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IB Environmental Systems and Societies

4.2 Access to Freshwater

Significant Ideas

The supplies of freshwater resources are inequitably available and unevenly distributed, which can lead to conflict and concerns over water security.

Freshwater resources can be sustainably managed using a variety of different approaches.

Freshwater Use

1. Humans use a lot of fresh water in their daily lives. List the uses of freshwater under the categories below. (Focus on what grey can be used for, not what is commonly used for)

<i>Water in a river ↑ that flows quickly</i>	<i>Waste water ↑ from washing, cooking cleaning etc but has not come into contact with human waste.</i>
<p>"White" water has a lot of bubbles</p> <ul style="list-style-type: none">• Drinking water• showering• cleaning hands• swimming• Cooking• Water Parks• lives	<p>"Grey" water</p> <ul style="list-style-type: none">• Water for cleaning the car• irrigation• toilet flushing• gardens• industries• livestock farming

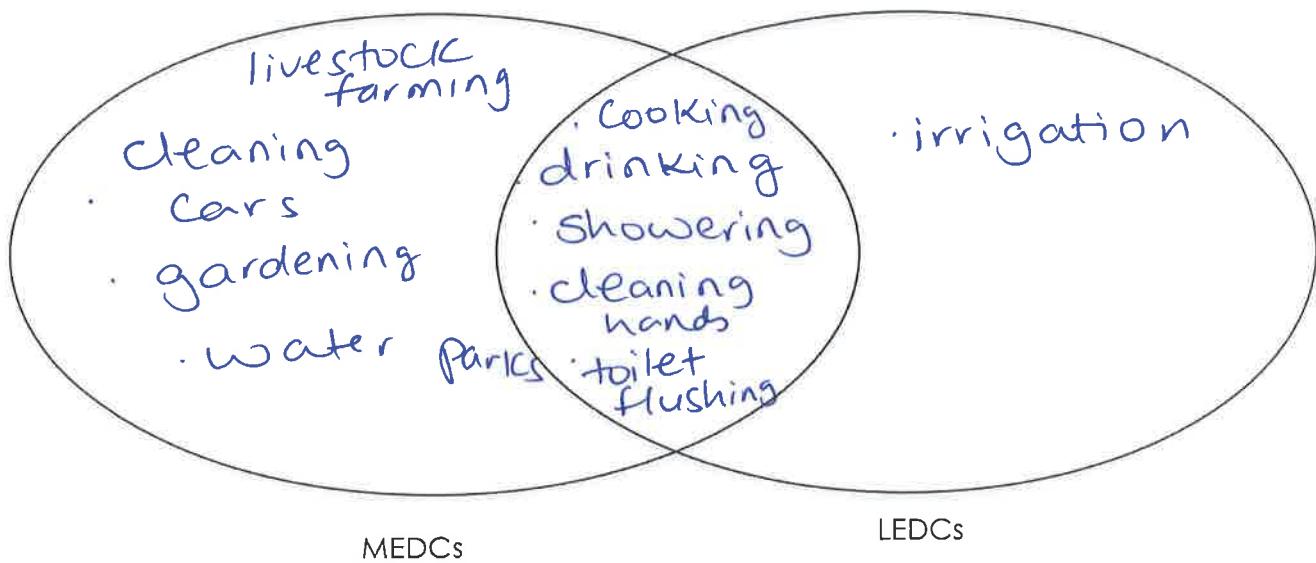
Black water is contaminated with sewage.

2. State a similarity and difference between white and grey water.

Similarity: both should be treated

Difference: white water is cleaner

3. Look at your lists in question 1. Categorise the uses into those mostly used by people in MEDCs, those mostly used in LEDCs, and those used in both.



4. What can you deduce from your diagram above?

Water is used for leisurely pursuits in MEDC, more wasteful.

5. The diagram above is a type of model. Evaluate this model.

- Too simplistic • impact on the environment is not known
- Many MEDCs are now deindustrializing where should 'industries' be put MEDC

or MEDC or both
religious use of water is missing

Freshwater Supply

6. Explain why the freshwater requirements of a nation increases over time with respect to:

Population

Increase in population increases fresh water consumption. Average quality of life is increasing and this leads to water scarcity & water degradation.

Industrial Development

Industries release pollutants into surface water bodies. Industries and electricity plants release warm water into oceans. Warm water can hold less dissolved oxygen than cold water.

Expansion of farmland

Farms need regular supply of water. More ^{the} population, more farmland will be required to feed it. Growing exotic plants, not suited for a particular climate, adds to the burden

So aquatic organisms that take their oxygen from the water (fish, crayfish) are negatively affected. Dead and decaying matter reduces fresh water quality. Industries use more water for various processes.

7. Briefly describe the ways that the following can limit the supply of freshwater

Industrialisation

release pollutants into water bodies, release warm water, aquatic animals die as less DO, water is contaminated.

Irrigation of farmland

Much of the water is evaporated, causes salinization

Use of pesticides

Pollute streams and rivers. DDT used as pesticide causes biomagnification

Use of fertilisers

Fertilizers pollute streams, causes eutrophication, positive feedback destroys the fresh water ecosystem

High extraction rates from aquifers

This means eventually aquifer cannot be used anymore, which strongly affects agriculture. Buildings get

affected or damaged when the soil is shrinking because the water is taken away.

8. Explain how the following issues linked to climate change can influence the availability of water.

Factor	Effect on water supply
Rising sea level	<ul style="list-style-type: none">Rising Sea levels leads to mixing of salt water and fresh water (Brackish water)It also risks fresh water supply on small islands where aquifers get contaminated with sea water easily.
Changing rainfall patterns	<p>Climate change increase our risk of both heavy rains and extreme droughts. Heavy rains will lead to floods, this will lead to contamination of fresh water with sewage. Droughts are the result of extreme temp, excess evaporation.</p>
Changes in amount and timing of snow melt	<p>more snow melt will disturb the ocean current (thermohaline currents). This will lead to extreme temp in North Western Europe excess snow melt will reduce albedo, more warm oceans, sea level will</p>

9. Outline how water scarcity can lead to conflict.

Water is needed for survival.
Lack of water has already lead to clashes. People in the slums of New Delhi have killed over the argument on water. Global demand for water will be 40% above today in 2030 as a result of population growth. Demand is ⁶ more than supply.

10. Describe and explain the distribution of freshwater and water scarcity around the globe.

Consider addressing at least the following ideas: Is it distributed evenly around the globe? Can we use saltwater somehow? Why doesn't everyone do that? Are we damaging freshwater at all? In what circumstances is there a large amount of freshwater but still a water scarcity issue? Why?

Only 2.6% is fresh water
over 68% is in ice-caps and
glaciers
ground water is 30.1% of the
total fresh water
rivers and lakes make only 0.3%.

many societies are now
primarily dependent on
groundwater, this water
is not renewable

increase in population has
contributed to large increase
in pollution eg. eutrophication

industrial and sewage pollution
of rivers

Contamination of aquifers by
industrial activities eg.
leaking tanks, heavy metals

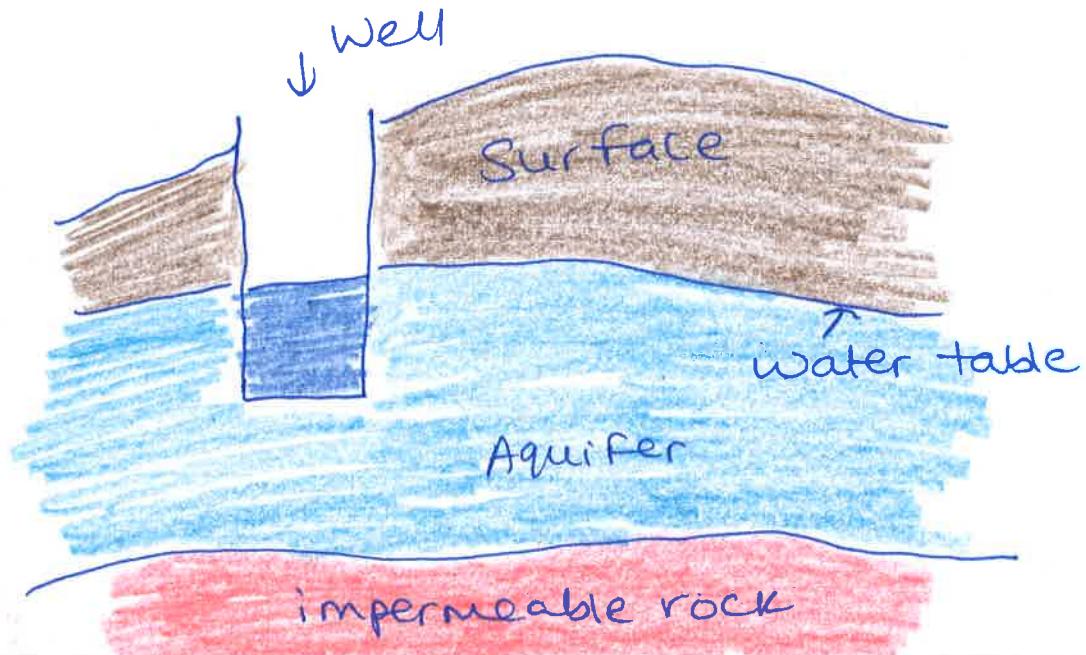
increased rate of soil erosion
as water table is lowered.

When demand exceeds supply: Two rivers

- Syr Darya and Amu Darya which input water into the Aral Sea had been diverted to irrigate cotton fields upstream in Uzbekistan.
- insufficient water reached the Aral causing it to shrink to a third of its original size
- water has become contaminated with pesticides run off and salt due to evaporation

Enhancing Freshwater Supplies

11. Draw a labeled diagram to show the structure of an aquifer.



12. State what is meant by "aquifer".

Aquifers are underground layers of rock that are saturated with water.

13. Look at the following ways to increase water supply. Describe and evaluate each one.

Method	Brief Description	Evaluation
Build reservoirs	This will increase fresh water supply → It is a large natural or artificial lake used as a source of fresh water.	Can be breeding ground for diseases, esp in tropical areas mosquitoes can grow in slow moving water.
Redistribute water	When the government or an international organization divides and distributes water to the key stakeholders.	Leads to fights and arguments In California some farmers will get water, others won't based on when their land was first irrigated in

Early years.
This system is not great when responding to drought

Desalination	removal of salt from the sea water	<ul style="list-style-type: none"> only for countries that are near the sea quite expensive
Rainwater harvesting	Rainwater harvesting is a technique of collection of rainwater into natural reservoirs or tanks.	<ul style="list-style-type: none"> suitable for irrigation reduces demand on ground water not suitable for drinking
env. damage during process possibility of contamination from surface run off	The main purpose is to store excess water for later use, reduce salinization	<p>This technology use in Argentina, Jamaica</p> <ul style="list-style-type: none"> useful when countries depend on groundwater and rainfall doesn't allow for recharge of aquifer.
Closed-water car washes	wash cars in car-washes with a closed water system.	reduces pollution by oil
Grey water recycling	grey water recycling - grey water is water from showers, baths, household, laundry, kitchen etc	<ul style="list-style-type: none"> this water can be reused on site for flushing toilets, garden irrigation not fit for drinking expensive
Use drought resistant crops	use GM crops that are drought resistant and need less water	<ul style="list-style-type: none"> health risks including accelerated infertility, aging with GMOS

Reduce fertilizer and pesticide use	<p>reduce the amount of pesticide and fertilizer used, use the smallest possible amount at app. times</p>	can lead to the reduction in productivity.
Use organic (instead of chemical) fertilisers	<p>replace chemical fertilizers with organic ones - the release of nutrients is slower & more likely to be absorbed by plants.</p>	<ul style="list-style-type: none"> less run off less eutrophication not sufficient for commercial farming, enough for subsistence
Water treatment by factories	<p>Industries can remove pollution from their wastewater with water treatment plants.</p>	<ul style="list-style-type: none"> not enforced by law in many countries Sg Changi Reclamation plant does it
Reduce temperature of water discharge	<p>regulating max temp of released cooling water. Using cooling towers to cool water. This water can be reused</p>	<ul style="list-style-type: none"> not enforced by law Some of the water is lost in evaporation from the cooling tower.

CASE STUDY: Freshwater and conflict

Conduct your own research to answer the following questions about water scarcity in North Eastern Africa.

A helpful article regarding the freshwater supply of the Nile Basin can be found at:

<http://www.futuredirections.org.au/publication/conflict-on-the-nile-the-future-of-transboundary-water-disputes-over-the-world-s-longest-river/>

14. List the countries that rely on the River Nile for freshwater

Burundi, D R Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, South Sudan, Tanzania and Uganda (11 countries)

15. State why the above nations are motivated to claim a share of freshwater from the Nile

It is the only major renewable source of water in the region

16. Describe how freshwater distribution has changed as a consequence of the Entebbe agreement.

The Entebbe agreement allows the countries of the upper Nile Basin to build dams and undertake water development projects. Current signatories include Ethiopia, Rwanda, Uganda, Kenya, Tanzania, and Burundi.

Until recently Ethiopia had not bothered to make use of its rivers. In 2011 it announced plans for the construction of its Great Ethiopian Renaissance Dam (GERD). With agreement earlier (1951) Nile water allocation three quarters of the total water and Sudan one quarter, Egypt was allocated one quarter.

17. Discuss, using specific examples, the instances of conflict over the freshwater resources from the River Nile. In your answer, include historical instances and speculations about future conflicts.

- Nile's origin is outside the borders of Egypt - yet Egypt takes the lion's share of its waters.
- A 1929 treaty between Egypt and Burundi, Kenya, Rwanda, Tanzania and Uganda awarded 57.1% water to Egypt, and approval was required by Egypt for any major water project.
- In 1959 Egypt and Sudan signed the Nile Water Agreement in which Egypt was allocated three quarters of the total water volume and Sudan one quarter.

2010 Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda Signed Entebbe agreement

Entebbe agreement was rejected by Egypt and Sudan

2011 → Entebbe agreement came into force allowing countries of the upper Nile basin to build dams & undertake water projects.

Egypt's historic rights to the Nile have led to the over dependency on river-Nile accounts for 97.1% of Egypt's

water needs.

2011 - Ethiopia announced plans for construction of Great Ethiopian Renaissance Dam (GERD) Egypt demanded suspension of this construction

- GERD could result in the evaporation of 3 billion cubic metres of Nile water
 - Aswan dam is responsible for the evaporation of 12 billion cubic metres of Nile water annually
 - Together these two dams could lead to much-reduced flows downstream.
 - Nile is threatened by many environmental pressures - Climate change, Salinization, pollution, land degradation, increased likelihood of droughts & floods.
 - Large scale water development carry a dual threat - conflict with neighbouring countries, and internal conflict due to displacement of many countries.
 - Egypt has tended to use military threats in Nile disputes but is unlikely to be able to follow such threats though.
 - A UN-backed plan suggests using the Nubian Sandstone Aquifer for water. Egypt, Sudan & CHAD & Libya have agreed the plan. There could be 400 years worth of water available.
- It should be used sustainably*