# SL IB Geography

Your notes

## 4.4 Water Management Futures

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# 4.4.1 Water Management


Your notes

## Communities & Water Management

- According to the **World Bank,** there are nearly **2 billion** people who do not have access to clean water
- Increasing numbers of people are gaining access to clean water
  - Between 1990 and 2008, half of the people who gained access to clean water lived in India and China
- To increase access to clean water, sustainable management is needed
- There are various approaches to water management

**Approaches to water management**

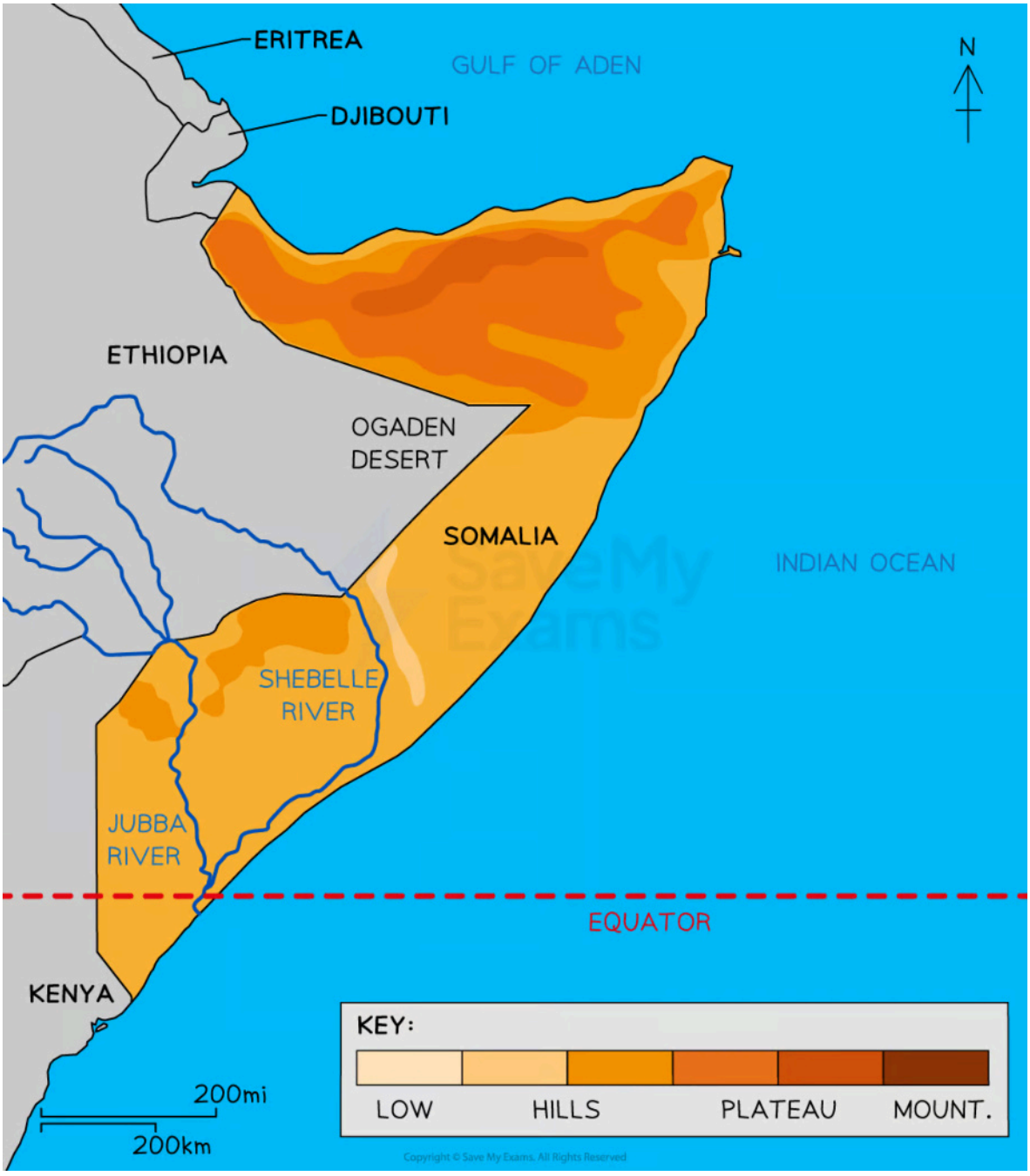
| Method | How it works |
|---|---|
| Water saving | Reduce bath water usage<br><br>Turn off taps when not in use and promptly fix dripping taps<br><br>Dishwashers and washing machines should only be operated when full<br><br>Use taps with push-down mechanisms that automatically turn off after a short time |
| Customer pricing | In many places, people pay for water and in some places, water is subsidized<br><br>Water can be wasted in areas where it may be subsidized<br><br>Domestic water can be charged through the use of meters<br><br>In the UK, a regulating authority exists to allow competition between water providers so that water monopolies do not exist |
| Water purification | Removes harmful chemicals, suspended solids and gases<br><br>Water is disinfected so that it can be used for human consumption<br><br>Processes like light filtration and sand filters can distil the infected water<br><br>The most common type of disinfectant is chlorine, which has been used since 1854 in London |
| Zoning | Protecting areas from development to allow the safeguarding of water quality<br><br>Reduces the risk of subsidence due to over-abstraction<br><br>Organisations such as the European Union have set up directives and legislation to control water pollution levels |

| | |
|---|---|
| Rainwater harvesting | Water harvesting captures water<br><br>In Bermuda, the people collect their water through the rain as there are no rivers on the island<br><br>Constructing dams across stream waters<br><br>Using gravel-filled reservoirs to store water |
| New technologies | **Nanotechnology infiltration**<br><br>**Membrane Chemistry**<br><br>**Seawater desalinisation**<br><br>**Biomimicry**<br><br>**Smart monitoring**<br><br>**Precision irrigation systems**<br><br>**Highly mobile water treatment** |

Your notes

### Water management in Somalia

Your notes




***Location of Somalia a low-income country***

- Somalia is a low-income country in Africa
- The average income is around US$2 a day
- Only 52 percent of the population have access to a basic water supply
- According to UNICEF:

- Approximately 28% of the population defecate in open spaces
- Over the last 3 years, more than 900 people have died from cholera
- Collecting water is often the responsibility of women and girls
- Many women and girls have faced sexual abuse at water-collecting points

- For Somalians who do not live along the Jubba or Shebelle rivers water is provided through **groundwater**
- The main sources of groundwater supplies in Somalia are **shallow wells**, springs and boreholes
- **Boreholes** are a significant supply of water
  - Most have a water supply throughout the year
- Boreholes range from 90–250 metres, but in some locations are as deep as 450 metres
- The majority of shallow wells in Somalia are less than 20 metres deep, and water availability varies from one area to another
- Somalia is known for its poor water quality due to the **salinity** of the water
- Many shallow wells suffer from **contamination** due to animal waste
- Somalia experiences river floods and flash flooding

## Improvements in water management

- **Somalia Water And Land Information Management (SWALIM)** was established to improve water quality and access
- The organisation works with the **UN WASH programme** and the Somalian government; it has completed:
  - A hydrological survey of selected areas in Somaliland was completed
  - Helped to assess how to provide more efficient and sustainable groundwater supplies
  - Prepared a GIS Database of groundwater supplies
  - Identified areas for future groundwater supplies
  - Provided education for people living along the Juba and Shabelle rivers, where flooding can occur
- Somalia relies on **international aid** to support its water management
- **USAID Bureau of Humanitarian Assistance** provided solar technology, which enabled renewable energy for boreholes in villages such as **Adaroosh** in northern Somaliland
- Solar energy can reduce or eliminate the costs of extracting and pumping water
- **Borama town** has around 20 households living in the village and a limited water supply
- The town had to rely on diesel-powered generators for the extraction and pumping of water, which was costly to run
- UNICEF worked with the government and other aid agencies to provide solar power to increase **water sustainability** for the village

## Water management in Peru

- Peru is a Middle country, according to the World Bank (2023)
- Nearly 4% of the world's freshwater resources can be found in Peru
- The majority of Peru's water reserves can be found in the Amazon Rainforest but fewer than 5% of Peruvians live there
- Lima is the capital of Peru and the second-largest desert city
- In Greater Lima, 1.5 million residents lack access to running water and use expensive **water delivery trucks**

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- In **Mantaro Basin, Lake Titicaca** and **Lake Junín,** the mining industry has contaminated some water supplies
- The Ica Valley, is a popular area for agriculture
  - Water has been diverted to this industry and locals have faced shortages
- Farming in the Ica Valley extracts 90% of groundwater supplies for products like asparagus, which means residents only receive a few hours of water per week
- The government implemented a 2015–2035 **National Water Plan**:
  - Plans to increase crop area under mechanised irrigation from 2% to 24%
  - Install water meters in homes
  - In upstream watersheds, implement reforestation to avoid sedimentation in reservoirs
  - Double the use of treated urban wastewater for irrigation
  - In the Moyobamba region, a pilot programme of payment for environmental services has been implemented and the money collected is used for reforestation programmes
  - The plan states that desalinisation should be a last resort because of the cost involved with regard to technology, transport and management of the tanks


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# 4.4.2 Contemporary Dam Building

Your notes

## Case Study: Multipurpose Water Schemes

- The number of dams being built around the world is increasing
- This increase is due to the need to manage water supply due to:
  - Water shortages
  - Increased water demand
- There is conflict between people who say more dams should be built and those who do not think more dams should be built
  - **Advocates** of building more dams believe that the structures act as buffers against **extreme water flows**
    - They contain water during flooding and then release the water in times of drought
  - **Opponents** of dam building believe that there are significant **impacts on ecosystems**
    - There is scientific research which says that the reservoirs created by dams emit more greenhouse gases
    - The flooding of valleys to create reservoirs destroys habitats
- Recently, there has been minimal building of dams in Europe and North America
- In countries such as China and Brazil, dams are built as **multipurpose schemes**
  - The dams are used to:
    - Control of river flooding
    - Produce **hydropower** - Hydropower from dams now supplies 17% of global energy production
- Floods caused by dam failure can be very destructive
- Dam failure can be caused by:
  - **Seepage**
  - Internal erosion
  - Landslides
  - Earthquakes
  - A breach in the dam

### Grand Ethiopian Renaissance Dam (GERD)

- Ethiopia began constructing the Grand Ethiopian Renaissance Dam in 2011
- The dam is located along the Blue Nile downstream of the Tana Lake

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***Location of the Grand Ethiopian Renaissance Dam***

- Tana Lake has an average altitude of 1800 m

**Facts about GERD**

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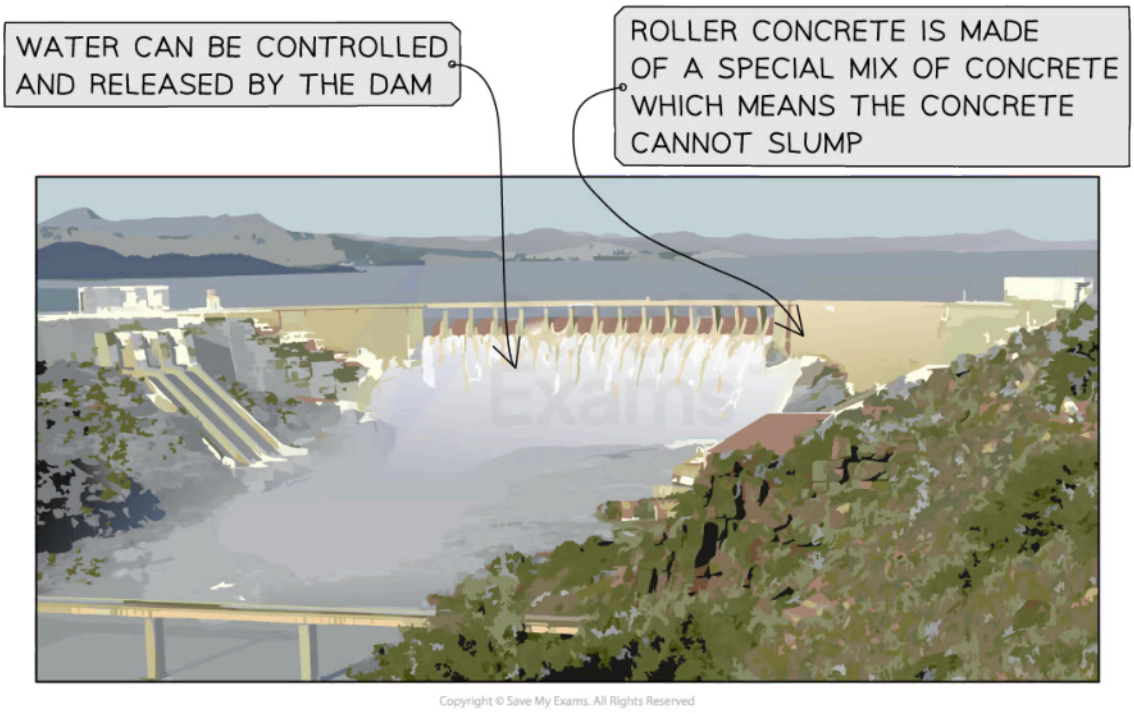
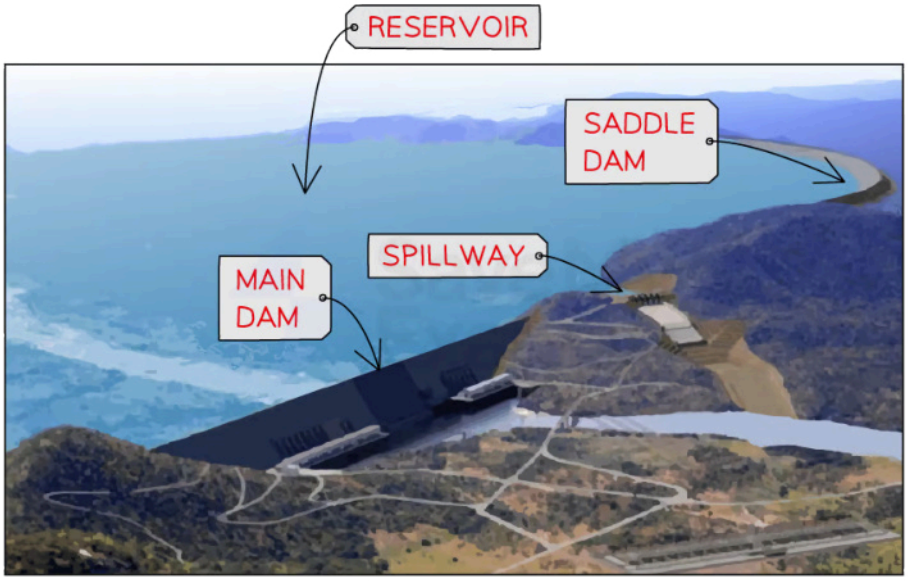



***Ethiopian Gerd Dam***

- The Grand Ethiopian Renaissance Dam:
  - Is a **roller-compacted** concrete-type dam
  - Has two power stations, three spillways and a **saddle dam,** which is a secondary dam
  - Will be Africa's biggest hydroelectric plant
  - Cost US$5 billion
  - Stands 170 metres tall
  - Began generating electricity in February 2022
  - Has created a reservoir containing 74 billion cubic metres of water

Your notes





***Saddle Dam of the GERD***

- Chinese banks invested and provided loans to the Ethiopian government for the construction of the dam

**Advantages and Disadvantages of the GERD**

| Advantages of building the dam | Disadvantages of building the dam |
|---|---|
| GERD will be used to generate hydropower with an installed capacity of 6 000 megawatts | Countries downstream are concerned about water availability - it will reduce water supplies to downstream Egypt by more than one-third |
| The Ethiopian government estimates that the GERD can generate up to 2% of the country's annual GDP | The dam may alter the natural flow of the Nile, which could potentially affect ecosystems and biodiversity downstream |
| Improved water control could allow for the expansion of agricultural land by an estimated 2 million hectares | In periods of ongoing drought, there may be a possibility that the reservoir exacerbates water scarcity downstream |
| The dam includes a flood retention basin, which can provide protection downstream during periods of heavy rainfall | The construction of the dam has resulted in the displacement of communities |

| | |
|---|---|
| The dam has a storage capacity of 74 billion cubic metres, which can act as a strategic reserve during drought | Geopolitical disagreements have taken place because there has been a lack of comprehensive agreements about the operation of the dam between all countries |
| Ethiopia has taken the diplomatic route of working with Egypt to resolve water disputes | The construction of the dam was delayed, meaning that it went over the expected budget |
| Hydropower is a clean resource, which means that Ethiopia can reduce its carbon emissions | Possible increase in waterborne diseases |
| Ethiopia invested heavily in infrastructure by constructing over 15,000km of transmission lines, which has contributed to the development of the region | Egypt has said that they have concerns over the structural integrity of the dam and its potential to fail |
| Ethiopia could double their electricity production, which is useful for the 60 million people who do not currently have access to electricity | Egypt relies on the Nile for 97% of its water needs |
| The dam is designed to trap 100 years of sediment inflow | The UN has said Egypt could run out of water by 2025 |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# 4.4.3 Integrated Drainage Basin Management

Your notes

## Integrated Drainage Basin Management

- According to **Integrated Water Resources Management (IWRM)**, Global Water Partnership Technical Advisory Committee 2000

"Integrated river basin management (IRBM) is the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, to maximise the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems."

- Components of **integrated drainage basin management (IDBM)** include:
  - Water quality
  - Water supply
  - Flood control
  - River channels
- Successful drainage basin management works with the river compared to working against the river
- There are seven key elements to successful IDBM:
  - **Integration**
  - **Timing**
  - **Participation**
  - **Scale**
  - **Knowledge**
  - **Capacity**
- According to the WWF, there is a need for IDBM due to:
  - The freshwater crisis the world is facing
  - The melting of glaciers in Pakistan and India
    - This is increasing **discharge** in rivers
  - An increase Glacial outburst floods, caused by failures of dams containing a glacial lake
  - Increased land use due to urban development
  - The increasing use of water for agriculture
  - Approximately 12% of all animals live in freshwater and will be affected by reduced or polluted water

**Costs and benefits of IDBM**

| Costs | Benefits |
|---|---|

| | |
|---|---|
| Difficulties in involving all the stakeholders who have differing priorities and views | Helps to preserve biodiversity and maintain the ecosystem |
| Projects are costly | Ensures sustainable water use |
| Accurate data is difficult to obtain | Minimises the risks and impacts of flooding |
| Transboundary issues can be difficult to resolve | Provides a reliable water supply |


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# Case Study: Amur Drainage Basin

Your notes

## The Amur basin

- WWF recently launched a project which targets the Amur River in China


AMUR BASIN SERVES OVER 75 MILLION PEOPLE

AMUR RIVER IS ONE OF THE WORLD'S LONGEST NATIONAL BORDER RIVERS

11th LARGEST RIVER BASIN IN THE WORLD



***Amur River Integrated Drainage Basin Management***

- Over 93% of the population in the Amur basin lives on 43% of the land in northeastern China
- Increasingly, the river has been used for hydroelectric power, with dams being built along the river
- In 2019, there were over 100 dams in the Amur Basin
- The basin is home to diverse ecosystems, such as the snow sheep and Siberian tiger
- Environmental threats exist because of rapid population and economic growth due to more people needing to use river basins for water supplies and for governments to use the river basin to support the people

- Most rivers of the basin are usually frozen from October to April
- There are alternating dry and wet periods in the basin, which can last up to 40 years, which means that the basin is either more affected by possible flooding or droughts
- The problems of the water basin expand into Japan because the ecosystems supply nutrients to the Sea of Japan


Your notes

## Floods in the Amur Basin

- A catastrophic flood took place in the basin in 2013
- The flood led to:
  - Eighty-five deaths
  - Over 100 missing people
  - More than 860,000 people were displaced from their homes
  - Property damage totalled $2.6 billion
  - More than 120,000 people, including 10,000 soldiers, helped with relief and rescue efforts in the Chinese section of the river basin
  - More than 30,000 volunteers helped distribute 53 tons of food and supplies to flood victims in the Russian section of the basin

## Integrated Drainage Basin Management

- Long-term goals for the river basin:
  - Reduce logging in the area to reduce flooding
  - Try to limit overfishing of sturgeon
  - Improve existing international agreements between Russia and China
  - Sharing of data across international boundaries about the river basin
  - Existing areas of protected networks to be regularly assessed
  - Increase wetlands in the area
  - Prevent future dams from being built
  - Improve military security issues in the area

**Integrated Management of the Amur Drainage Basin**

| Management factors | Examples in the Amur Drainage Basin |
|---|---|
| International Cooperation | Countries like Russia, China, and Mongolia have engaged in the "Trilateral Meetings" since 1991, promoting dialogue and cooperation |
| Treaties and Agreements | The 2008 "Agreement on the Conservation and Sustainable Use of Water and Aquatic Ecosystems" outlines principles for equitable resource use, preventing disputes |
| Scientific Collaboration | The "Amur-Heilong River Basin Information Network" supports data exchange, joint research and informed decision-making |

| | |
|---|---|
| Environmental Considerations | Shared initiatives like the "Amur-Heilong River Basin Wetlands Conservation Project" show a commitment to environmental preservation |
| Conflict Resolution Mechanisms | The "Amur-Heilong River Basin Mechanism for Cooperation and Communication" establishes ways of addressing disputes and maintaining open communication channels |


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## Conflicts caused by Integrated Drainage Basin Management Plans

- **Integrated Drainage Basin Management Plans (IDBMPs)** can cause conflicts between different groups of people:
  - Reports suggest that **indigenous communities** were not consulted in the dam production at Evenkiiskaya
    - This led to the construction of the dam being stalled
    - There is conflict when local people believe their land is being taken away from them in the form of 'land grabbing' for dam building, such as at Evenkiiskaya
  - The flow regimes of the Zeya and Bureya rivers have changed significantly
    - This change resulted in the alteration of the natural floodplain ecosystems of both rivers
  - There have been suggestions that governments do not listen to Non-governmental organisations such as **WWF-Russia**
    - The WWF-Russia has carried out impact assessments on the Amur River Basin
  - Both China and Russia have different legislation about how to manage the Amur River Basin
    - This is not a constructive way of utilising IDBMPs
  - There might be unclear responsibilities of interested government agencies
    - Departments that measure water quality might clash with urban and rural planners
  - IDBMPs are **not usually legally binding** which means companies and governments can disregard the plans
  - Governments may disregard the IDBMPs because of the need to use the rivers for economic growth

# 4.4.4 Wetlands

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## Pressure on Major Wetlands

- Wetlands have the following characteristics, they:
  - Are areas of land which are permanently flooded
  - Can be man-made, inland or coastal
  - Are diverse and make up 6% of the world's habitats

**Types of wetland**

| Name of wetland | Description |
|---|---|
| Riverine | Located on floodplains |
| Lacustrine | Located close to lakes |
| Palustrine | Fens and peatlands |
| Tidal | Coastal and caused by fluctuating tidal waves |
| Marine | Coastal wetland which is formed near lagoons, estuaries and spits |

### Threats to wetlands

- The threats to wetlands include:
  - Clearance to make way for housing and industry
  - Global warming
    - Warmer temperatures, drought and evapotranspiration can lead to water loss
  - Wetlands are highly dependent on water levels
- Wetlands can provide social, economic and environmental benefits:
  - More than 1 billion people depend on wetlands to make a living for example through fishing
  - **Groundwater recharge**
  - **Shoreline stablisation**
  - Storm protection
  - **Flood mitigation**
- Wetlands can be used for:
  - Tourism
  - Peat
  - Wildlife resources

### The Ramsar Convention

- Examples of sustainable management of wetlands exist at varying scales due to the **Ramsar Convention**
- The Ramsar Convention was developed in Iran in 1971

- Over **60 countries** endorse the Ramsar Convention
- The aim of the Ramsar Convention is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world"
- The convention requires signatories to do the following:
  - Designate international wetlands
  - Sustain their ecological character
  - Plan for wise use
  - Allocate certain areas as nature reserves
- Over 500 Ramsar sites span 30 million hectares around the world


Your notes

## Case Study: Lake Kuyucuk

Your notes

- Türkiye became a party to the Ramsar Convention in 1994




***Location of Ramsar Sites in Türkiye***

- **Lake Kuyucuk** is a wetland in Türkiye
- A freshwater stream and spring-fed lake its area is 245 hectares
- The wetland site was chosen to be Türkiye's European Destination of Excellence in 2009
- The wetland provides economic resources to local people
- The habitat is home to over **230 species of bird**
- Located on the African-Eurasian migration routeway for birds
- The government spent over $220,000 in creating Türkiye's first bird island
- Local villagers started their own non-governmental organisation for conservation and tourism because it was the only source of water for 3 villages
- Türkiye's government funded a visitor centre and guesthouse to increase tourism to the area
- Threats to Lake Kuyucuk include:
  - The Lake has dried up twice in 2019, 2021 and 2023
  - The lake cannot be fed from other reservoirs in the region because they contain fish eggs which would mean migratory birds would not visit
  - Cereal production and agriculture is a source of income in the area which uses a considerable amount of water
  - Overgrazing by cattle has caused a disturbance for the birds

- A report by Turkish Scientists in 2021 said that the lake dries up because of unregulated use of groundwater and illegal damming of streams
- The conflict between local farmers and conservationists arose when the local government ordered the illegal dams to be pulled down and local farmers rebuilt them a few weeks later
- Lack of snowfall to feed the lake

- Future possibilities for Lake Kuyucuk are that the lake could dry up
- Plans have been put in place by the Kars Governorship to demolish artificial ponds in the upper part of the lake in hope of restoring groundwater flows
- It is hoped that more birds return to the area as shown by the return of coots, gray ducks and shelducks
- A borehole has been drilled to feed the lake to limit the lake from drying up


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