# PAKISTAN FLOODS 2010: A HYDRO-METEOROLOGICAL DISASTER

*At the end of July 2010, heavy monsoon rains caused rivers to burst their banks in northwest Pakistan. The worst river flooding since the 1920s continued through the summer, affecting 17 million people across the country. Entire villages were destroyed, millions of people displaced, and 1,600 people were left dead. This extreme flooding is an example of a major hydro-meteorological disaster affecting a poor and vulnerable population. Severe flood events such as this may be on the rise due to global warming.* ***This case study illustrates many important ideas and concepts in Edexcel GCE Geography Unit 1 – Global Challenges.***

Photo by Sgt. Monica K. Smith (Flickr creative commons license) http://www.flickr.com/photos/soldiersmediacenter/4885278484/

***Photograph 1 Surveying the damage in Pakistan: U.S. Army Sgt. Paul Gilman looks out of the back of his Chinook helicopter at the water damage while flying over the Swat valley in Pakistan (August 5, 2010).***

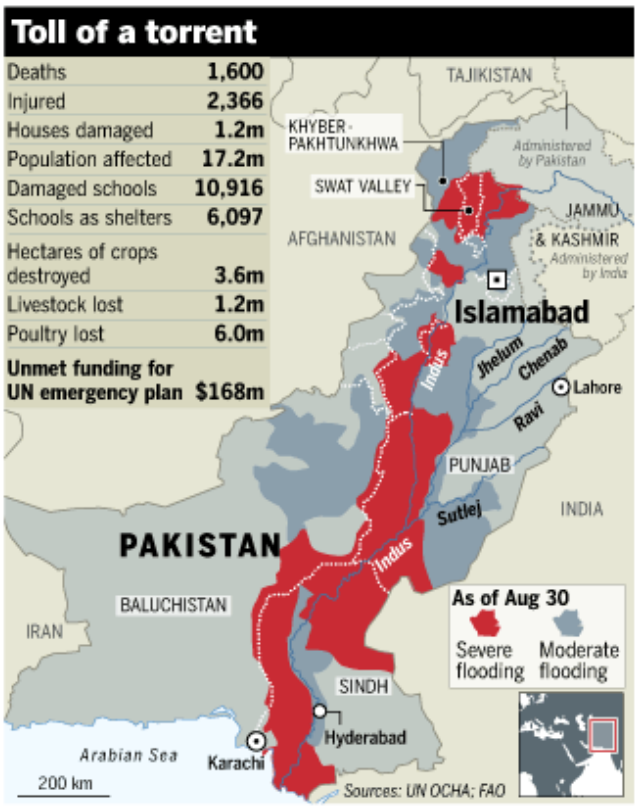
## WHY DID PAKISTAN HAVE A MAJOR FLOOD?

Each year Pakistan has a monsoon season that brings heavy rainfall. However, in the summer of 2010 the rains were unusually intense, lasting for over a month without ceasing. The floods started in northwest Pakistan with the onset of the annual monsoon rains.

The first area to be severely affected was the Swat Valley. As the rain continued, the floods headed south, enveloping large areas for the first time in nearly one hundred years. At its worst, one fifth of the country, along the entire length of the Indus River, was under flood water.

In part, this was due to unusual weather conditions. A fast-moving trough in the sub-tropical jet stream (a band of air movement in the upper atmosphere) combined with the annual monsoon event to produce record levels of rainfall. Warm, moist monsoon air drawn off the Indian Ocean rose far more quickly (and higher) than in normal years, due to the unusual jet stream conditions. This resulted in much heavier rainfall.

High levels of illegal logging and deforestation in the Indus drainage basin may also have played a role, resulting in increased levels of run-off and a far 'flashier' response by rivers already experiencing 'supercharged' monsoon rainfall conditions.




Source: Financial Times

*Figure 1 Affected areas of Pakistan, August 2010*

The intensity of this year's rainfall could additionally be a symptom of climate change. Global warming is predicted to bring more **hydro-meteorological hazards** and extreme weather events. One reason for this prediction is because warmer air has a greater capacity to hold moisture, thereby increasing the amount of rainfall during storm events.

Some climate scientists have noted that Indian subcontinent monsoons appear to have been getting increasingly more extreme over the last fifty years. According to the National Centre for Atmospheric Research, the Indian Ocean's surface waters have become warmer by nearly 2°C during the last thirty years. This heats up the air, allowing it to hold more moisture, which ultimately introduces more water vapour into monsoon systems.

One **IPCC** scientist has stated that "these are events which reproduce and intensify in a climate disturbed by greenhouse gas pollution. Extreme events are one of the ways in which climatic changes become dramatically visible." Peter Stott (head of climate monitoring at the UK Met Office) believes that: "there has been a rise in the number of extremely warm temperatures recorded worldwide and there have been increases in the number of heavy rainfall events in many regions over land. "Evidence, including in India and China, that periods of heavy rain are getting heavier, is entirely consistent with our understanding of the physics of the atmosphere in which warmer air holds more moisture. Our climate change predictions support the emerging trend in observations and show a clear intensification of extreme rainfall events in a warmer world."

## KEY TERMS

**Hazard** A physical event or process with the potential to harm human life, welfare or assets.

**Disaster** The actual realisation of a hazard that brings harm to human society.

**Hydro-meteorological hazard** A hazard formed by hydrological processes (floods) and / or atmospheric processes (such as storms, drought and bushfires).

**IPCC** Intergovernmental Panel on Climate Change (a grouping of many of the world's leading climate scientists).

**Geophysical hazard** A hazard formed by tectonic or geological processes (such as earthquakes, volcanoes, mass movements).

**Disaster hotspot** A place where two or more natural hazards threaten a vulnerable population.

## HOW DID HUMAN FACTORS CONTRIBUTE TO THE FLOOD DISASTER IN PAKISTAN?

A **disaster** is the realisation of a **natural hazard**. Human factors contributed to the disaster that struck Pakistan in numerous ways:

- Two-thirds of the population of Pakistan are dependent on farming for their income, leaving them especially vulnerable to the effects of flood hazards that result in a loss of livelihoods as well as their homes.
- Many people live in close proximity to rivers in order to gain access to water and fertile alluvial soils to help grow their crops.
- Many people live below the poverty line of US$1.25 a day income. Prior to the floods, 33 per cent of Pakistanis lived below the poverty line (that figure has now risen to 40 per cent). The flooded area was so large that it was able to spread into the densely-populated urban areas in the south of Pakistan, where poverty is worse than in the north and where communities are therefore more vulnerable.
- The country's poor infrastructure prevented rescue teams getting to some of those who most needed help and emergency aid. American army helicopters formed an essential part of the relief effort in remote areas (Photograph 1).
- In some places such as the Swat Valley, infrastructure had previously been weakened by the

2005 earthquake and had not yet been repaired – this is an example of how **geophysical hazards** and hydrometeorological hazards can combine in a vulnerable populated region to create a **disaster hotspot**.

■ The vulnerable flood victims looked to their government for aid but this was slow in coming, revealing a low capacity to cope for the country as a whole. President Zardari was criticized for his slow response to the crisis (he did not visit the flooded areas until two weeks after the rain began). Many of those affected by flooding felt the Pakistani Army was slow to rebuild bridges, deliver aid or set up relief camps.

Pakistan was also not helped by a global phenomenon of "donor fatigue" that aid agencies identified. Charities were surprised by the slow international response. One UN spokesperson noted that: "the scale of the response is still not commensurate with the scale of the disaster." (10 days after the 2010 Haiti earthquake, US$495 had been pledged globally for each victim. In contrast, 10 days after the floods hit Pakistan just US$4 had been pledged for each victim.)

Dr Elizabeth Ferris, senior fellow at the US-based Brookings Institution, a foreign policy think tank, says: "It should also be noted that the international humanitarian system isn't set up to deal with more than one major crisis a year. And among the general public there may be a feeling of, 'I donated to the victims of the Haitian earthquake and Haiti is needier than Pakistan.'"

The important role of human factors in contributing to the realisation of a disaster is shown by the disaster risk equation (Figure 2).

$$\text{RISK} = \frac{\text{HAZARDS} \times \text{VULNERABILITY}}{\text{CAPACITY TO COPE}}$$

*Figure 2 The disaster risk equation*

## CHANGING DISASTER TRENDS OVER TIME

The number of people killed was not nearly as great as for some 20th Century events such as the flooding of China's Yellow River in 1931 which led to the deaths of between 1 and 4 million people. This observation is in line with the general global hazard trend: *fatalities are falling while the numbers affected in non-fatal ways is rising* (Table 1).

This generalisation applies to countries at all stages of development. Although the Pakistani government response and levels of international assistance could clearly both have been improved, greater and more effective relief efforts were eventually put in place than for similar flood events occurring in the early 1900s.

The global media brings disasters to the attention of the global community far quicker than in the past thereby allowing relief efforts to be launched more quickly. The United Nations, which has not always been in existence, can also help to organise present-day relief efforts and strives to limit the number of casualties hit by after-effects of flooding, such as disease or food shortages.

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| **Human Impacts** | The disaster affected more people than the number of those hit by the 2004 Asian tsunami and the 2010 earthquake in Haiti combined. In the worst-affected areas, entire villages were washed away without warning by sheets of flood water. The lack of access to the flood survivors left hundreds in need of clean water supplies and food - and at risk from outbreaks of waterborne illnesses, particularly diarrhoea, dehydration and cholera. 1,600 people were left dead and 1.2 million houses were damaged, leaving millions homeless. Damage to 11,000 schools has interrupted the education of an entire generation of children. In total, around 17 million people were adversely affected in some way. |
| **Economic losses** | Flooding severely damaged the economy with losses running into billions of dollars. The farming sector, which is central to the country's economy, was badly hit. Many cotton farmers had their crops destroyed (standing water suffocates roots systems and kills plants). Prior to flooding, Pakistan was the world's fourth largest producer of cotton (a global rise in cotton prices is now predicted as a result of the 15% fall in Pakistan's cotton crop resulting from the floods). 80% of fields were left waterlogged in some areas, preventing farmers from sowing new seeds. In addition to the 3.6 million hectares of crop (all types) that was destroyed, 1.2 million livestock animals and 6 million poultry were lost. According to the World Bank, the total cost of these losses was more than US$1 billion. |

*Table 1 How flooding in Pakistan affected 17 million people (but killed just 1,600)*


*Figure 3*

*NASA satellite image of flooding in Pakistan by Robert Simmon (based on Landsat 5 data from the USGS Global Visualization Viewer. Caption below written by Holli Riebeek. Instrument: Landsat 5 - TM*

Flickr Creative Commons Credit: NASA's Earth Observatory

"By mid-August, the extreme monsoon floods that had overwhelmed northwestern Pakistan had travelled downstream into southern Pakistan. The lower image, acquired by the Landsat 5 satellite on August 12, 2010, shows flooding near Kashmor, Pakistan, just before the second wave of the flood hit. The top image, provided for context, shows the region on August 9, 2009.

"Even before the second wave reached this section of the Indus, floods covered much of the city of Khewali and the surrounding farmland. The flood-widened river is muddy and brown in the lower image, and it impinges on the cement-grey town of Khewali.

"As if constrained by a belt, the river is cinched near Khewali. The constraint is the Guddu Barrage, a barrier designed to channel irrigation water to farmland in the northern Sindh district. The "C"-shaped barrier that controls the shape of the flood in the lower image is itself visible in the top image. Canals extend away from the barrage on both sides of the river. A road runs along the canal, and it too appears to be flooded. Stream gauges at the Guddu Barrage recorded extremely high levels of water (more than 910,000 cubic feet per second) flowing down the Indus on August 12. The flow rate increased on August 13 as the second wave of flooding reached the barrage." (source: NASA)

Photo by Staff Sgt. Wayne Gray (Flickr creative commons license) http://www.flickr.com/photos/dvids/4996560018/

*Photograph 2 An aerial view of a town surrounded by flood water*

## SYNOPTIC LINKS: BRIDGING PAKISTAN'S DEVELOPMENT GAP

Are natural hazards making it harder for Pakistan to bridge the development gap and build up economic strength as its neighbour India has done in recent decades? This is a theme that you can return to as part of your A2 Unit 3 Geography course dealing with economic development.

The 2010 floods have undoubtedly set back Pakistan's ability to achieve sustainable economic growth. For instance:

- Economic growth is predicted to sink from 4% in 2010 to a much lower figure in 2011.
- Runaway inflation, triggered by rising food prices, is now extremely likely.
- Flooding has further damaged an economy already weakened by widespread poverty amongst a largely poor and young population of 180 million.
- Any further increase in poverty due to natural disasters could aid the rise of political militancy and extremism. Pakistan already has difficulty maintaining a stable democratic government (in 2007 prime minister Benazir Bhutto was assassinated).
- The country is already the focus of a US-led hunt for Taliban terrorists, contributing to political instability (notably so in the flood-hit Swat valley region).
- Pakistan now faces increased difficulty in re-paying international development loans.
- Closure of 11,000 schools damages the education of a whole generation of potential human resources and makes it less likely that Millennium Development Goals will be met there.

The economic and social development of Pakistan has undoubtedly been set back by this flooding.

Photo by Giro555 (Flickr creative commons license)

*Photograph 3 Pakistan flood survivors*

## KEY POINTS

- The flooding of Pakistan was a major hydro-meteorological disaster.
- Some experts say climate change may have contributed to the severity of this extreme weather event.
- The vulnerability of Pakistan's population combined with the government's limited capacity to cope created a disaster that affected 17 million people.
- However, far fewer people died than would have been the case for a similar event 100 years ago.
- The long-term development of Pakistan may have been hindered by this disaster.

## EXAM QUESTION PRACTISE ZONE

**Study Figure 1. Describe the areas affected by the flooding.**
3 marks

(Tip: Make sure you capture the main trend and any unusual 'anomalies'. Try to use data – perhaps by estimating the number of square kilometres hit by severe flooding - in your answer. Do not start explaining the flooding.)

**Study Table 1. Suggest why the human and economic costs of flooding in Pakistan were very high.**
10 marks

(Tip: Focus on the key concepts of vulnerability and capacity to cope. Use these concepts to produce a structured report around one page long. Do not spend too long describing the costs as this is not asked for.)

**Explain why hydro-meteorological disasters are increasing in frequency.**
15 marks

(Tip: You should be able to access a high level mark by producing a structured account that looks at physical as well as human factors. The former might include climate change. The latter should look at population growth in areas where there is a natural hazard threat. Use this case study alongside your own examples of drought and storms / hurricanes)

## REFERENCES FOR FURTHER RESEARCH


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