DP IB Environmental Systems & Societies (ESS): SL

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Access to Fresh Water

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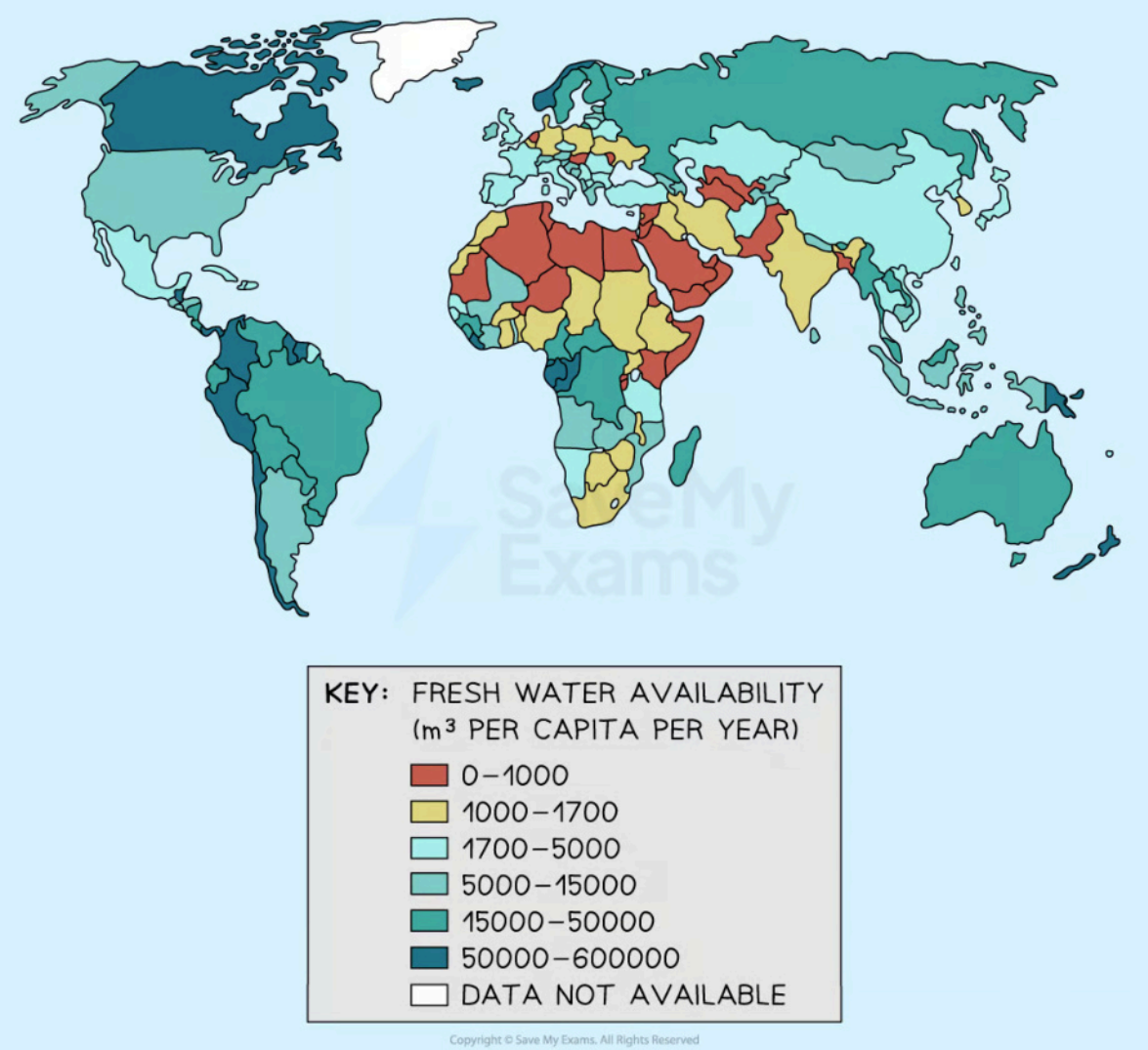

Access to fresh water around the world

- Access to an adequate supply of freshwater varies widely across the globe due to a number of factors:

1. Geographic location

- Some regions naturally contain abundant freshwater resources due to factors such as **proximity** to large **rivers**, **lakes**, or **high rainfall**
- Others, like arid and semi-arid regions, naturally have limited water availability

2. Climate

- Areas with high levels of **precipitation**, such as tropical rainforests or coastal regions, generally have better access to freshwater compared to arid or desert regions with low rainfall

3. Topography

- Mountainous regions often have better access to freshwater due to higher precipitation rates and the presence of glaciers and snowpack that act as **natural reservoirs**
- Conversely, flat or low-lying areas may face challenges in water availability

4. Population density

- Regions with higher population densities tend to experience **greater pressure** on water resources
- Increased water demand for domestic, agricultural, and industrial purposes can strain available supplies, leading to **water scarcity**

5. Water management and infrastructure

- The presence of well-developed water management systems, including reservoirs, dams, canals, and pipelines, can enhance water availability and **distribution**
- Conversely, inadequate infrastructure can limit access to freshwater, especially in **rural** or **underdeveloped** areas

6. Economic development

- Wealthier nations often have greater financial resources to invest in **water infrastructure** and management, which can result in better access to freshwater
- In contrast, poorer countries may lack the means to develop and maintain robust water systems

7. Political stability and governance

- Political stability and effective governance play a vital role in water management and **equitable distribution**
- Regions with political instability or weak governance may struggle to provide access to an adequate supply of freshwater for their populations
- It's important to note that these factors are **interconnected** and can influence each other
- The combination of multiple factors often contributes to the wide variation in access to an adequate supply of freshwater across the globe


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Problems Facing Fresh Water Access

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- Access to freshwater is essential for human survival, agriculture, industrial activities, and maintaining healthy ecosystems
- However, numerous **challenges** and problems threaten the availability and accessibility of freshwater resources worldwide
- The key problems facing freshwater access include:
  - The impacts of climate change
  - Increasing population, irrigation and industrialisation
  - Contamination
  - Unsustainable abstraction

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Satellite images of the Aral Sea in Central Asia between 1989 and 2009 show a dramatic loss of water due to unsustainable abstraction

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1. Climate change

- Climate change can **disrupt rainfall** patterns, leading to increased variability and **unpredictability** in precipitation
- This can result in more frequent and severe **droughts** and **floods,** impacting the availability of freshwater resources
- Rising temperatures can accelerate evaporation rates, further reducing water availability in already water-stressed regions
- Melting glaciers and reduced snowpack in mountainous areas can affect the timing and magnitude of water flow in rivers, potentially leading to water scarcity during dry seasons
- Sea-level rise can lead to saltwater intrusion in coastal areas, **contaminating freshwater sources** and making them unsuitable for human consumption and agriculture

2. Access to fresh water in developing countries

- The increasing global population, along with expanding agricultural practices and industrial activities, puts significant pressure on freshwater resources
- As the population grows, so does the demand for food production, which often requires extensive irrigation
- This further strains water supplies as large amounts of water are diverted for agricultural purposes
- Industrialisation demands substantial water resources for **manufacturing** processes, **energy production**, and **cooling** purposes
- The growth of industrial sectors intensifies competition for freshwater, particularly in water-stressed regions

3. Contamination

- Freshwater supplies can become contaminated due to various human activities, including industrial **discharges**, agricultural **runoff** containing fertilisers and pesticides, and **improper waste disposal**
- Pollution from industrial chemicals, heavy metals, and sewage can render water sources unsafe for consumption and harm ecosystems
- Contamination of freshwater bodies, such as lakes and rivers, can make water treatment more challenging and costly, reducing the availability of clean and safe drinking water

4. Unsustainable abstraction

- Unsustainable abstraction refers to the **excessive withdrawal** of water from freshwater sources without allowing sufficient time for **replenishment**
- Over-extraction of groundwater through wells and boreholes can lead to declining water tables, depletion of **aquifers**, and land subsidence
- In some regions, surface water bodies, such as rivers and lakes, are over-allocated for abstraction, leading to reduced flows and ecological degradation
- Lack of proper **regulation** and **monitoring** of water abstraction practices can exacerbate water scarcity issues, particularly in areas with high water demand
- These interconnected challenges create a complex web of issues that require comprehensive and integrated approaches to ensure sustainable access to freshwater for present and future generations


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Fresh Water Conflicts

Fresh water conflict in the Nile basin

- Water scarcity is a pressing global issue that can lead to **conflicts** between human populations, especially when water sources are **shared**
- As a vital resource for life and an essential resource for various sectors, including agriculture, industry, and domestic use, access to water becomes a matter of **survival** and **societal development**
- Freshwater conflicts occur for a variety of reasons:

1. Competition over limited resources

- Scarcity of water creates competition among populations dependent on the same water source, such as rivers, lakes, or groundwater reservoirs
- For example, the **Nile River basin**, shared by multiple African countries, has experienced conflicts over water allocation due to increased demand for agriculture, hydropower, and domestic use

2. Transboundary water disputes

- When water resources cross national boundaries, disagreements over their management and allocation can **escalate** into conflicts
- For example, the dispute between India and Pakistan over the Indus River's waters has led to tensions and political conflicts, with both countries relying heavily on the river for agriculture and irrigation

3. Environmental degradation

- Water scarcity often results from overexploitation, pollution, and environmental degradation, further straining already limited resources
- For example, the shrinking of the **Aral Sea**, caused by excessive irrigation and diversion of its tributaries, has led to conflicts between countries in the region due to reduced water availability and economic impacts

4. Climate change and drought

- Climate change exacerbates water scarcity by **altering precipitation** patterns, leading to more frequent droughts and reducing water availability
- For example, the prolonged **drought** in the **Western United States** has intensified conflicts between agricultural, industrial, and urban sectors, highlighting the challenges of managing scarce water resources

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Worked Example

Discuss, with reference to a case study, how shared freshwater resources have given rise to international conflict.

Answer

The Nile River, one of the world's longest rivers, stretches across eleven African countries, making it a prime example of how the shared use of a freshwater resource can lead to international conflicts. This history surrounding the shared use of the Nile River basin is highly complex and various factors have contributed to conflicts over water allocation and management.

Historical Background:

The Nile basin countries were historically colonised by different European powers, resulting in various agreements and treaties being imposed that favoured certain countries over others. For example, the 1929 and 1959 Nile Waters Agreements between Egypt and Sudan granted them a very large share of the Nile's waters, while upstream countries were marginalised.

Asymmetric Water Access:

Historically, downstream countries like Egypt and Sudan have enjoyed significant control and utilisation of Nile waters, while upstream countries have had limited access. For example, Egypt heavily relies on the Nile for agriculture, with the river providing over 90% of its water supply, enabling it to sustain a vast population and agricultural output.

Population Growth and Development:

Rapid population growth and increasing development in upstream countries have heightened the demand for water resources, intensifying conflicts over water allocation. Ethiopia, with a rapidly growing population and economic aspirations, seeks to harness the Nile's waters for hydropower and irrigation through projects like the Grand Ethiopian Renaissance Dam (GERD), raising concerns among downstream nations.

Upstream-Downstream Power Dynamics:

Power dynamics between upstream and downstream countries have played a role in shaping conflicts, with downstream countries asserting historical rights and resisting changes to the status quo. Egypt has historically perceived any alteration to the Nile's flow or water usage by upstream countries as a threat to its national security and economic stability, leading to tensions and diplomatic disputes.

Lack of Cooperative Framework:

Absence of a comprehensive and cooperative framework for Nile water management has hindered collaborative efforts, heightening conflicts among the Nile basin countries. The absence of a

binding basin-wide agreement has impeded efforts to resolve disputes and establish equitable water allocation mechanisms, leading to a stalemate in negotiations.

Climate Change and Uncertainty:

The impacts of climate change, including changing precipitation patterns and prolonged droughts, have added to the uncertainty surrounding the Nile's future water availability, heightening tensions. The potential reduction in water flows due to climate change raises concerns among all Nile basin countries regarding their ability to meet growing water demands, amplifying the urgency to secure their water rights.

The Nile River basin is an example of how the shared use of a freshwater resource can give rise to international conflicts. To address these conflicts, the countries involved must engage in constructive dialogue, prioritise equitable water management, and work towards establishing a comprehensive and cooperative framework that ensures sustainable water use for all stakeholders in the Nile River basin.


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Sustainable Management of Fresh Water Resources

- Fresh water supplies can be enhanced through various strategies that promote sustainable management of freshwater resources

Strategies used to Enhance Fresh Water Supplies

Strategy	Description	How strategy enhances freshwater supplies
Reservoirs	Construction of reservoirs helps store water during periods of high rainfall for use during dry seasons	Reservoirs regulate water flow, ensuring a consistent supply for agriculture, industry, and domestic use - they also provide opportunities for hydropower generation, contributing to renewable energy production
Redistribution	Efficient water redistribution systems, such as canals and pipelines, can transfer water from water-rich regions to areas experiencing scarcity	Redistributing water resources can help balance supply and demand, particularly in densely populated or arid regions
Desalination	Desalination processes remove salt and other impurities from seawater or brackish water, making it suitable for various purposes	Desalination technologies, such as reverse osmosis and distillation, provide an alternative water source in coastal regions with limited freshwater availability
Artificial recharge of aquifers	Artificial recharge involves injecting treated or excess water into aquifers, replenishing underground water storage	Recharging aquifers helps prevent groundwater depletion and maintains a sustainable supply of water for wells and springs
Rainwater harvesting	Rainwater harvesting captures and stores rainwater runoff from rooftops, landscapes, and other surfaces	Collected rainwater can be used for non-potable purposes like irrigation, toilet flushing, and cleaning, reducing the strain on freshwater sources - it also mitigates stormwater runoff, helping reduce flooding and erosion

- There are also some other key considerations for sustainable freshwater management:

1. Conservation and efficient water use

- Promoting water conservation practices, such as using water-efficient appliances, fixing leaks, and adopting sustainable irrigation techniques, to reduce water wastage
- Public awareness campaigns and education initiatives can encourage responsible water use

2. Water recycling and re-use

- Implementing grey water recycling and re-use systems to treat wastewater to a safe level for various non-potable purposes, such as irrigation, industrial processes, and toilet flushing
- This practice reduces freshwater demand, minimises pollution, and maximises water resource utilisation
- Water conservation and grey water recycling can both help to reduce demand but often require a change in attitude by the water consumers, which can take a long time and substantial effort to achieve

3. Sustainable agricultural practices

- Encouraging farmers to adopt sustainable agricultural practices, such as precision irrigation techniques, crop rotation, and efficient fertiliser use, reduces water consumption and minimises runoff

4. Protecting ecosystems and natural water sources

- Preserving and restoring natural ecosystems, such as wetlands and forests, helps maintain water quality, regulate water flow, and support biodiversity
- Establishing protected areas around water sources safeguards them from pollution and overuse
- Sustainable management of freshwater resources requires a **combination of strategies** to enhance water supplies
- Reservoirs, redistribution, desalination, artificial recharge of aquifers, and rainwater harvesting offer effective approaches to increase water availability
- However, these measures should be complemented by conservation practices, recycling and reuse, sustainable agriculture, and ecosystem protection
- By adopting a comprehensive and balanced approach, societies can ensure the sustainable use of freshwater resources, promote resilience, and address the challenges of water scarcity


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