



2022 Flooding in Pakistan: Causes, Consequences and Challenges

GeoTopics | Saad Bhatti | 15 June 2023



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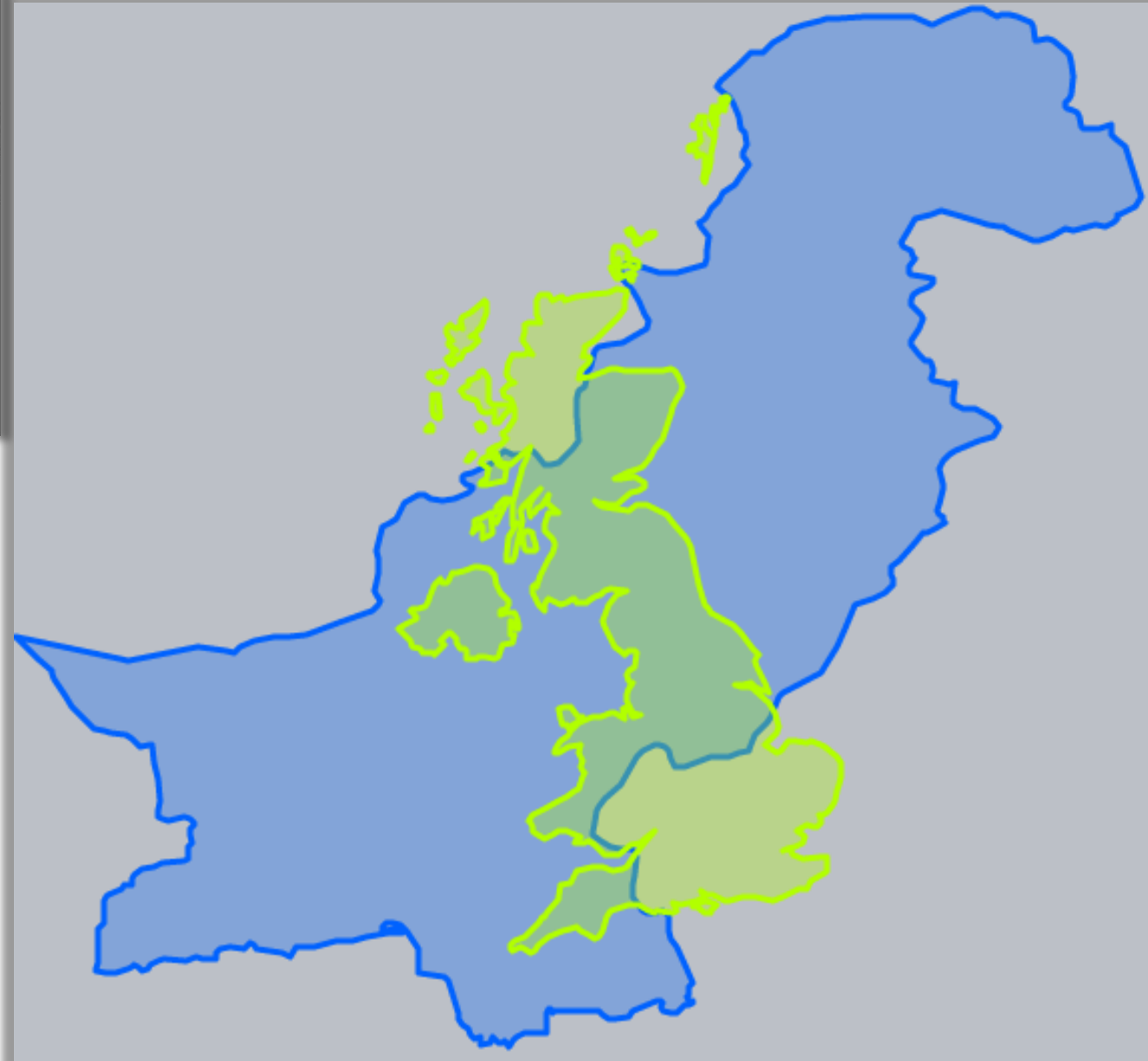
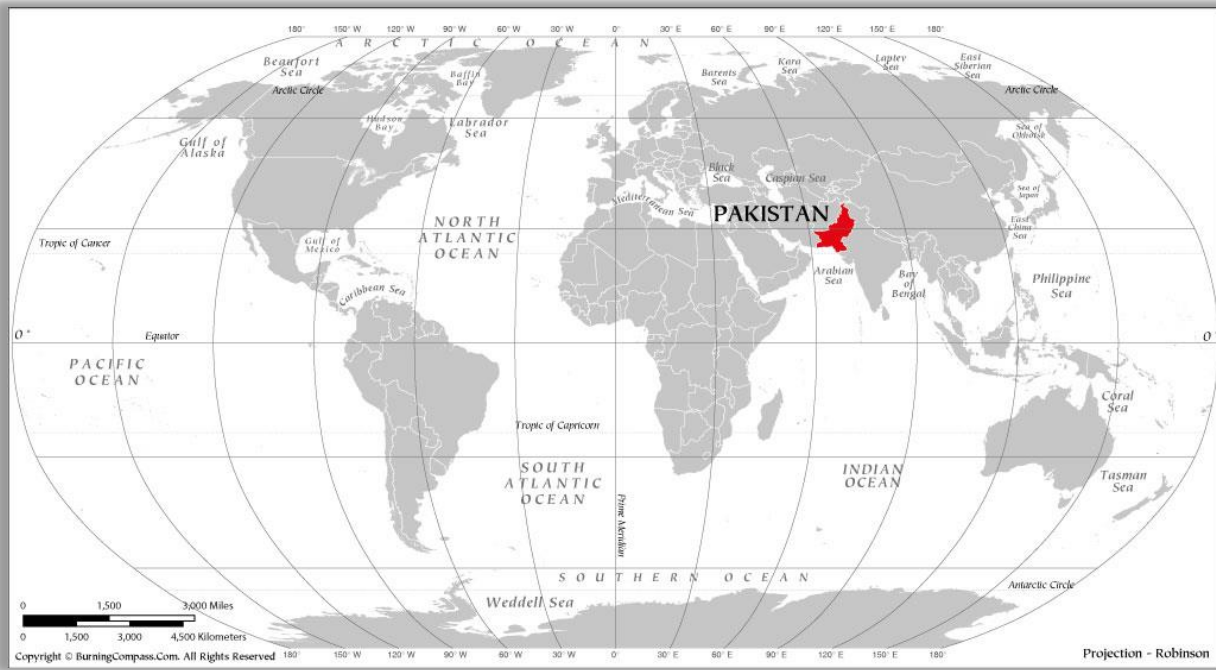
Go to vevox.app

Enter the session ID: **185-067-525**

Or scan the QR code

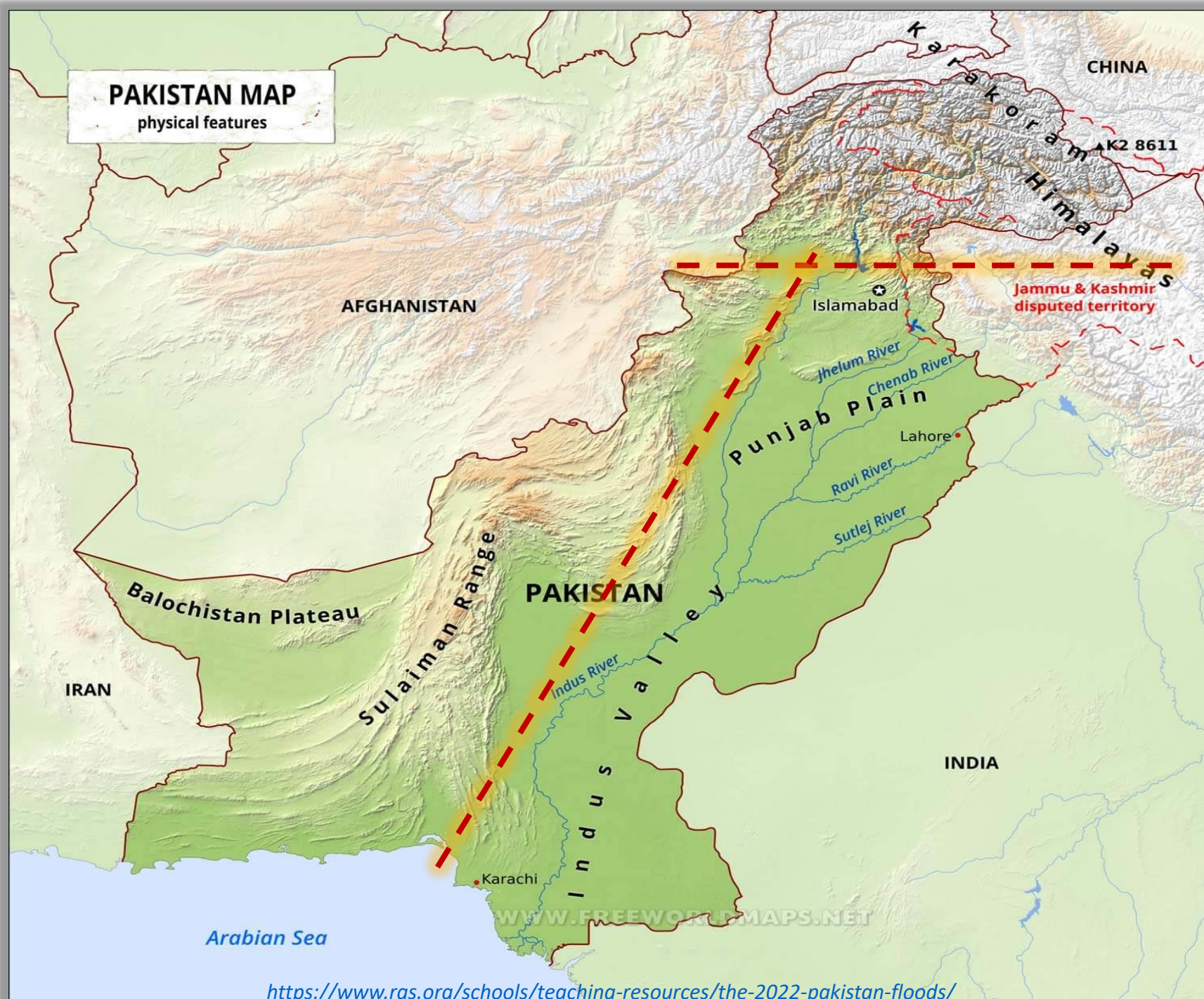


Background



Area: ~ 340,000 sq mi
UK: ~ 94,000 sq mi
NI: ~ 5,500 sq mi

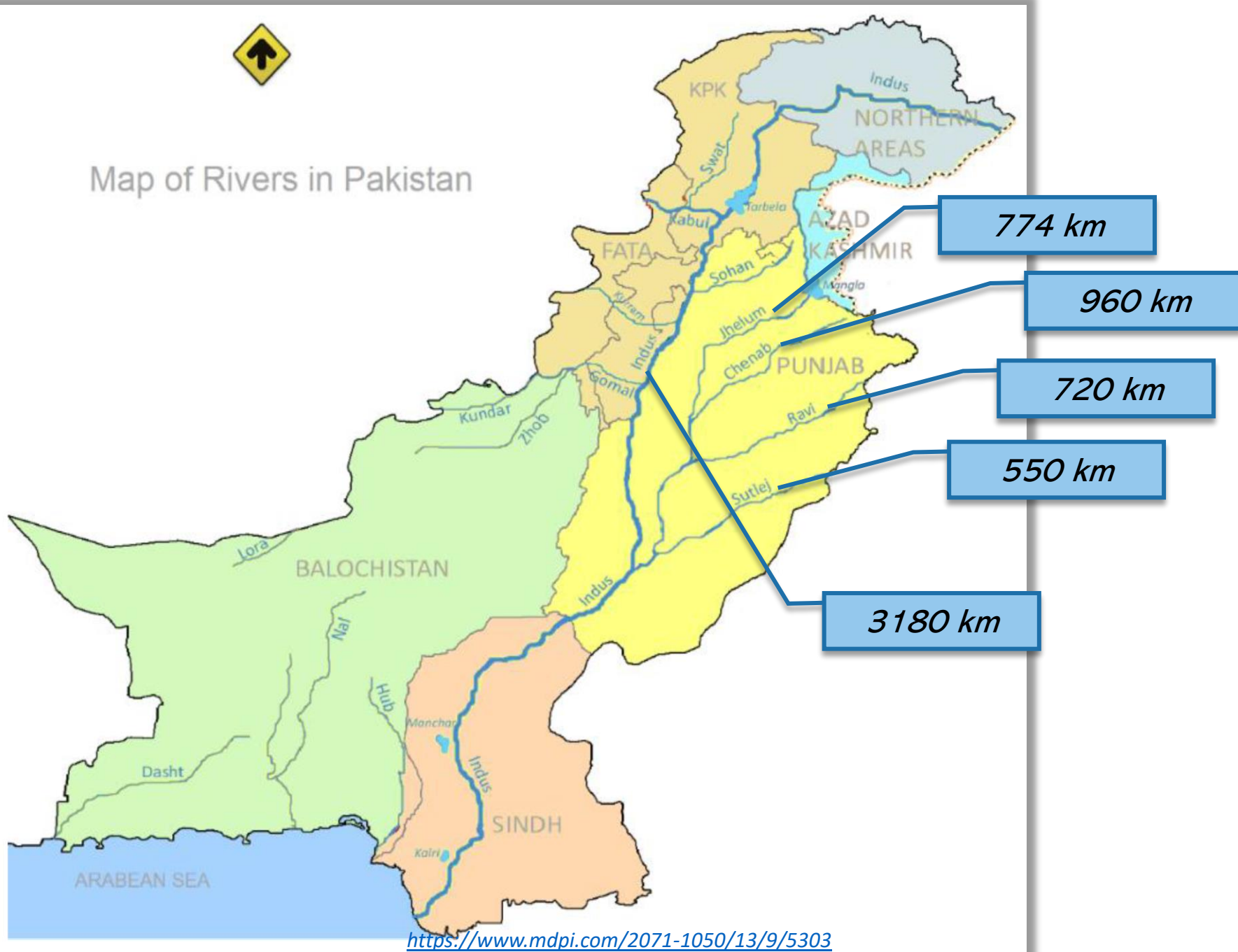




WWW.FREEWORLDMAPS.NET



Map of Rivers in Pakistan



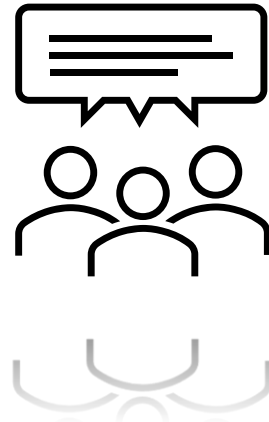
<https://www.mdpi.com/2071-1050/13/9/5303>

<https://www.dawn.com/news/884890/geography-the-rivers-of-pakistan>

Causes

Q

- What were the main causes of 2022 floods in Pakistan?



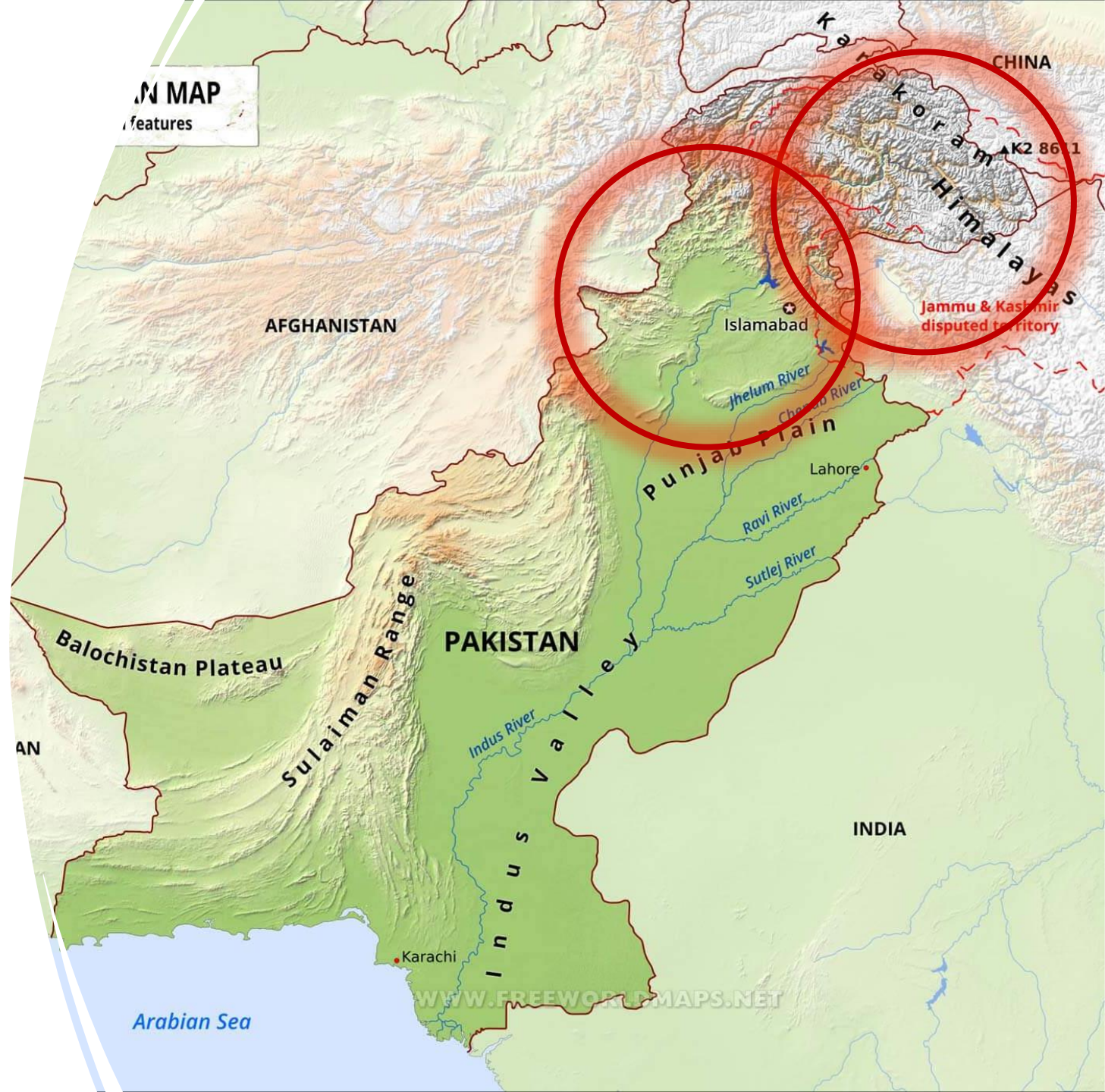
General Causes

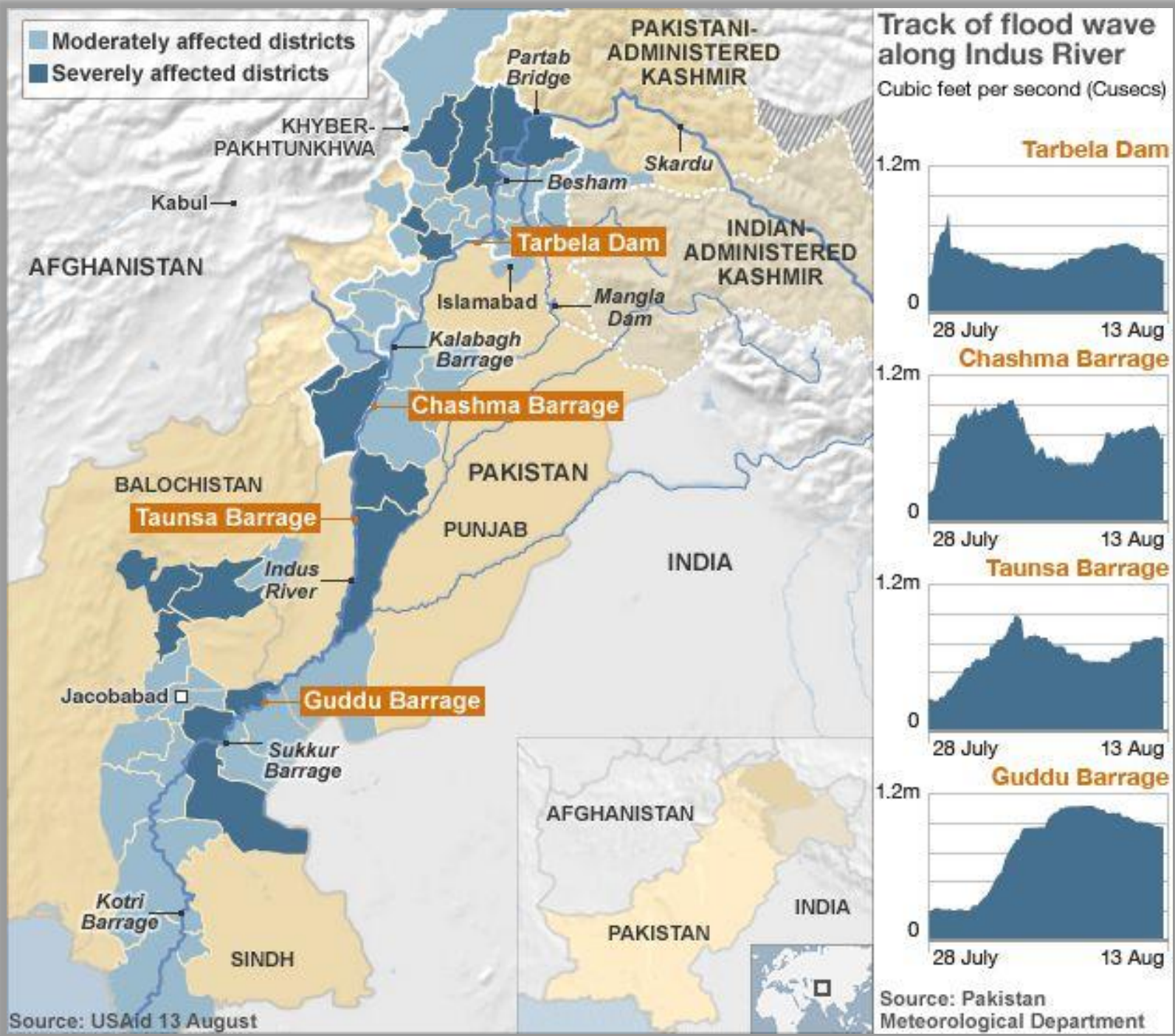
- Terrain
- Erratic rainfall (monsoon rains during summer months)
- Climate change and global warming = rapid snowmelt

- Human
 - Deforestation
 - Water storages for irrigation purposes (e.g., dams), results in increased sedimentation of water channels and canals, resulting in reduced capacity to transport water
 - Settlements in floodplains, etc...

2010

- Snowmelt
 - Higher than normal temperatures in the northern areas (Himalayas)
 - Glacial lakes outburst flooding (GLOF)
- Monsoon rains (July-Sept)
 - Intensity
 - Areal coverage (extending to northern areas, KPK)



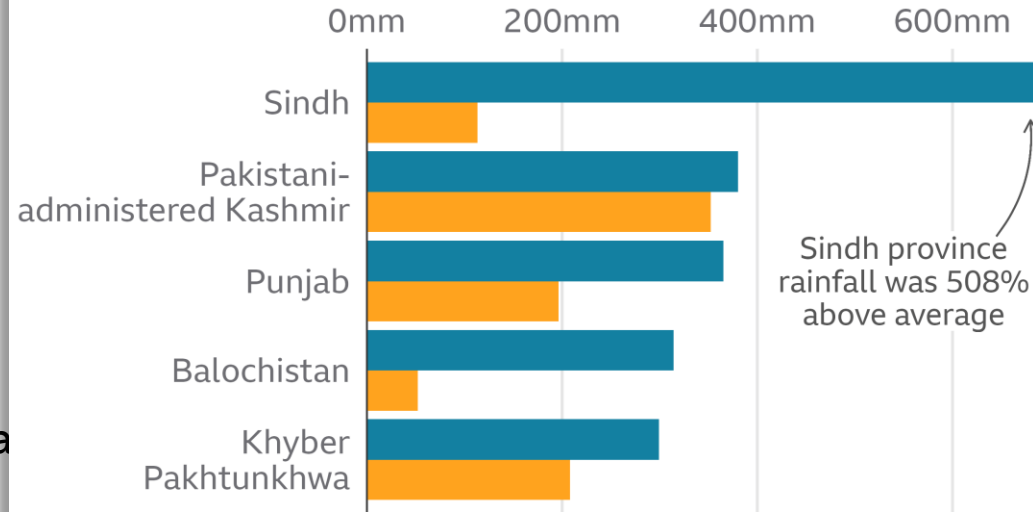


2022

- Severe heatwave (hottest Ma subcontinent since 1901)
 - Possible reason – climate change
 - GLOF also recorded and northern highlands
- Monsoon rains (July – Sept)
 - Exceptionally high multiday precipitation due to preceding heatwave
 - The southern provinces received more than 350% of average precipitation in July and August as compared to the 2001–2021 mean

Rainfall well above average in most regions

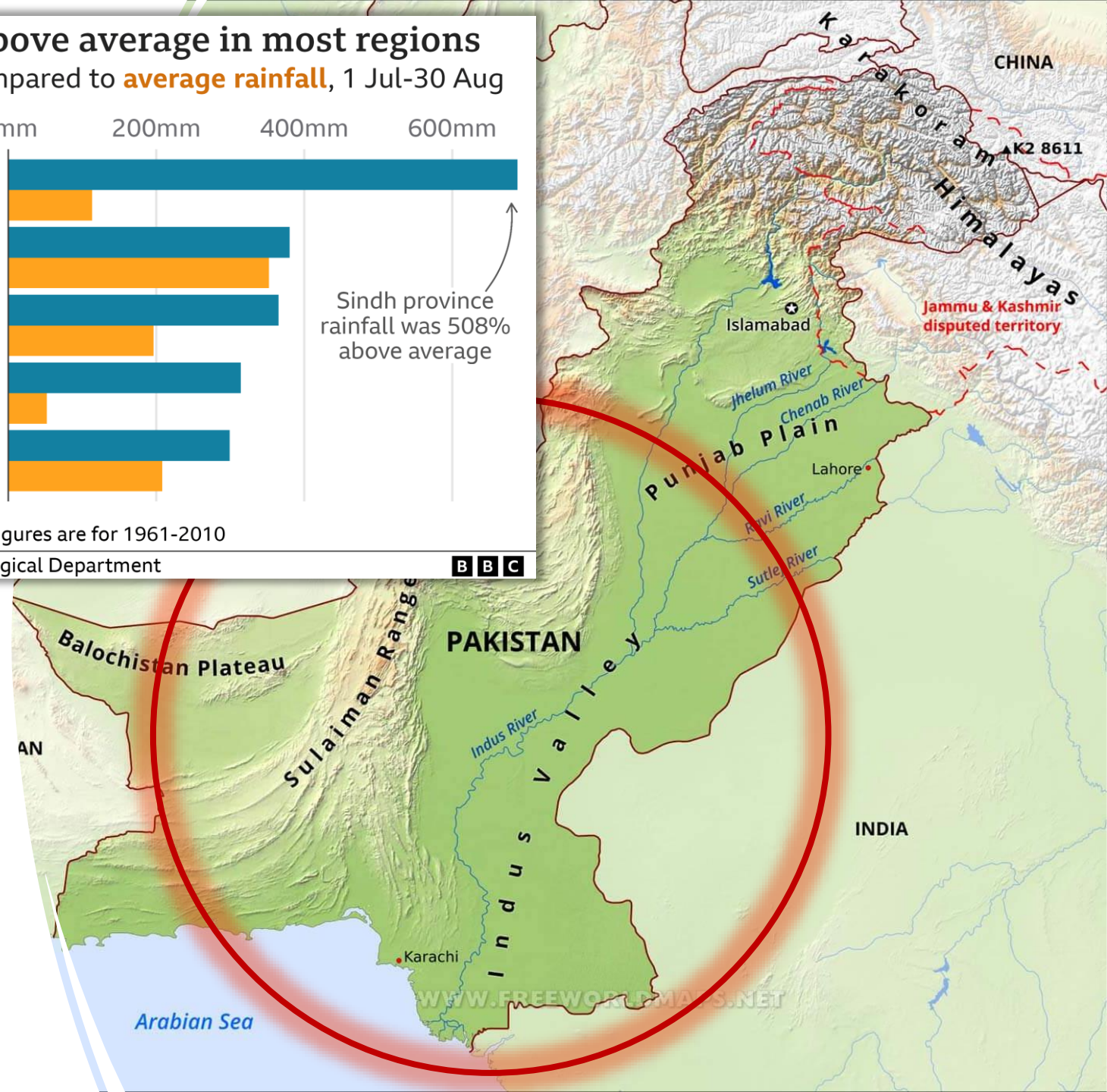
Rainfall in 2022 compared to average rainfall, 1 Jul-30 Aug



Note: The average rainfall figures are for 1961-2010

Source: Pakistan Meteorological Department

BBC



PAKISTAN

IMAGERY ANALYSIS: 01 TO 29/08/2022 PUBLISHED 31/08/2022 V1.



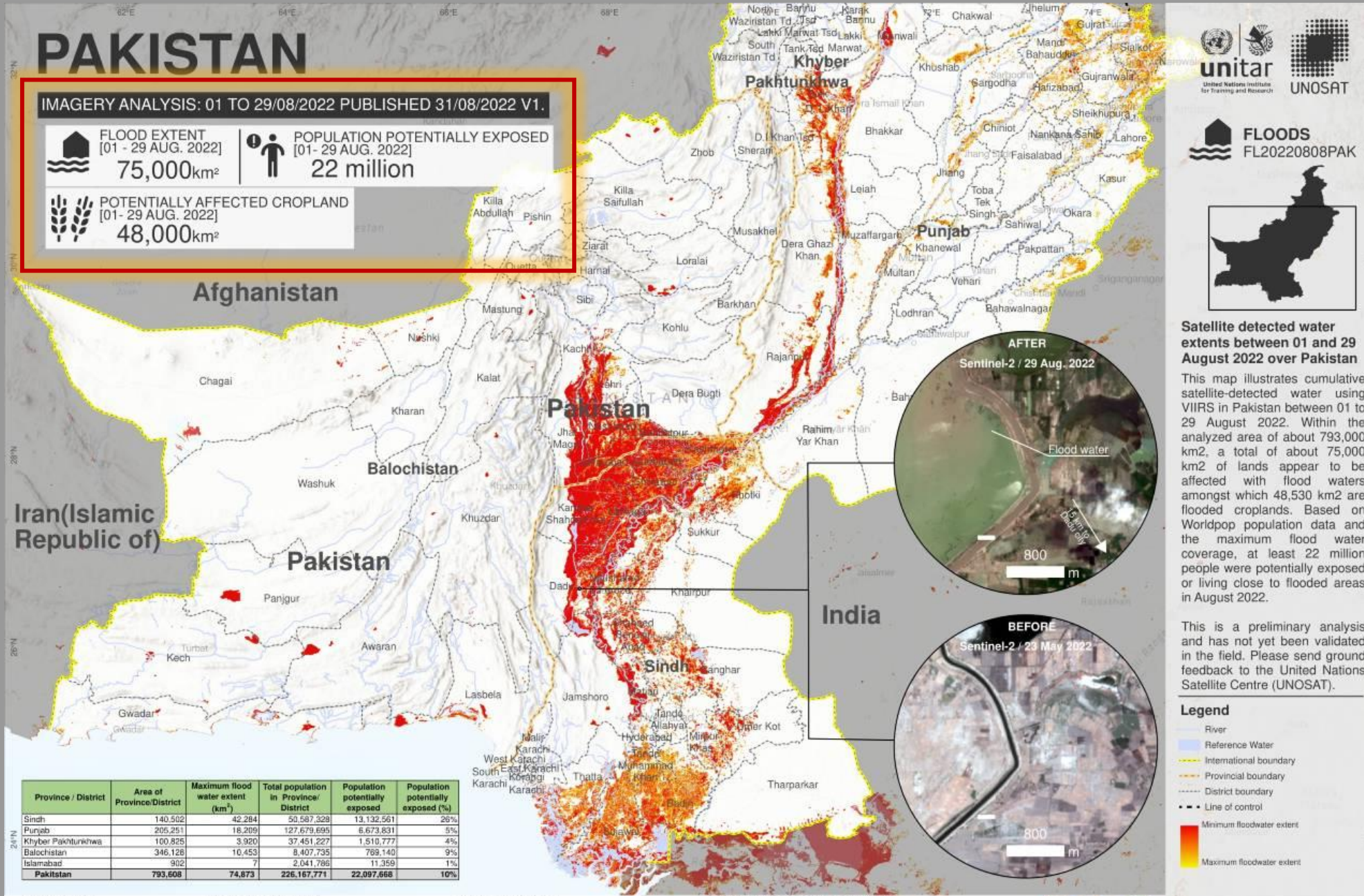
FLOOD EXTENT
[01 - 29 AUG. 2022]
75,000km²



POPULATION POTENTIALLY EXPOSED
[01 - 29 AUG. 2022]
22 million



POTENTIALLY AFFECTED CROPLAND
[01 - 29 AUG. 2022]
48,000km²



FLOODS
FL20220808PAK



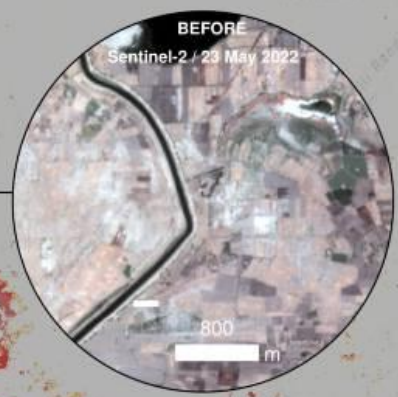
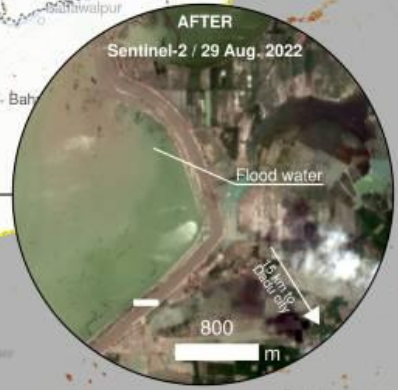
Satellite detected water extents between 01 and 29 August 2022 over Pakistan

This map illustrates cumulative satellite-detected water using VIIRS in Pakistan between 01 to 29 August 2022. Within the analyzed area of about 793,000 km², a total of about 75,000 km² of lands appear to be affected with flood waters amongst which 48,530 km² are flooded croplands. Based on Worldpop population data and the maximum flood water coverage, at least 22 million people were potentially exposed or living close to flooded areas in August 2022.

This is a preliminary analysis and has not yet been validated in the field. Please send ground feedback to the United Nations Satellite Centre (UNOSAT).

Legend

- River
- Reference Water
- International boundary
- Provincial boundary
- District boundary
- Line of control
- Minimum floodwater extent
- Maximum floodwater extent



Province / District	Area of Province/District (km ²)	Maximum flood water extent (km ²)	Total population in Province/ District	Population potentially exposed	Population potentially exposed (%)
Sindh	140,502	42,284	50,587,329	13,132,561	26%
Punjab	205,251	18,209	127,679,695	6,673,831	5%
Khyber Pakhtunkhwa	100,825	3,920	37,451,227	1,510,777	4%
Balochistan	346,128	10,453	8,407,735	788,140	9%
Islamabad	902	7	2,041,786	11,359	1%
Pakistan	793,608	74,873	226,167,771	22,097,666	10%

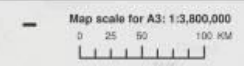
Spatial Reference
Name: WGS 1984 UTM Zone 42N
PCS: WGS 1984 UTM Zone 42N
GCS: GCS WGS 1984
Datum: WGS 1984

Satellite Data : NOAA-20/VIIRS
Imagery Date: 01 to 29 Aug. 2022
Resolution: 375 m
Copyright: NOAA/Suomi NPP
Source: NOAA
Boundary data: Pakistan Census Office (PCO)

Waterways: OpenStreetMap
Population data: Worldpop [2020]
Background: ESRI Basemap
Landcover data: © ESA WorldCover project 2020 / Contains modified Copernicus Sentinel data (2020) processed by ESA WorldCover consortium

Analysis: United Nations Satellite Centre (UNOSAT)
Production: United Nations Satellite Centre (UNOSAT)

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not been agreed upon by the parties.



Shishper Glacier



Source: PlanetScope

On May 7, 2022, floodwater swept down a small tributary of the Hunza River in Kashmir, [destroying a bridge](#) along the Karakoram Highway. The water came from the draining of a glacial lake trapped behind the snout of Shishper (also spelled Shishpar) Glacier. This pair of [PlanetScope](#) images shows the lake on May 2 and May 8 (just one day after the flood). **In the May 2 image blue-green water is visible, with chunks of glacial ice floating on the water. On May 8 the ice was resting on the valley floor, with only a few pools of liquid water remaining.**

<https://www.planet.com/gallery/#!/post/flood-in-the-karakoram>



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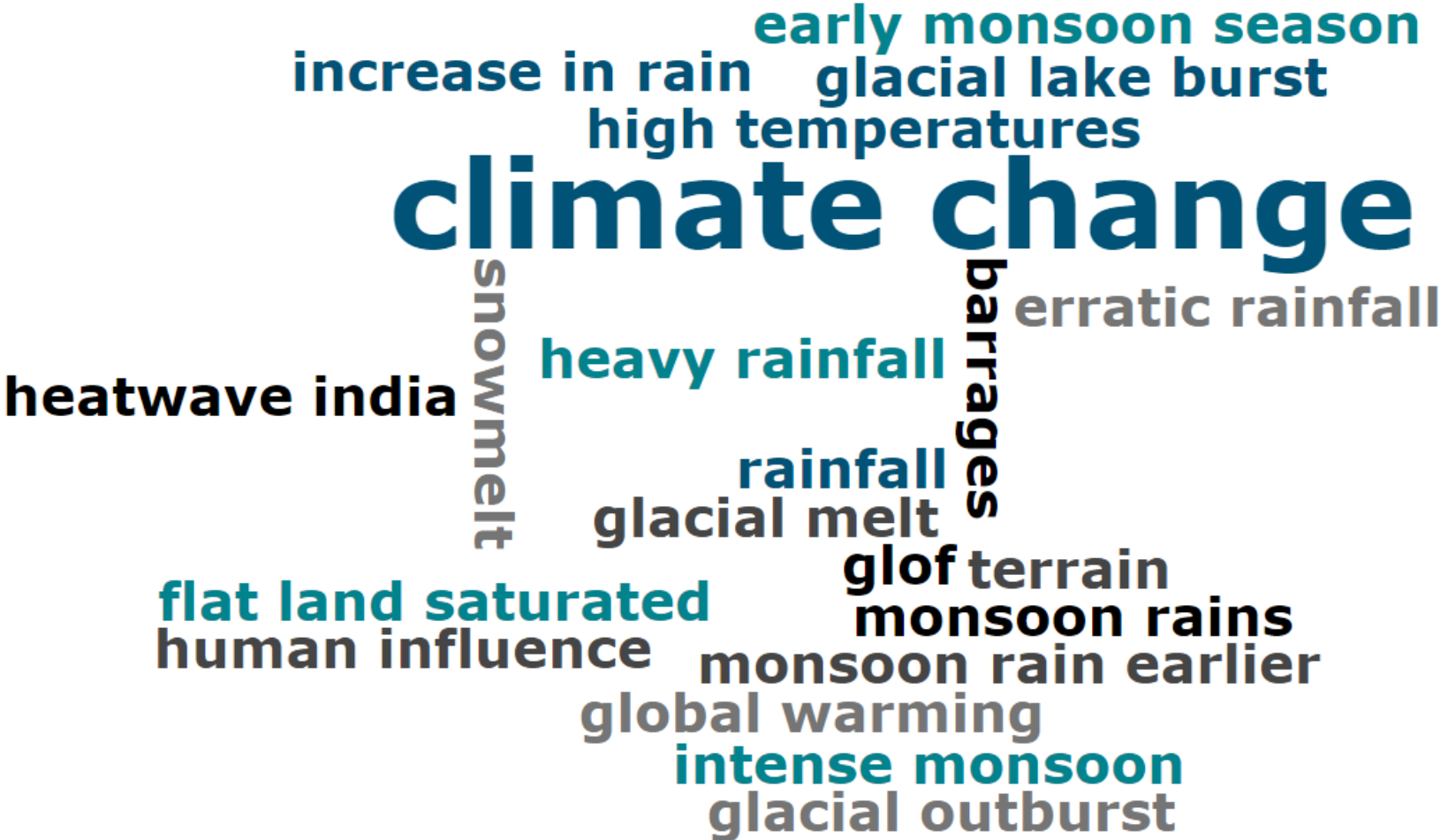
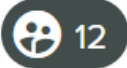
Join at: vevox.com

ID: 185-067-525

Question slide

What were the main causes of 2022 floods in Pakistan?

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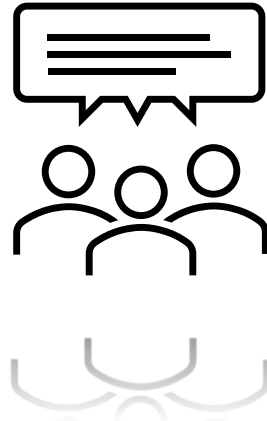


Consequences

Physical events (extreme rainfall, rapid snowmelt, GLOF, etc.) can trigger flooding, however human factors (settlements in floodplains, deforestation, etc.) can aggravate the impact!

Q

- What are the key social, economic and environmental impacts of 2022 floods in Pakistan?



WHY ARE PAKISTAN'S FLOODS SO BAD?



sky news

EXPLAINS

Sehwan Sharif Airport



Source: Skysat

Although the 2022 Pakistan floods peaked in August & September, [flood waters linger](#) months later. This sequence of true-color [SkySat](#) images shows Sehwan Sharif Airport, a landing strip on the shore of Manchar Lake. The first image, collected on October 29, 2020 shows the airport surrounded by pale agricultural fields. On September 24, 2022, it was completely inundated by green water from the overflowing lake. A month later, on October 26, elevated areas like an access road and the runway were only beginning to emerge from the floodwater.

<https://www.planet.com/gallery/#!/post/lingering-floodwater>

Pakistan floods situation report

1,100+
Deaths



1,600+
Injured

325,000

Houses
destroyed



733,000

Houses
damaged

735,000
Livestock
lost



2 million

Acres of
crops affected



Getty Images

Source: Pakistan Government, UN, 30 Aug 2022



Impacts

- Hospitals and health centers damaged/destroyed: 2,000+ ¹
- Livestock loss: 1.1 million+ ²
- Government of Pakistan (November 2022) ³
 - Human loss: 1,700+
 - Housed damaged/destroyed ~ 2 million
 - Losses and rebuilding estimates: ~ \$30 bn
- “Pakistan needs massive financial support to respond to this crisis as according to initial estimates the losses are around \$30 billion.” (United Nations Secretary-General Antonio Guterres) ⁴

¹ <https://www.bbc.co.uk/news/world-asia-63080101>

² <https://www.dawn.com/news/1724000/over-11m-farm-animals-lost-in-floods-seminar-told>

³ <https://www.bbc.co.uk/news/world-asia-63218139>

⁴ <https://www.dawn.com/news/1709212/pakistans-contribution-to-climate-change-minimal-but-country-among-most-affected-un-chief>

Long-term Impacts

- Children exposed to contaminated and stagnant floodwater: ~ 4 million (January 2023) ¹
- Physical health: high malaria and cholera cases
- Mental health: stress, anxiety, or trauma as the affected people thought about the future ²
- Negative coping strategies - selling income-producing assets, increased debt, withdrawing children from school and skipping meals ³

¹ <https://www.dawn.com/news/1730870/up-to-4m-children-still-living-next-to-contaminated-floodwater-in-pakistan-unicef>

² <https://www.dawn.com/news/1732645/the-post-flood-mental-health-crisis-in-balochistan>

³ <https://www.dawn.com/news/1736110/flood-survivors-resorting-to-negative-coping-strategies-un>

Regional Impacts

- Monsoon flooding 2022 (EM-DAT)
 - India: 2,035 deaths, \$4.2bn losses
 - Bangladesh: 7.2m people affected
 - China: \$5bn in economic losses



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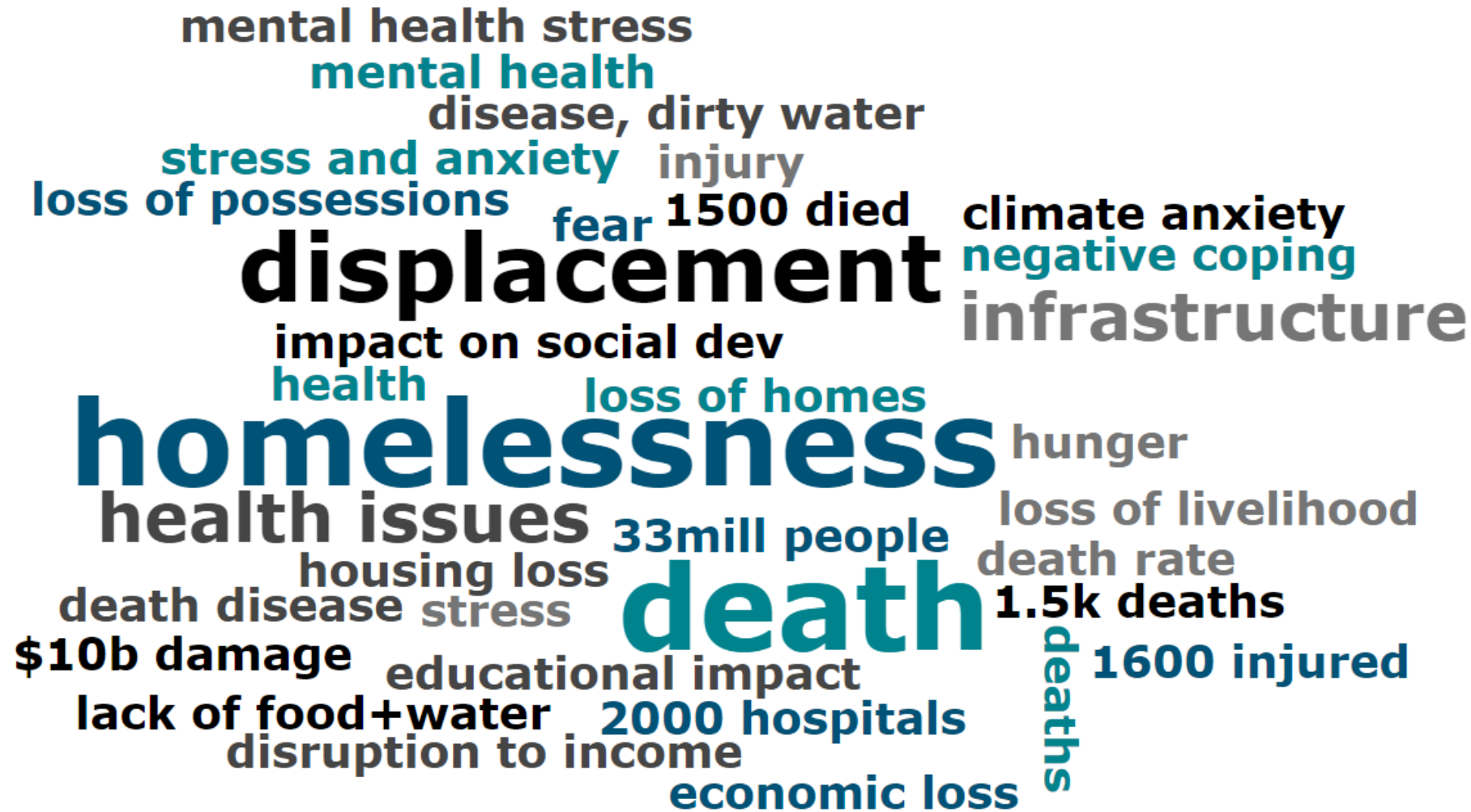
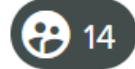
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Question slide

What are the key SOCIAL impacts of 2022 floods in Pakistan?

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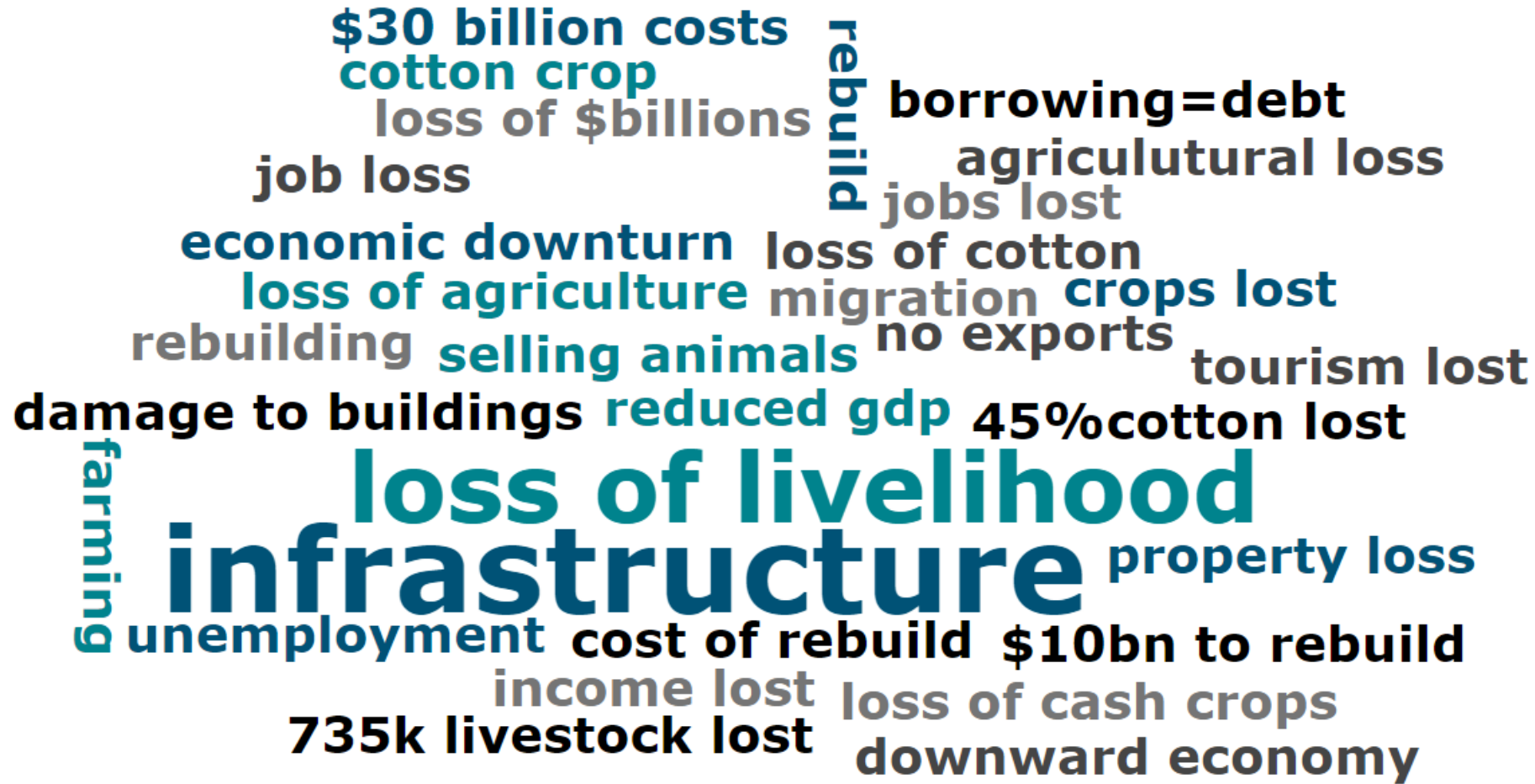
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Question slide

What are the key ECONOMIC impacts of 2022 floods in Pakistan?

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Question slide

What are the key ENVIRONMENTAL impacts of 2022 floods in Pakistan?

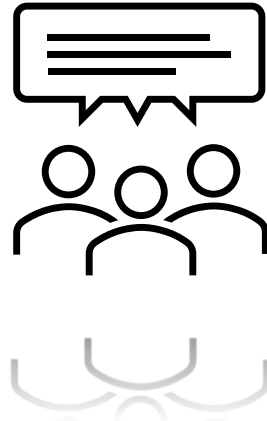
What are the key ENVIRONMENTAL impacts of 2022 floods in Pakistan?



Challenges

Q

- What are the main challenges for developing countries like Pakistan towards flood prevention and mitigation?



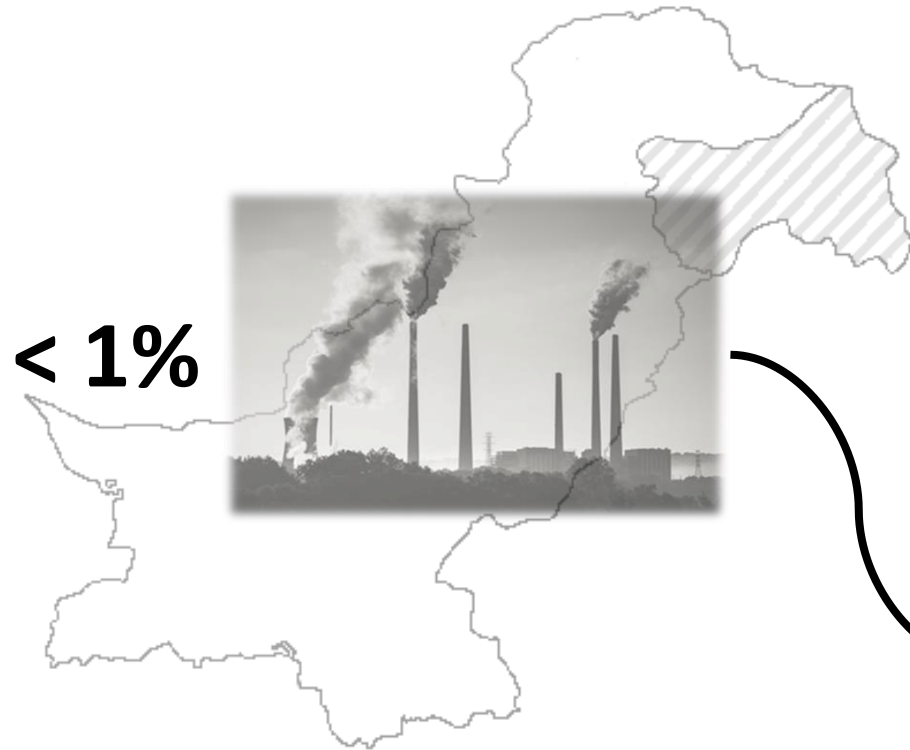


Table 2: The Long-Term Climate Risk Index (CRI): The 10 countries most affected from 2000 to 2019 (annual averages)

CRI 2000-2019 (1999-2018)	Country	CRI score	Fatalities	Fatalities per 100 000 inhabitants	Losses in million US\$ PPP	Losses per unit GDP in %	Number of events (2000–2019)
1 (1)	Puerto Rico	7.17	149.85	4.12	4 149.98	3.66	24
2 (2)	Myanmar	10.00	7 056.45	14.35	1 512.11	0.80	57
3 (3)	Haiti	13.67	274.05	2.78	392.54	2.30	80
4 (4)	Philippines	18.17	859.35	0.93	3 179.12	0.54	317
5 (14)	Mozambique	25.83	125.40	0.52	303.03	1.33	57
6 (20)	The Bahamas	27.67	5.35	1.56	426.88	3.81	13
7 (7)	Bangladesh	28.33	572.50	0.38	1 860.04	0.41	185
8 (5)	Pakistan	29.00	502.45	0.30	3 771.91	0.52	173
9 (8)	Thailand	29.83	137.75	0.21	7 719.15	0.82	146
10 (9)	Nepal	31.33	217.15	0.82	233.06	0.39	191

Physical and Human Factors

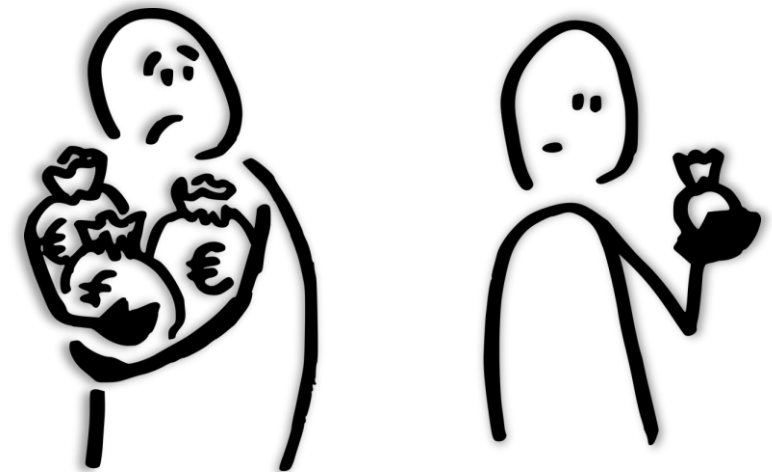
- GLOBAL WARMING AND CLIMATE CHANGE
- Glacial Lake Outburst Floods (GLOF) ¹
 - Over 3,000 glacial lakes in the country's northern mountain ranges
 - Of these, nearly 30 are susceptible to GLOFs
- Heatwaves ²
 - Extreme rise in temperature leads to the rapid melting of glaciers and contributes to the streamflow in the upper tributaries of the Indus river basin
 - Intense monsoon rains
- Settlements around nutrient-rich floodplains and scenic lakes

¹ <https://www.undp.org/pakistan/projects/scaling-glacial-lake-outburst-flood-glof-risk-reduction-northern-pakistan>

² <https://www.nature.com/articles/d41586-022-02813-6>

Preparation and Adaptation

Recovery from such events take several years!



Perception

Self-perception vs actual events = adaptation disparity!!!

Psychological distancing to climate change



Psychological distance to climate change varies between formal and informal settlements. Household income and number of children influenced the psychological distance to climate change.



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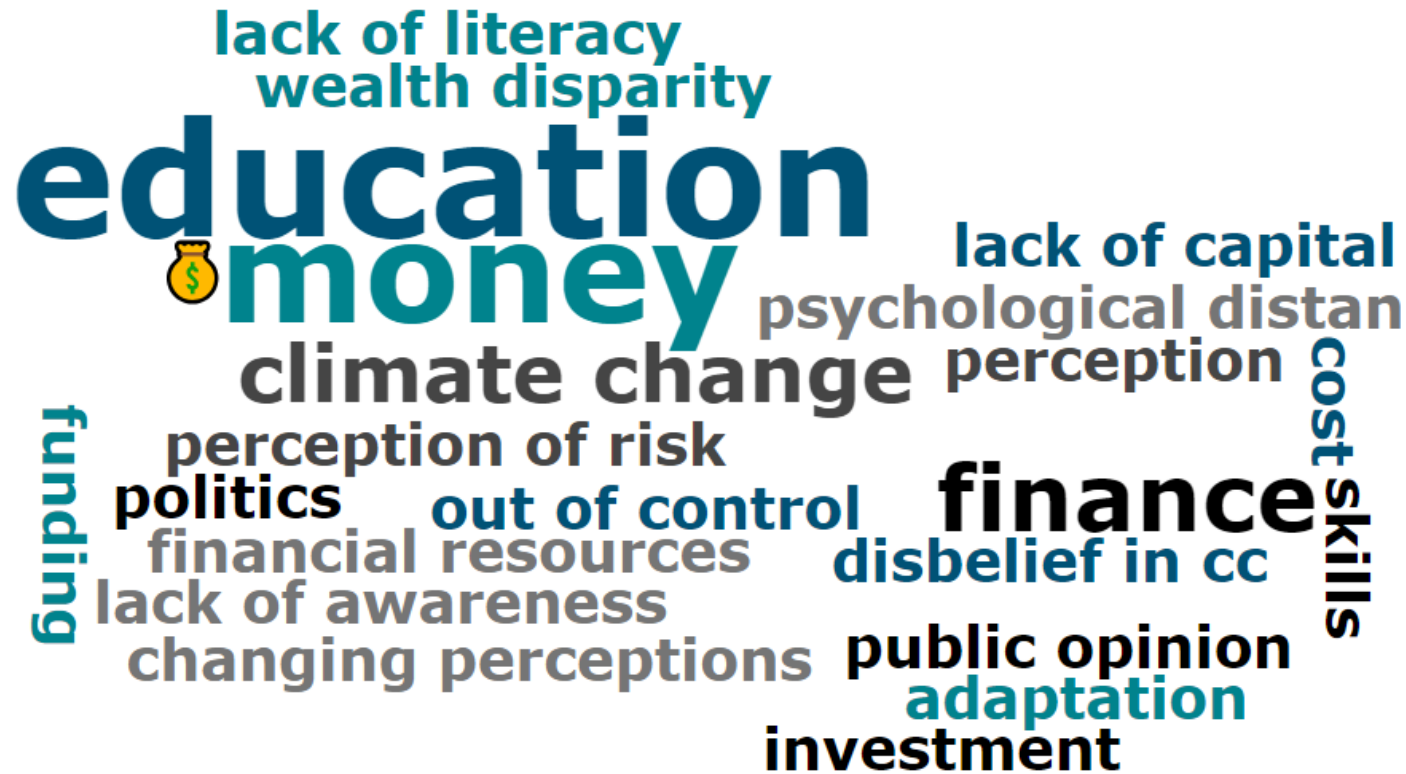
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Question slide

What are the main challenges for developing countries like Pakistan towards flood prevention and mitigation?

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Reference Material (PDF)



GeoTopics: 2022 Pakistan Floods
15 June 2023

- 1 Some reads and maps
 - [The Pakistan Flood of August 2022: Causes and Implications - Nanditha - 2023 - Earth's Future - Wiley Online Library](#)
 - [Royal Geographical Society - The 2022 Pakistan floods \(rgs.org\)](#)
 - [List of Rivers in Pakistan | Graana.com](#)
 - [Satellite Imagery Gallery | Planet](#)
 - [Why are Pakistan's floods so extreme this year? \(nature.com\)](#)
 - [Scaling-up of Glacial Lake Outburst Flood \(GLOF\) risk reduction in Northern Pakistan | United Nations Development Programme \(undp.org\)](#)
 - [Pakistan 5th most vulnerable country to climate change, reveals Germanwatch report - Pakistan - DAWN.COM](#)
 - [The impact of psychological distance to climate change and urban informality on adaptation planning - ScienceDirect](#)
- 2 An example flood mapping tool
 - [UNU-INWEH Flood Mapping Tool](#)
- 3 Example before and after images
 - [Pakistan floods: before-and-after images show extent of devastation | Pakistan | The Guardian](#)
 - [Pakistan floods: Before and after satellite images of the devastation \(axios.com\)](#)
 - <https://www.planet.com/gallery/#!/post/flood-in-the-karakoram>
 - <https://www.planet.com/gallery/#!/post/lingering-floodwater>
- 4 Some news reports and articles
 - 4.1 May 2022
 - [Extreme heat events expose climate vulnerabilities - Pakistan - DAWN.COM](#)
 - [Climate change swells odds of record India, Pakistan heatwaves - BBC News](#)
 - 4.2 September 2022
 - [Climate change is real. So are illegal structures on Pakistan's riverbeds. Will we ever](#)

Flood Mapping Tool

<https://floodmapping.inweh.unu.edu/>

Thanks!

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