are more vulnerable. For instance, the population living in houses with makeshift and tarpaulin roof materials are more likely to be affected by floods. In urban areas, especially in developing countries, irregular settlements that develop housing areas with makeshift materials heighten their disaster risk areas and expose their lives and assets to the strong winds and floods.

- It is necessary for the government and policy makers to focus resources and attention in building resilient communities in order to reduce disaster vulnerability, especially for those in developing countries like the Philippines, Pakistan and Bangladesh.