

AQA Geography GCSE

Water Resource Management Detailed Notes

This work by [PMT Education](https://www.pmt.education) is licensed under [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)

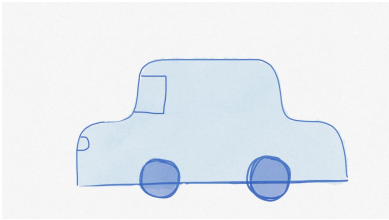




Resources across the Globe

There are many resources that humans need to live or use to enhance their living. A resource is a product that is **valuable** to living. Essential global resources can be split into three groups: **food, water and energy**.

Water Distribution

Water is important for human life, as it is essential for humans to survive to drink clean water daily. We also use water in **business** and **food production**. For example, these everyday items consume vast amounts of water to produce:

		
Cars require 76,000 litres of water	Jeans require 8,000 litres of water	A barrel of beer requires an additional 6000 litres of water

This water is used in **cooling** materials down, to produce **electricity** and to wash away (to **dilute**) any waste products.

Alternatively, **food production** requires a large amount of water to keep crops well **irrigated**. This can be increased by planting crops in **unsuitable environments**. Some examples of water consumption in food includes:

		
To produce 1kg of beef requires 15,500 litres of water	To produce 1kg of olives requires 4,400 litres of water	To produce 1kg of chocolate requires 24,000 litres of water

To measure water distribution, we measure the **water surplus and deficit** for each country.

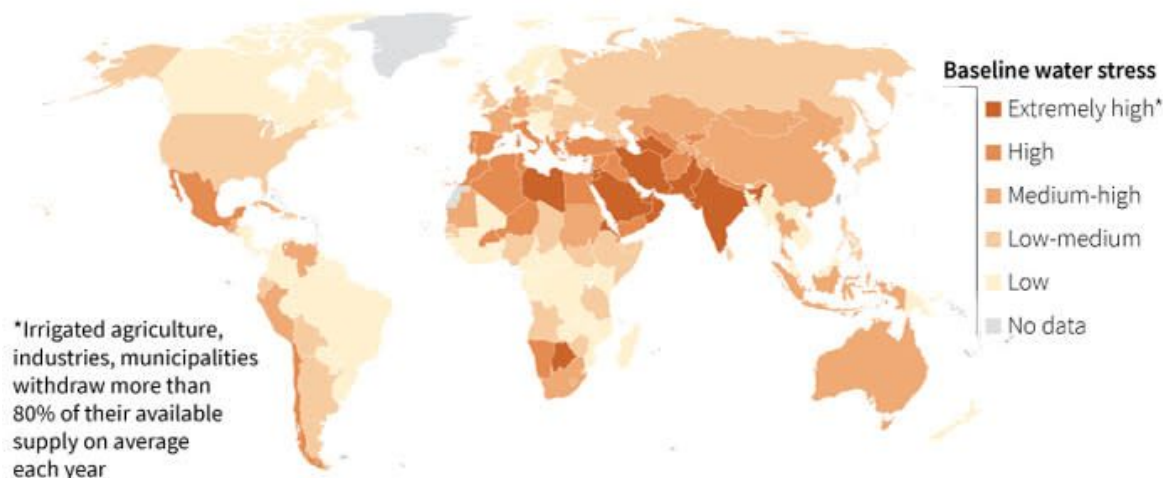
- **Water Surplus** - The supply of water **exceeds the demand** for water
- **Water Deficit** - The supply of water is **less than the demand** for water
- **Water Stress** - There could be a large enough volume of water to meet demand, but not enough clean, good quality water is available or the water is inaccessible.



Below is a map of global water **surplus** and **deficit**:

Water stress

17 countries -- home to nearly a quarter of the world's population -- face extremely high levels of water stress*



Comparing this graph to the country's **level of development**, you might see that the newly industrialised countries have the highest levels of water stress. **Newly industrialised countries** with extremely high levels of water stress include: India, Saudi Arabia and Iran.

MEDCs (such as the UK and Canada) have medium levels of water stress as they have a **high demand** for water for consumable goods, but the **efficiency** of their industries has also improved. Increased efficiency will reduce the amount of water used in industries and businesses, as well as reducing the amount of water wasted by households. On the other hand, **LEDs** (such as Zambia and Kenya) have **smaller scale industries** and tend to **conserve water**, using only what they need to use.

Water Security

Water security means to have a **clean, reliable** source of water that meets **demand** throughout the year. Therefore countries will suffer from water insecurity if:

- Their water source is **contaminated** or **polluted**
- Locals cannot **clean/purify** the water before drinking it
- The volume of water varies over the year due to **drought**, lack of rain or the water **freezes**



Source: Liberals Backward Thinking



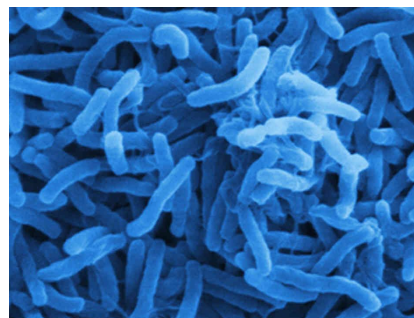
It is very important for a community to have a reliable, clean water source for their **health and wellbeing**, as well as for the **local economy**. Water insecurity can lead to **water stress**, when the volume of clean water falls below **1700m³ per person** per year.

The amount of clean water across the world is **decreasing**, whilst the consumption of water is greatly **increasing**. This is because the **world's population** is increasing massively. Also, some water sources are becoming **polluted** by industries. In addition, **climate change** is reducing the amount of rainfall in hot climates and also increasing the frequency of weather hazards, which can damage clean water supplies and increase water insecurity.



Impacts of Water Insecurity

- **Water-borne diseases**, such as Cholera and Typhoid, occur when pollution (especially unsanitary pollution such as **sewage**) contaminates a water source used for drinking. Symptoms of water-borne diseases include:
 - Diarrhea
 - Vomiting
 - Dehydration
 - Stomach Cramps



Source: NPR.org

In addition, contaminated water can become a breeding ground for **parasites**, such as mosquitoes (who carry **Malaria**) and worms. Water-borne disease can be **fatal**, resulting in **829,000** deaths around the world in 2016.

- Water shortages can impact **food and agriculture**, as crops need to be **irrigated** and cattle kept hydrated. **Droughts** can have a direct consequence in causing **crop failures** and reduces the yield produced, which in turn increases food insecurity in the world. In addition, other **industries** require a constant supply of water too. Businesses that require water may move to another country, causing **job losses**, if there isn't enough water available in a region.
- **Conflict** can occur over water supplies. This happens when the supply cannot meet the demand for a region. In the world today, there are **many disputes** over water sources between different states or between different countries. For example:
 - **The Nile** is the source of conflict between Egypt and Ethiopia, since Ethiopia plans to build a **dam** upstream to reduce water insecurity. Despite being the source of the river, Ethiopia has quite a **dry climate** and so has limited fresh water supplies, because most of the freshwater flows downstream to Egypt. However, the dam could starve Egypt of water further downstream. Egypt is especially worried about losing



Source: Food Collapse



water since its **population** is increasing rapidly. This has caused **conflict** between the two countries.

- In 2000, violent protests in **Bolivia** resulted in nine people being killed. This was caused by a **private company** taking control of the country's water supplies, which could be seen as a threat against water security (locals would need to pay to access water).



Source: Nato Council

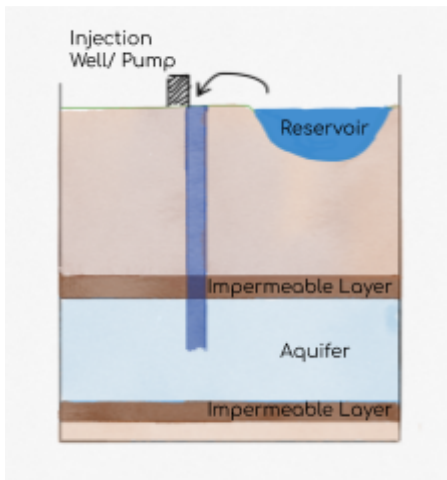
For further examples of water conflicts, take a look at this map produced by [World Water](#). It lists all small and large scale conflicts in the history of humanity up until the present day.



Strategies to Increase Water Supplies in the World

It's not just the UK that is trying to **increase the supply** of clean water available. There are many countries who are trying to reduce their **water insecurity**, to improve their population's health or to improve their country's economic development.

Underground Storage



Source: PMT

Description: In countries where surface evaporation is high, water is pumped underground and stored in aquifers.

- 👍 Reduces water loss due to evaporation, which could supply extra houses
- 👍 Works for infrequent rainfall, so water can be stored for times of no/little rainfall
- 👎 Expensive to construct and run constantly
- 👎 Are there any environmental problems with forcing water underground (tremors, similar to fracking)?

Dams and Reservoirs



Source: Basic Civil Engineering

Description: Naturally occurring valleys are dammed, so the river floods the valley and water is trapped till it is needed

- 👍 Dams control the river flow, and can reduce the risk of flooding downstream
- 👍 Electricity can be generated using the dam, through hydroelectric power
- 👎 Some villages and towns must be flooded to create the reservoir, meaning locals lose their homes
- 👎 Reservoirs can lose water from its surface through evaporation. This makes them unsuitable for hot climates



Water Transfer Schemes

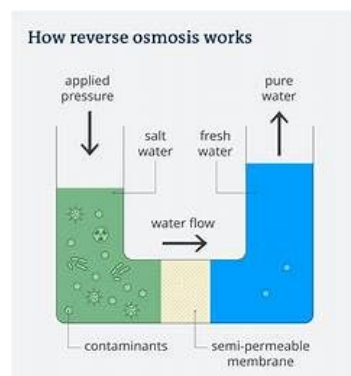


Source: Economist

Description: Water can be transported from areas of large supply to areas of large demand. This may be between states, or between countries where water is traded.

- 👍 Supplies large urban cities, where there isn't room to build large reservoirs
- 👍 For countries with surplus water supply, water trade can be very profitable (for example, [Lesotho](#))
- 👎 Very expensive to construct
- 👎 Risk of leakages, which would waste water and lose money. Because pipelines can be hundreds of kilometers long, it's difficult to find where the leak is

Desalination



Source: DW

Description: Salt water is converted into fresh water through reverse osmosis

- 👍 Increases the volume of freshwater available, especially in coastal areas where there are few lakes and freshwater stores
- 👍 New research uses [graphene](#) to make small scale desalination filters for households
- 👎 Desalination requires energy, which adds cost to cleaning water
- 👎 The waste brine is very concentrated, which could be hazardous when pumped back into the sea

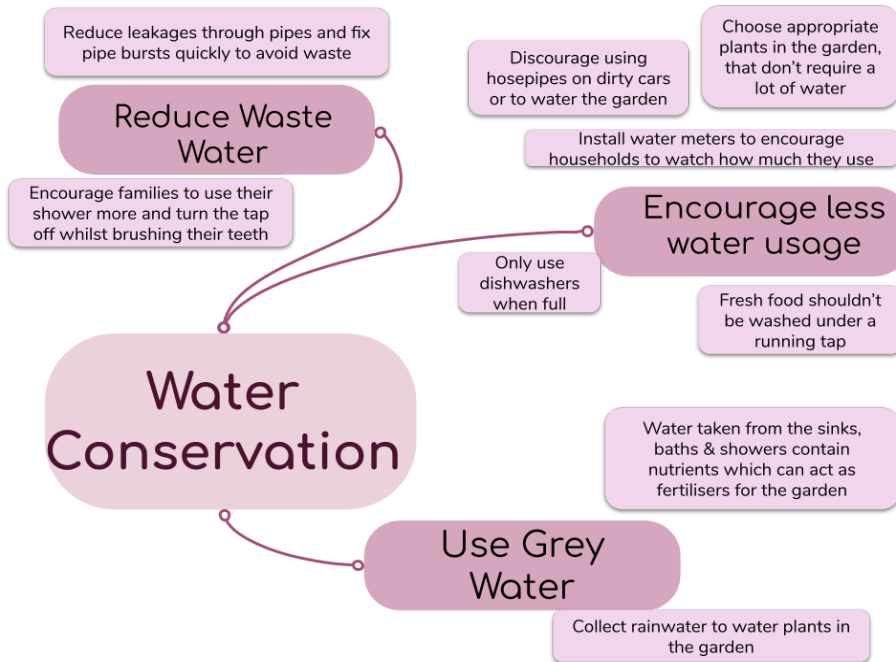
Sustainable Water Supply

The strategies above all **increase the supply** of water for areas of **high demand**. These strategies tend to be used for major **cities**, where there is a high population and existing water supplies are under high demand. But most strategies involve large **concrete constructions**, which releases **carbon dioxide** into the atmosphere, and any habitats or wildlife must migrate away from construction.

Therefore, some governments wish to look into more **sustainable** strategies. These schemes are also ideal for **smaller towns and villages**, who couldn't afford a reservoir or transfer scheme.

Water conservation can be an easy and cheap strategy to reduce the demand for clean water.





Other sustainable strategies include:

Groundwater Management

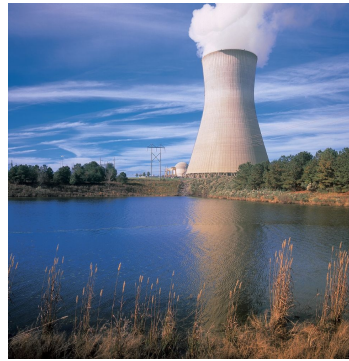


Source: water.ox.ac.uk

Description: Using laws to manage the number of water pumps to reduce the risk of over extraction from aquifers

- 👍 Reduces the risk of water being consumed and not replaced naturally (known as recharge)
- 👍 Reduces the risk of contamination. The lower the water levels in aquifers, the higher the risk of salt or pollution contaminating it
- 👎 Some people ignore laws, and continue to extract water illegally
- 👎 If there are too few pumps, water could be sold at an unfair price, which would increase water inequality

Recycling



Source: Joshua Kleind

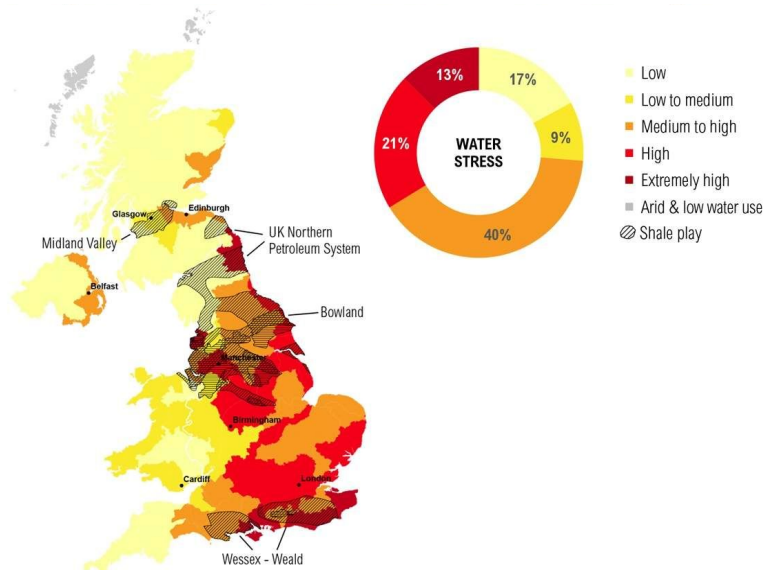
Description: Re-using domestic or industrial water, after treatment, in industrial cooling plants. Alternatively, sewage can be used in agriculture and farming

- 👍 Re-using water in industries can save many gallons of fresh water, that instead can be used for drinking
- 👍 Sewage in fish farming boosts algae, which feeds the fish, increasing the yield
- 👎 Some industries don't feel obliged to be sustainable. Also, treating the water increases its price



Water Provisions in the UK

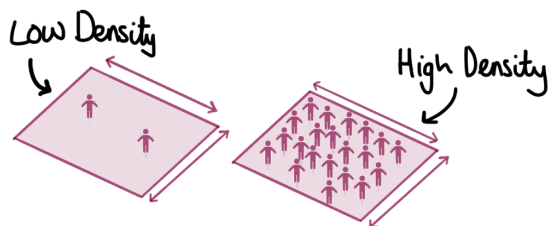
Most people would think that the UK has a good supply of water and shouldn't suffer from water stress, due to its **rainy maritime climate**. However, the rain does not fall on the entire UK evenly and factors such as the **growing population** and **water-intensive appliances** that we use in our house means that some areas do not have enough clean water. The map below shows the **water stress** for each region of Britain, where areas of **red** suffer from the greatest water stress.



www.wri.org/water-for-shale


 WORLD RESOURCES INSTITUTE

There are several factors that affect the water stress for a region:

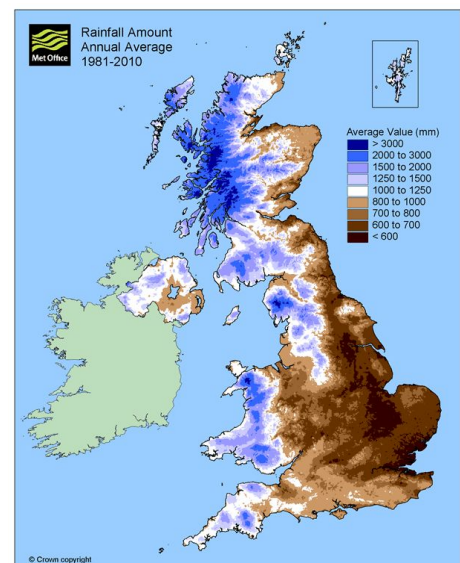


- Population density** is a measure of how many people live per area of land. If a region has a low population density, the demand for water per area is low. This is the case for North England and much of Scotland, where the population is spread out across the rural land.

- The amount of **rain** that falls in the UK isn't the same everywhere. Instead, the **precipitation levels** are high in **Scotland** and along the **west of England** and low in **South-East England**.

This is because weather systems (such as depressions) travelling from the **Atlantic Ocean** tend to be heavy with **moisture**, and lose this moisture over the first hills the weather system hits. In this case, rain tends to fall across the **Pennines** and the **Scottish Highlands**.

Therefore, the regions that have the highest demand for water don't receive the most rainfall!



- **21%** of the UK's water supply is **wasted** through leaks in pipe systems and wastage in the households. This is improving with advancing **technology**, such as dye for your drains or low-risk radiation. But because pipes are **underground**, it can be difficult to pinpoint the crack in a pipe and can continue leaking without anyone realising.

Water Management in the UK

There are several ways that the UK government and water companies are trying to reduce water stress:

- Increasing the amount of clean water available in areas of low rainfall,
e.g. Water Transfer Schemes, Reservoirs
- Reducing waste and improving the water efficiency of households
e.g. Increased Use of Grey Water, Government Campaigns
- Monitoring and protecting clean water supplies from pollution
e.g. Measuring water quality of rivers and reservoirs, Detecting Industrial Leakages into Water Supplies

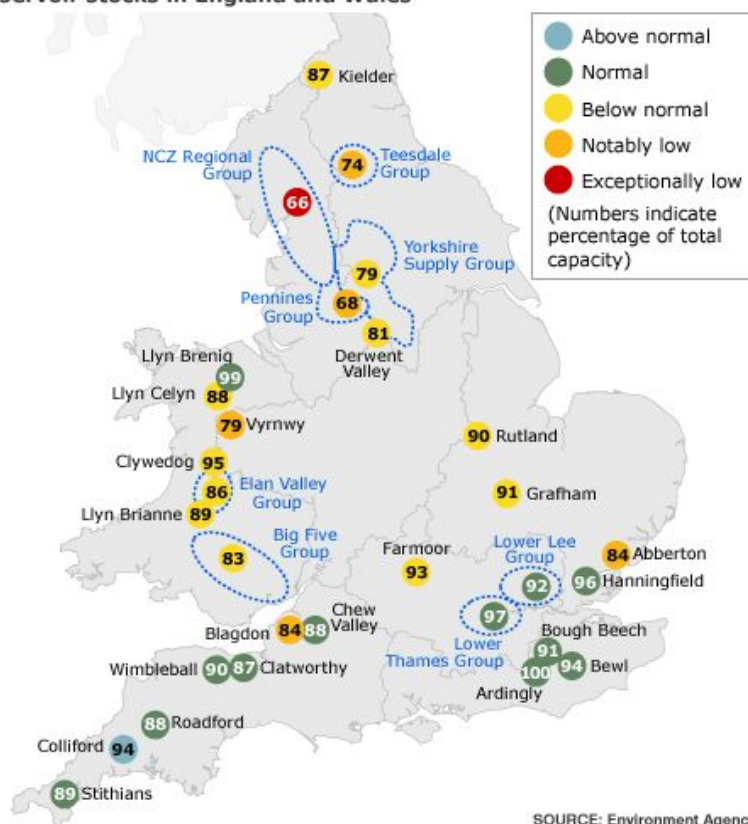
Water Transfer Schemes and Reservoirs

There are many **reservoirs** built across the UK. They are spread out to try to supply any nearby **cities** and reduce any **water inequality**.

The largest reservoir in the UK, **Kielder Water**, can hold up to **200 billion gallons** of water. The aim of a reservoir is to hold water after periods of high rainfall, so the water can be used in periods of low rainfall.

Many countries use **water transfer schemes** to connect water reservoirs in rural regions and transport water to a major city, where the supply of clean water is limited. However, in the UK, this has faced **opposition** and any schemes originally planned haven't begun.

Reservoir stocks in England and Wales



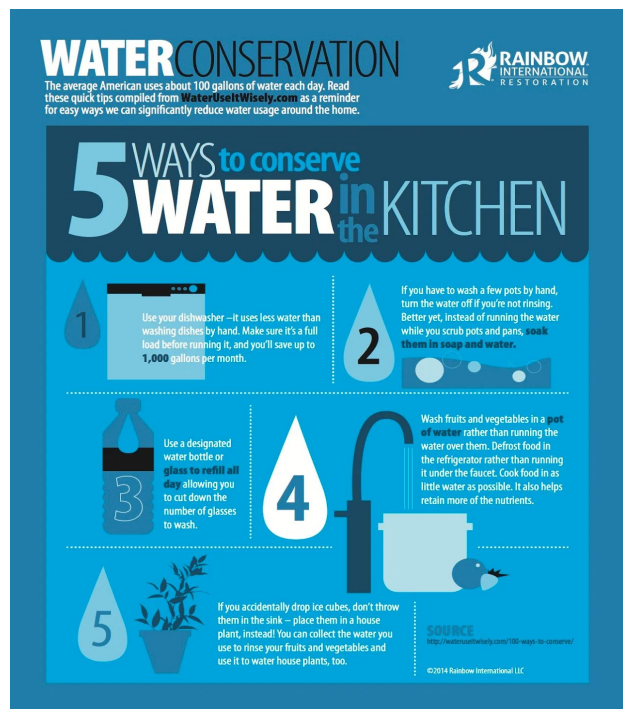
👍 Advantages	👎 Disadvantages
<ul style="list-style-type: none"> - Surplus water in the North of England could be used to supply London or Birmingham, rather than going to waste - Rural regions have more space for reservoirs than urban cities, so it would be cheaper to use land further away and pipe the water back to the city 	<ul style="list-style-type: none"> - Water transfer schemes are extremely expensive - Habitats and wildlife would be disrupted by the reservoir, as fish cannot migrate up the river if it has been dammed. Also, rural land would be built upon for the pipes, disrupting more UK wildlife. - Concrete used in engineering releases large amounts of carbon dioxide, which contributes to Climate Change.

Conserving Water

The UK Government has set up several **campaigns** over the last decade to try to reduce water **wastage** and limit household demand in the summer, when reservoirs are **at risk** of being emptied.

For example, from a young age UK school children are taught to **conserve water** in their lifestyle choices. This could be turning the tap off whilst you brush your teeth, or choosing to have a shower instead of a bath. These **marginal improvements** by each household add up for the entire UK population, making a difference to the demand of water.

Source: Our Greenish Life



WATER CONSERVATION
 The average American uses about 100 gallons of water each day. Read these quick tips compiled from WaterUseItWisely.com as a reminder for easy ways we can significantly reduce water usage around the home.

RAINBOW INTERNATIONAL RESTORATION

5 WAYS to conserve WATER in the KITCHEN

1. Use your dishwasher—it uses less water than washing dishes by hand. Make sure it's a full load before running it, and you'll save up to 1,000 gallons per month.
2. If you have to wash a few pots by hand, turn the water off if you're not rinsing. Better yet, instead of running the water while you scrub pots and pans, soak them in soap and water.
3. Use a designated water bottle or glass to refill all day allowing you to cut down the number of glasses to wash.
4. Wash fruits and vegetables in a pot of water rather than running the water over them. Defrost food in the refrigerator rather than running it under the faucet. Cook food in as little water as possible. It also helps retain more of the nutrients.
5. If you accidentally drop ice cubes, don't throw them in the sink—place them in a house plant, instead! You can collect the water you use to rinse your fruits and vegetables and use it to water house plants, too.

SOURCE
<http://www.rainbow.org/50-ways-to-conserve/>
 ©2014 Rainbow International LLC



Alternatively, **grey water** (water which isn't clean but hasn't got sewage in it - like shower water or washing up water) is becoming increasingly popular to reduce the demand for clean water. For example, some UK farms use grey water to **irrigate their crops**. Some households collect their own grey water using a water butt, to **water their gardens** instead of using a hose pipe.

Source: NY Times



Occasionally, during summers of **long drought** and **extremely low rainfall**, the government will ban the use of **hosepipes**. This is to reduce the unnecessary use of clean water, such as to fill up paddling pools or to clean cars. These measures are effective in conserving reservoirs' supplies and avoiding a **water deficit** in the UK.

Protecting Clean Water Supplies

The **Environmental Agency**, alongside water companies local to each region, **monitor** the UK's standard of water. It is important to protect waterways from pollution to protect the limited clean water supplies. The Environmental Agency will:



- **Regulate** water sports, stopping any sports in reservoirs to minimise rubbish in the water
- Monitoring rivers to reduce the risk of **pollution** being washed into a water supply
- **Filtering** and **purifying** water where necessary, such as adding chlorine or filtering out muds and sediments.

However, waste from **industries** can pollute a waterway. The biggest contributions to pollution in the UK are **disused mines** and **chemical fertilisers** used in farming.

