SL IB Geography

Your notes

5.4 Ocean Management Futures

Contents

5.4.1 Increasing Demand for Abiotic Resources

Your notes

What are Abiotic Resources?

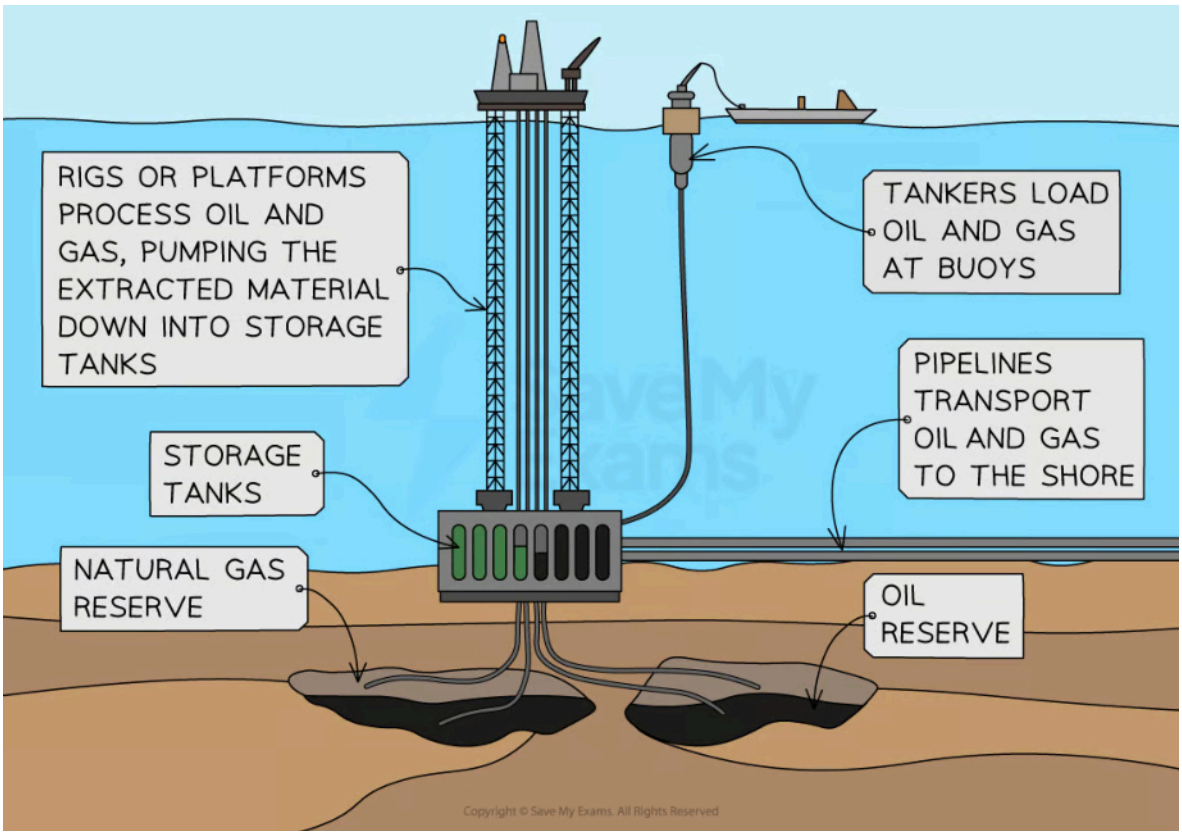
Abiotic resources

- Abiotic resources are **non-living** resources
- In the ocean, the main abiotic resources are **oil**, **gas** and **minerals**

Oil and gas

- The ocean houses tonnes of oil and gas, most of which is entirely **untouched**
- Oil and gas can be found under the continental shelf
- The Persian Gulf houses over ⅔ of the world's oil reserves
- **Offshore drilling** pumps oil and gas to the surface from deeper ocean reserves
- Infrastructure like **rigs** and **pipelines** are vital for collecting and transporting oil and gas

The process of oil and gas extraction from the ocean



The process of oil and gas extraction from the ocean

Your notes

Minerals

- Oceans house all sorts of minerals in different layers of the ocean
- Gold, copper, lead, silver, zinc and even diamonds are found on the ocean floor. They lie in the sediments transported by **wind, ocean currents** and **even melted icebergs**
- Sulphur deposits can be found in deep **rift valleys** or ocean ridges
- Many minerals wash into oceans from the land, so they can be found near the coastline
- Some are much further away. Mineral-rich (like iron or cobalt) nodules cover the abyssal plain
  - **Deep-sea dredging/vacuuming** extracts these minerals
- Gravel and salt are also extracted from oceans.
  - In flatter areas, water evaporates, leaving behind gravel and salt deposits
  - We use sea salt in our everyday cooking
  - Gravel extracts are used to make concrete or cement for infrastructure

Causes of Increased Demand

- Demand for abiotic resources is increasing
- As our world grows and technology improves, demand will rise

Increased use

- As economies **develop** further, demand for oil and gas increases
- Oil and gas are the building blocks of **industrialised** nations. They are vital resources for everything – whether that be cooking a meal or the entire **globalisation** process
- Even with the move towards **cleaner energy**, many of the products we use in our daily life come from oil
- For most countries, oil and gas are still the main source of fuel and energy
- **Seasonality** can influence increased demand. In wintertime, we use gas for heating and in summertime, we use it for cooling e.g. power plants
- Cleaner energy resources require metals from deep ocean stores e.g. electric cars or wind turbines
- Those ignoring climate warnings continue to extract deep oil and gas reserves

Technology

- Technology **needs** abiotic resources
  - We use deep-ocean minerals for everything in our daily lives, from small wiring to plane engines
  - We will even require deep sea minerals to build clean energy technologies
- Improvement in technology has made it significantly easier to extract abiotic resources
  - Monitoring seismic activity to extract oil is becoming more advanced
  - Underwater models can make it easier to extract materials
  - Automated drilling can increase the speed of extraction
  - Sensors for collecting important data are now much cheaper
  - Cloud computing makes it easier to deal with masses of data to increase efficiency

Consequences of Increased Demand

Positive and negative consequences of the increasing demand for abiotic resources

	Positive consequences	Negative consequences
Economic	With the advancement of extraction and monitoring technologies, it is much more **efficient** Oil, gas and mineral extraction is vital for the **global economy** and for the individual economies of nations It provides **employment** in a large industry	A drop in mineral worth causes **net losses** Demand may reduce as demand for **greener resources** rise Technological **malfunctions** can be incredibly costly
Environment	Minerals in the ocean are vital for the future of **clean energy** production Ocean extraction avoids major land alteration issues or deforestation, unlike terrestrial extraction The action of deep-sea mining causes less carbon emissions than terrestrial mining	**Contamination** from oil spills is harmful to marine biodiversity and can affect coastlines Oil spills damage coral reefs Burning of oil and gas is one of the main causes of **climate change** Oil supply will be depleted in some areas. This leads to exploration in more **remote** and **protected** areas, like the Arctic The ocean floor can be a **turbulent** environment. Mining for reserves may trigger earthquakes or tsunamis The ocean is an **unknown** environment – we don't know what kind of damage or species loss is occurring as a result
Geopolitical	Countries may collaborate in utilising abiotic resources, forming **diplomatic relationships** and increasing security Extracting resources can also bring **power** to a country. It is a **strategic** way of forming close relationships and allies	There are few regulations around deep-sea mining, which can cause **geopolitical disputes** Problems may arise from territory disputes. Many countries aim to claim territory with rich resources, like the Arctic

Your notes

	Vital **trade** and cooperation networks form through ocean extraction	Countries may extend their EEZ (Exclusive Economic Zone) to mine new, untouched areas of the ocean Other countries can dispute this with the UN, causing tensions or even conflict **Indigenous populations** are also put at risk by offshore exploration, e.g. displacement Environmental damage from ocean extraction leads to tensions over **sustainability** and **conservation**


Your notes

5.4.2 Trends in Use of Biotic Resources


Your notes

What are Biotic Resources?

Biotic resources

- Biotic resources are **living** resources
- In oceans biotic resources include small phytoplankton, fishes, crustaceans, mammals and any other living creature beneath the ocean's depths

Uses of biotic resources

- Fish and shellfish are the main constituents of **diets** across the world:
  - Food thickeners contain **sea algae**
  - Shampoos, creams and other cosmetics contain **seaweed**
- Phytoplankton is vital for **oxygen** production in the air that we breathe
- **Medicines** for all sorts of diseases contain **chemicals** from plants and animals in the ocean

Trends in Use of Biotic Resources


Your notes

- The use of biotic resources is increasing
- Increasing **demand** for biotic resources and the improvement of fishing technologies put pressure on the ocean environment
- With unsustainable fishing practices, global fishing stocks are **depleting**

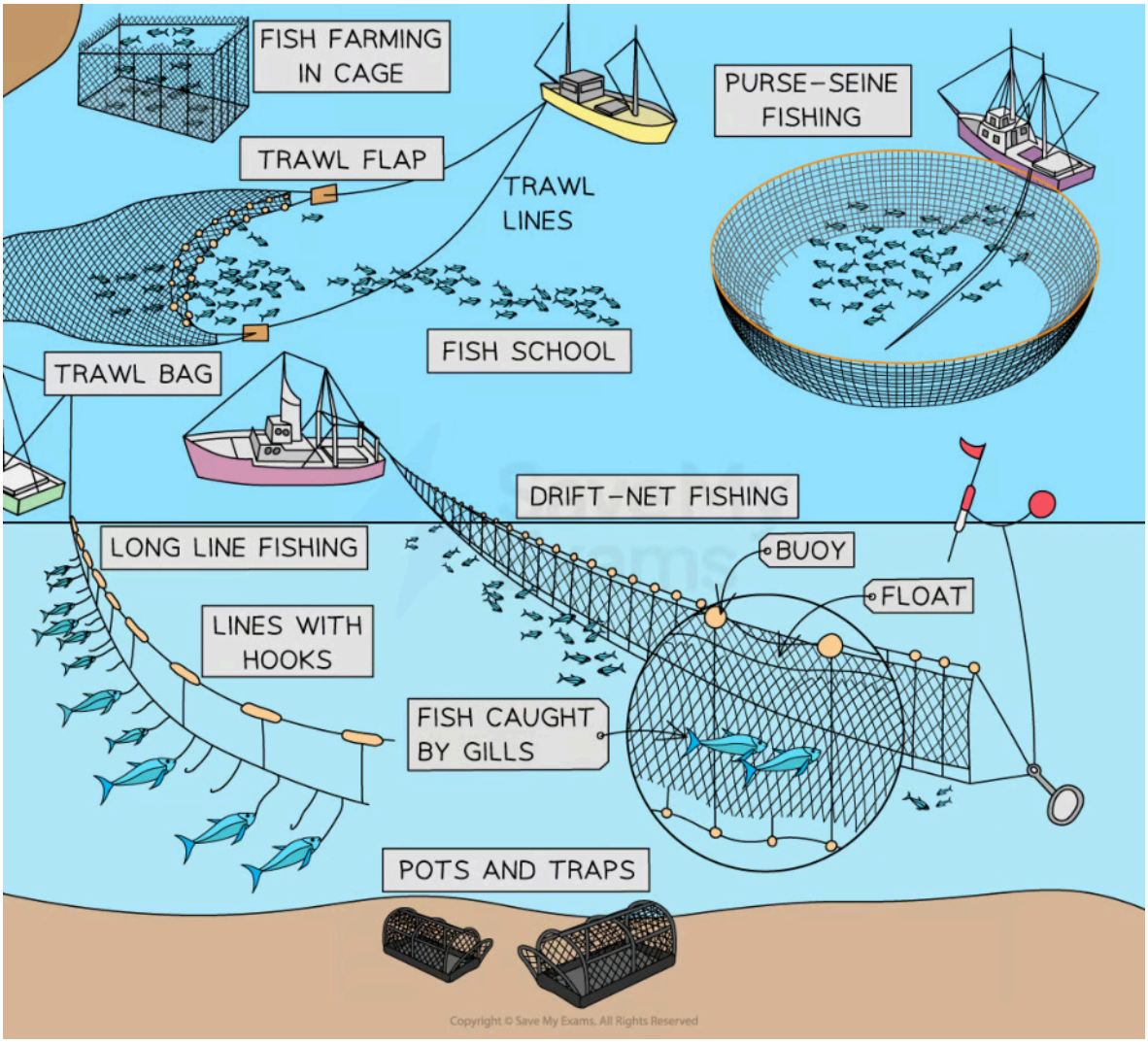
Overfishing

- **Overfishing** involves catching so many species that the **repopulation rate** can't keep up. This causes fish populations to deplete
- Valuable fishes like cod are in decline, whilst others are **endangered** or even **extinct**
- **Drift nets** are huge nets that move along the ocean, attached to floats on the ocean surface
- **Seine nets** operate from the coastline or boats. Large nets hang downwards, weighted at the bottom and connected to floats at the top
- **Traps and pots** line the seabed, ideal for catching crustaceans
- **Long-line fishing** involves a long line of wire (50–100km) with hooks attached. They can catch plenty of fish near the ocean surface
- **Bycatch**
  - Fishing nets are huge, typically used for commercial fishing in large quantities
  - A net used to catch small creatures, like shrimps, catches all sorts of other marine life, like turtles, dolphins or other fishes
  - Fishermen throw these "**spare**" dead animals back into the oceans
  - In some cases, bycatch can be larger than the overall net catch
- **Fish aggregating devices (FADs)**
  - FADs offer **shelter** for fish from other predators
  - They are used to attract fish to an area, where nets then catch the fish
  - They can be technologised beacons or just pieces of wood

Habitat destruction and pollution

- **Bottom trawling** involves dragging nets along the ocean floor
- This can damage the seafloor and other marine areas, including reefs
- Dragging heavy nets along the bottom of the ocean will pull up plant roots and disturb sediment
- **Dynamite baits** and **poison** are also destructive fishing techniques
- Fishing industries leave behind **ghost gear**, like nets, ropes and traps. This contributes to large percentages of **plastic pollution**
- This discarded material can still trap marine life and damage ecosystems

Overfishing of our oceans



Overfishing of our oceans

Exam Tip

Make sure you are aware of the trends in the use of biotic resources. As we use more, ocean numbers deplete. Think about what's causing it. Are fishing practices sustainable for the future?

Your notes

Alternatives to Overfishing

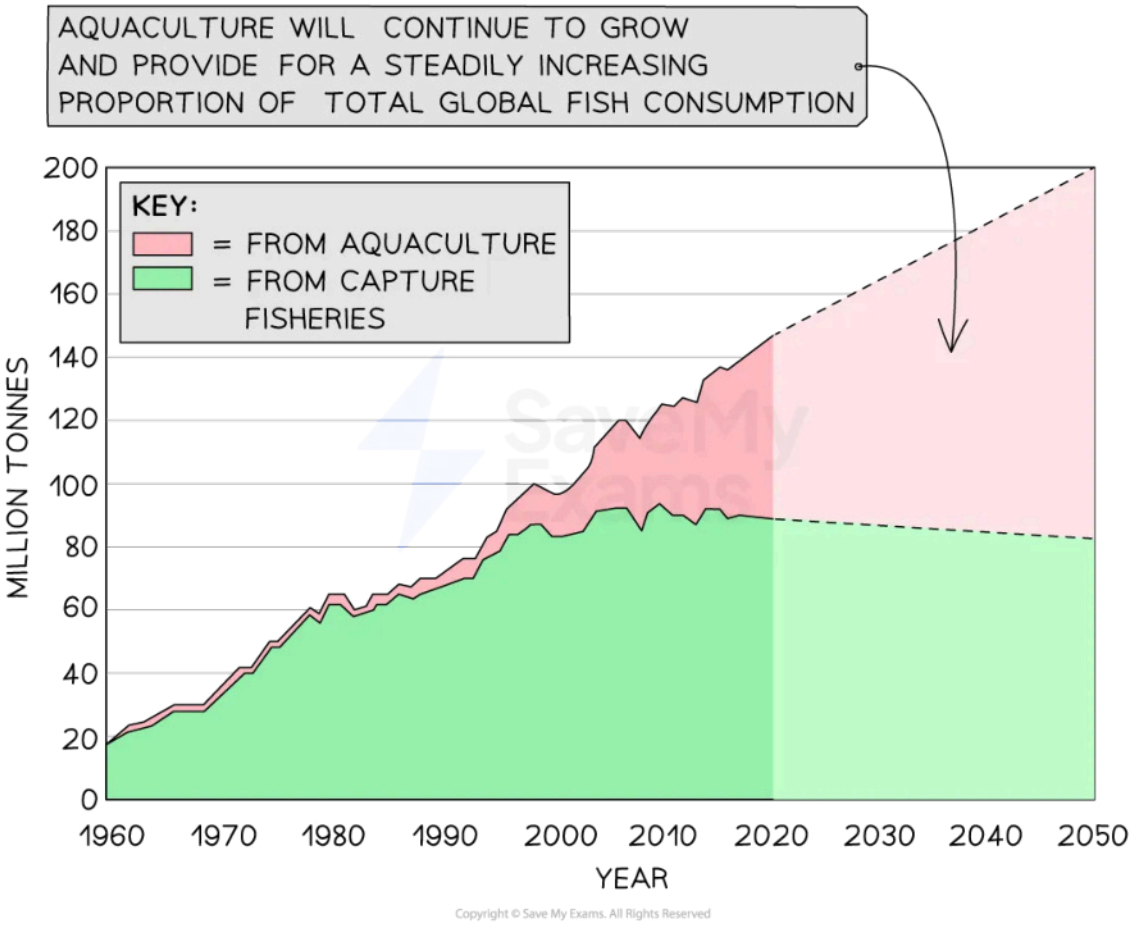

Your notes

Aquaculture

- Aquaculture is a useful **alternative** to overfishing
- Aquaculture is the **farming** of fish, crustaceans and marine plants in a controlled environment
- It is a **viable** modern innovation for aquatic seafood production
- It is a **solution** to counter the effects of mass overfishing and to increase yields to feed the population and reduce food insecurity
- Aquaculture is now one of the leading industries in food production
- However, there are **concerns** about pollution, deforestation, mangrove clearing and disease spread
- Some examples of aquaculture include:
  - **Pond systems** – artificial enclosed ponds to rear marine life like shellfish
  - **Open net pens** – man-made mesh enclosures floating on water bodies to rear fish
  - **Submersible net pens** – underwater cages to rear fish
  - **Recirculating systems** – indoor pond tanks with a water circulating system. The system moves waste water out, purifies it and reintroduces it back into the pond

The growth of aquaculture

Your notes



The growth of aquaculture

Sustainable fishing and conservation

- Sustainable fishing alternatives are vital for combatting overfishing, whilst also ensuring there is enough aquatic life in the future
- Getting involved on an **individual level**:
  - We can make better dietary choices like reducing seafood, choosing sustainably sourced seafood and minimising food waste
  - We can **educate** ourselves and others about the fishing industry and sustainability
- **Timed fishing**
  - Traditional fishing techniques by Indigenous People involve fishing at certain times of the year, historically managed by the tides and moon
  - Fishing at specific times of the year allows fish stock **replenishment**

- In some areas, fishing is **banned**

- **Sustainable technologies**
  - Traditional techniques can ensure direct catch with no risk of bycatch
  - **Reel and rod** fishing has developed from traditional hook-and-line. It minimises the amount of fish caught in one go and bycatch returns to the ocean quickly
  - Modern **spearfishing guns** mirror traditional spearfishing techniques, catching one fish at a time
  - **Floating fish traps** are nets held in place by anchors. Fish are "**caught**" without getting dangerously entangled. Any bycatch can be easily released
- **Monitoring overfishing**
  - Cameras attached to boats track fishing levels
  - **Remote Electronic Monitoring** helps to collect data about marine activity
- **Managing fisheries**
  - People at all levels work to manage fisheries
  - Many **stakeholders** value oceans differently, like fishermen, conservationists, and consumers
  - **International agreements** provide fishing laws to protect the oceans and reduce illegal fishing
- **Conservation areas**
  - Marine protected areas have particular **restrictions** on fishing activity, such as gear restrictions, fish species restrictions, and access restrictions
  - **No-take zones** are no-use areas**,** not just for fishing, but also for mining and other activities
  - Entering an area is forbidden during some parts of the year, like mating season
  - It can increase **productivity** in the area, develop more mature species (which lay more eggs) and increase species density
  - It **protects** the coral reef environment in the area


Your notes

Quotas

- **Quotas** are regulations set by governments concerning how much fishing can take place
- Governments or unions must meet the quota standards:
  - In the EU, Total Allowable Catch (TAC) provides a yearly fishing limit
  - This creates a fair balance for fishing industries, reducing competition and oversupply
- Quotas use **scientific information and advice** to create and enforce fishing regulations
- Some disputes may arise from transferring quotas between nations and individual people
- Quotas are a good sustainable method to combat overfishing

5.4.3 Management of Ocean Pollution

Your notes

Strengths and weaknesses of Management Initiatives

- Oil, plastic and radioactive waste pollute our oceans
- Management of ocean pollution takes place on local and global scales
- Individual consumers can minimise their impact on ocean pollution
- International treaties and conventions act as global strategies to reduce pollution problems
- Solving these issues is a large task for the future

Oil spills

- Oil spills come from oil rigs and tankers onshore and offshore
- Sometimes they are **accidental**, but in some cases, they can be **purposeful**
- Oil spills are **devastating** for the environment and marine life
  - Oil stops animal fur from keeping in heat and bird feathers from keeping out water, so animals are at risk of death from hypothermia
  - Oil is also poisonous to marine life
  - Even if not directly ingested, it enters the water column or food chain. Animals suffer from stunted growth, heart or lung issues and loss of reproductive abilities
- Oil spill cleanups can have negative effects on human health

Managing oil spills

Strategy	Description	Strengths	Weaknesses
Dispersion	Dispersion is the addition of chemicals to separate oil into smaller droplets, to help remove the oil from the water	Useful for removing oil from the surface waters of the ocean Smaller oil particles **biodegrade** more easily	Chemicals may also damage human and marine health Dispersants increase the amount of oil in the water column. They enter the food chain and can damage the environment e.g. coral reefs
Burning	Setting oil alight whilst it is still in the ocean. Floating "booms" stop the oil from spreading further	It is an efficient method, removing most of the oil from the ocean Don't need to use other resources to collect and store the oil	Emits toxic gases and causes **pollution** Can injure or kill wildlife in the region of the fire Toxic pollutants affect wildlife

Skimming	Skimmers attached to boats drag the oil off the ocean surface	Some skimmers can work with all types of oil thickness Some skimmers are very efficient in calm waters	Skimmers can be easily blocked by debris They need constant management They are ineffective in rough waters, as more water enters the skimmer than oil
Containment	Floating fences (**booms**) that stop the oil from spreading further	Some booms can soak up some of the oil spills They are useful when the water is calmer They cause the oil to merge in one place, making it easier for other collection methods	They are costly and difficult to manage They only keep the oil in one place; another method is required to remove the oil In rough conditions, the moving water and wind can cause the oil to spill out over the boom

Your notes

Plastic pollution

- Around **20 million tonnes** of plastic can be found in oceans per year
- The causes of plastic pollution include:
  - River runoff, sewage outputs and wind transportation
  - Plastic dumping
  - Industry (fishing)
  - Poor management of waste disposal
- Plastic can kill marine life:
  - Animals **ingest** pieces of plastic and plastic bags
  - Animals can become **entangled** in things like packaging or discarded fishing nets
  - Phytoplankton and even coral polyps can ingest microplastics

Managing plastic pollution

Strategy	Description	Strengths	Weaknesses

Consumer consciousness	Reducing your plastic waste, boycotting products, taking part in beach cleanups, supporting organisations	Beach cleanups minimise the amount of plastic reaching the ocean Elicits a feel-good factor Minimises plastic entering the system	Tackles the problem on a smaller level Needs lots of people to get involved
The Ocean Cleanup	An organisation using technology systems to clean up the Great Pacific Garbage Patch. The system involves a large floating barrage that scoops plastic up. The material is collected and sorted for recycling	It is reducing the plastic in our ocean It is a non-profit organisation The upgraded second system has removed enough rubbish to fill the country of Luxembourg	Uses ships that pollute the air with carbon dioxide Can harm ecosystems that float on the ocean surface Might not be that effective in collecting microplastics In the first system, it proved difficult to keep the plastic inside the barrages
River interceptors	Machines that sit at river mouths pick up rubbish before it enters the ocean. The Ocean Cleanup has created these technologies to trap material	Different technologies exist to cater to rivers of different sizes and types Solar powered	May not be stable during bad weather, resulting in pollution of the waterways The entrance is quite small; some larger debris may not fit


Your notes

Changing the plastic industry	Phasing out plastic, improving recycling technologies and ensuring plastic can break down more easily	Reduces pollution and the use of vital resources Creates jobs in new plastic and recycling industries	It is a huge task, involving all industries across the world Possibly an unrealistic solution


Your notes

Radioactive materials

- Nuclear waste typically comes from nuclear **power stations** or **mining**
- It can be solid, liquid or gas
- Radioactive material can stay radioactive for hundreds of years
- Contamination of marine life can occur through the **food chain**
- **Contaminated organisms** may make their way into clean waters
- Humans consume this radiation by eating contaminated fish
- Earthquakes and tsunamis can exacerbate radioactive waste leaks
- There are no real solutions for dealing with nuclear waste; it is an unknown territory
- There are global conventions and laws in place concerning the disposal of nuclear waste e.g. the London Convention

Possibilities for managing radioactive waste

Strategy	Description	Strengths	Weaknesses
Storage	Using concrete or glass to keep the radioactive waste trapped inside; buried in sediment in the ocean or in containers under the ocean	Stops waste leaking into the surrounding waters Radioactive material settles in the clay sediment, undisturbed Burying the material even deeper is much safer, protecting humans	If storage is not undertaken properly, it can be catastrophic Containers can decay Deep sea burial is not yet legal Ocean pressure could damage containers
Waiting time	Keeping material on the land until radiation levels go down	This means that the material doesn't have high radiation levels when entering the ocean	This can take a very long time

			This isn't a very viable option Impacted by laws and conventions

Your notes

Exam Tip

Make sure you know the types of pollution and the effects they cause. You might be asked to discuss the sources and issues of ocean pollution.

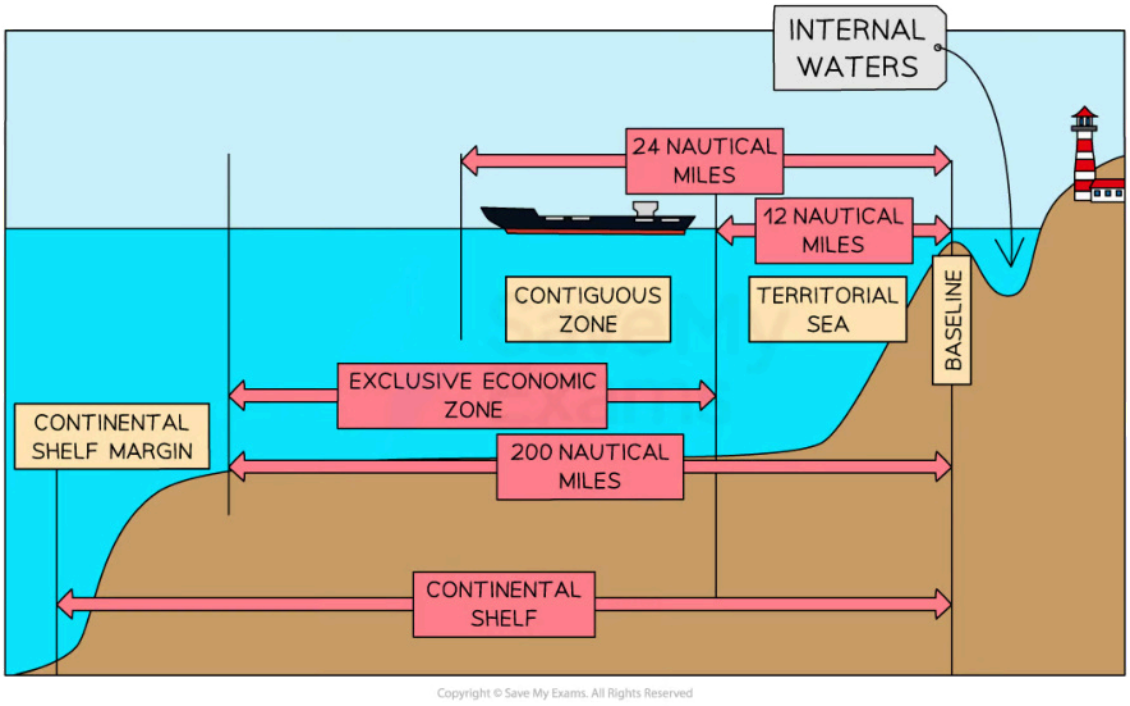
Global strategies

United Nations Convention on the Law of the Sea (UNCLOS)

Your notes

- A convention created in **1982**
- It is the **law** and **governance** of all oceans and resources
- The convention separates the ocean into 5 marine areas:
  - Internal waters
  - Territorial sea
  - Contiguous Zone
  - Exclusive Economic Zone
  - High seas

The Maritime Zones of UNCLOS



The Maritime Zones of UNCLOS

- Different laws operate in each marine area, with guidance for the responsibilities of governments and states
- The convention guidance includes:
  - Territory limits
  - Ship passages

- Conservation and management
- Protection
- Dispute settlement
- Resource use
- Marine research

- **UNCLOS** has 168 signatures from states or other governing bodies
- **UNCLOS** states that all signatories should do everything possible to:
  - Take all measures possible to minimise pollution
  - Analyse the scientific effects and consequences of pollution
  - Enforce laws and restrictions to combat pollution
- It has been a **successful** initiative to support states in reducing ocean pollution
- On the other hand, this guidance is **extensive** and **vague**
- A "**take into account**" strategy of certain international rules and guidelines results in the state's decision on what or how many restrictions operate


Your notes

International Convention for the Prevention of Pollution from Ships (MARPOL)

- **MARPOL** deals with reducing pollution from ships
- This convention was created in 1973
- It provides regulations to all ships with the **flag** of a country that signed the convention
- It provides six **annexes**, working to prevent pollution from:
  - Oil
  - Noxious substances
  - Substances in packages
  - Sewage
  - Garbage
  - Air pollution
- It aims to make sure that transport via ship is the least damaging form of transport to the environment
- It has **successfully** reduced shipping pollution
- If there are violations of MARPOL, it can result in fines, probation and even imprisonment
- In some cases, the **flag system** is an issue. Some vessels fly the flag of a country that has weaker laws (**Flags of Convenience or FOC**):
  - These are typically developing countries
  - There is not enough money to regulate ships or care about pollution

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)

- This convention aimed to reduce waste dumping in ocean waters, including plastic
- It was created in 1975
- It aims to control and stop waste pollution
- In 1996, the convention added the **London Protocol**, which **banned** waste dumping (with some exceptions)

- It provides guidance and advice on dumping and how to deal with waste
- In 2006, the **London Protocol** became the official name
- It provides a **complete ban** on radioactive waste and sewage sludge dumping
- However, radioactive dumping may still be occurring e.g. Fukushima began pumping wastewater into the ocean in 2023


Your notes

5.4.4 Value of Oceans

Your notes

Strategic Value of Oceans

- Oceans are valuable places, particularly for global superpowers
- They are vital for economies, maritime trade and security

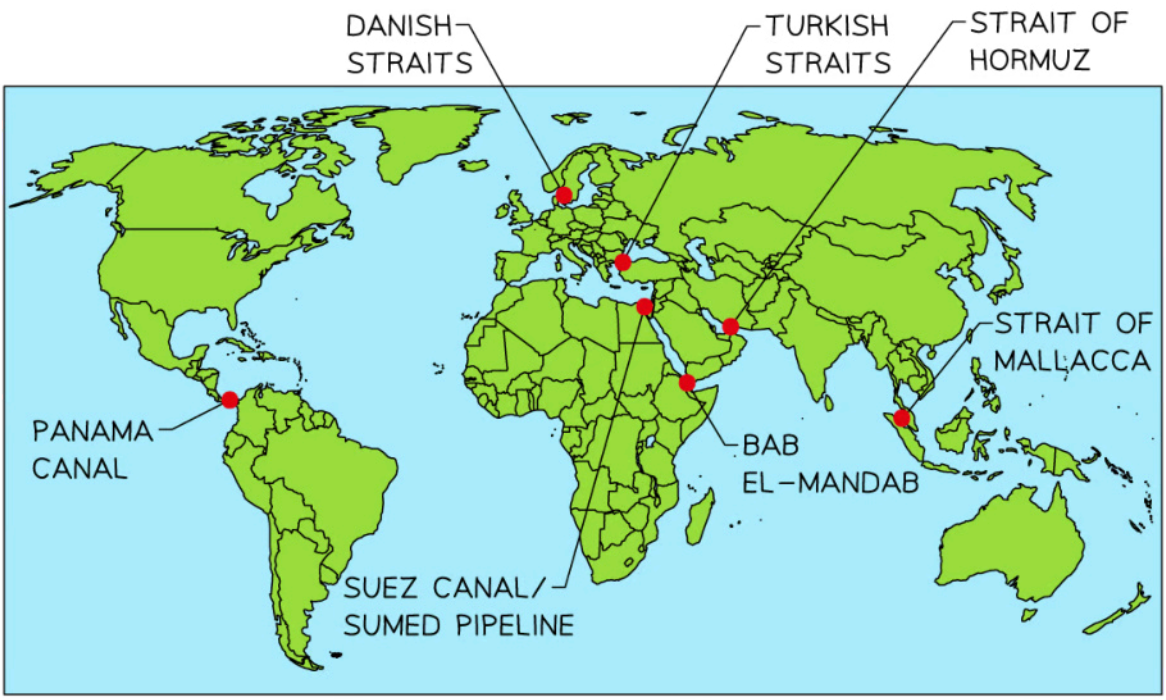
Economic Value

- Oceans have extensive economic value
- They provide **trade routes** around the world. Roughly 80–90% of all trade around the world moves through the oceans
- This movement of goods sustains the **world's economy**
- It is a building block of **globalisation**

Security

- **Oil transit chokepoints** are channels inside trade routes
- Some chokepoints are canals, which act as shortcuts for trade routes
  - Over 60% of world oil is transported via the sea
  - Chokepoints must remain open to ensure energy security and reduce **international conflict**
  - Examples of chokepoints include:
    - Strait of Hormuz
    - Strait of Malacca
    - Suez Canal
    - Panama Canal
- Stronger **maritime powers** can control chokepoints and routes, increasing the country's security
- Countries like China, India, the UK and the US are global maritime powers. They have a significant **naval military force**:
  - Having military control over chokepoints and routes makes a country much more powerful. They are ideal for attack and defence strategies

Global Transit Chokepoints



Global Transit Chokepoints

Your notes

Sources of International Conflict


Your notes

- Oceans are areas of international conflict
- Conflicts at sea can impact global superpowers and the world economy

Transit chokepoints, canals and islands

- If chokepoints close, it can cause huge problems for the world economy and countries that depend upon oil imports
- Some countries can **threaten** to close chokepoints, which could cause a huge rise in oil prices:
  - Ships and tankers would need to find an alternative route, one which is typically much longer
  - In 2012, Iran threatened the blockage of the Strait of Hormuz
- Sometimes, large shipping vessels get **trapped** in the chokepoints:
  - In 2021, the *Ever Given* ship blocked the Suez Canal
  - This caused major disruption of goods transportation
- Political turmoil exists (and has existed) at canal and transit chokepoints, where countries rival over ownership and power:
  - Iran has conflict with the UAE over the Strait of Hormuz:
    - Iran controls most of the islands in the strait, yet the UAE demand their sovereignty
    - These islands are vital for the control of the chokepoint
  - The Suez Crisis in 1956 involved Britain, France and Israel invading Egypt to claim control of the Suez Canal:
    - In the end, Egypt won, leaving a trail of political issues for Britain

Piracy and terrorism

- Chokepoints are often at risk from piracy and terrorism
- Piracy takes place out of the **territorial watermark** (of the **UNCLOS Maritime Zones**)
- **Pirates** hijack ships, capture the crew and goods and hold them as ransom
- Chokepoints are typical places for marine **terrorist attacks** to take place

Resource exploitation

- Oceans contain vast amounts of resources
- Both **biotic** and **abiotic** resources from oceans are vital
- **Exploitation** of these resources occurs daily
- Many **conflicts** occur as a result of resource exploitation and claims for territory
- With **climate change** and risks to **food security**, resource conflicts will inevitably rise

Case Study: South China Sea

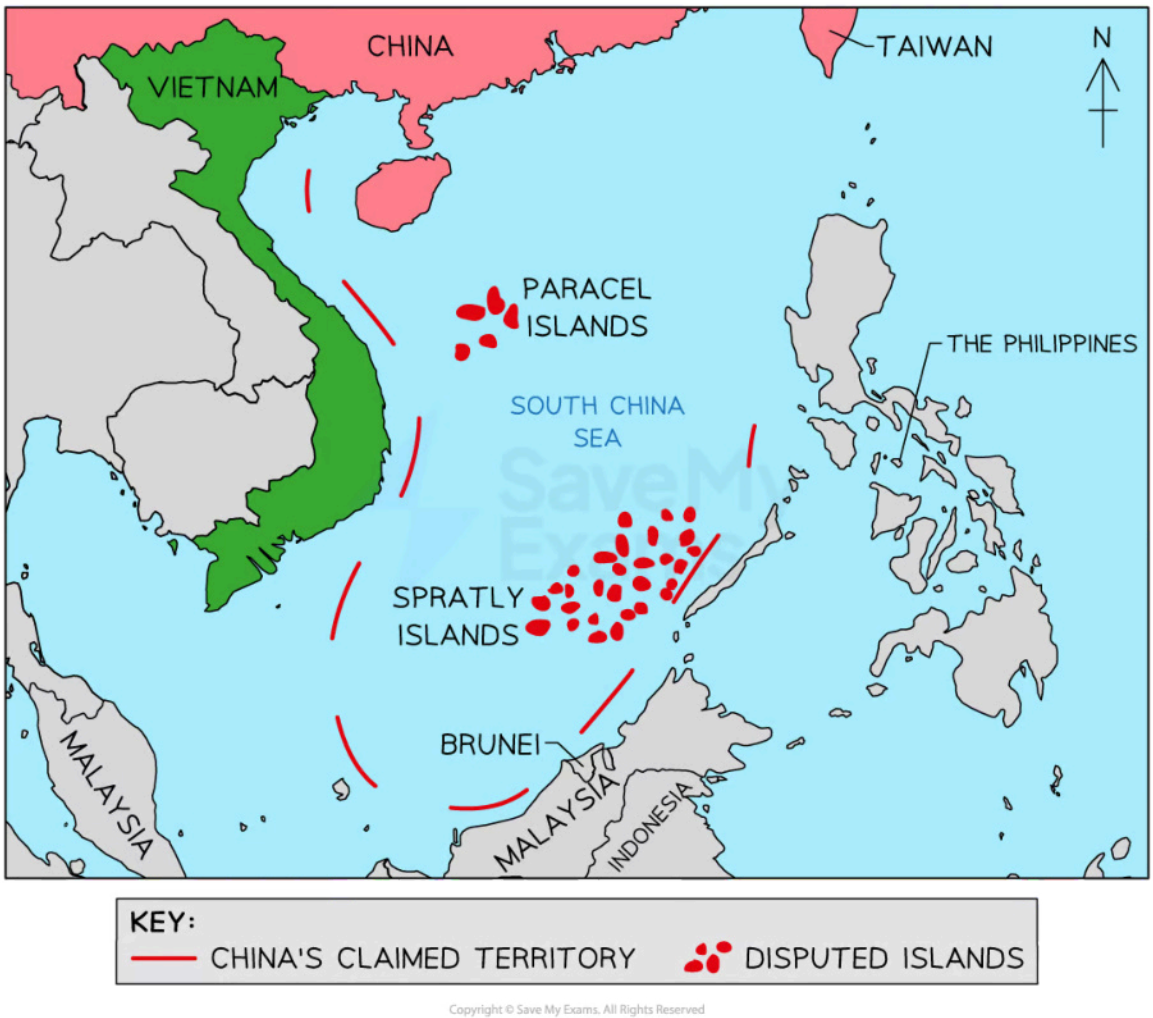

Your notes

The South China Sea

- The South China Sea is a **contested environment**
- China states that they have ownership over the majority of the sea, marked by the **9-dash line**
- Countries like Taiwan and Vietnam **contest** the 9-dash line
- The vagueness of the intentions of China's 9-dash line raises questions over territorial claim, sovereignty and resource use
- In a **2016 tribunal** between the Philippines and China, the 9-dash line was legally proven insignificant, but China still believes it to be true
- Maps of the area now conflict with each other
- China continues to assert its dominance, ignoring the legal outcome of the 9-dash line

China's 9-dash line and conflicted islands

Your notes



China's 9-dash line and conflicted islands

Value

- **Trade**
  - The South China Sea links the Pacific and Indian Ocean
  - It is a **crucial trade route** for resources like oil and gas
  - Economies in the area are dependent on the sea for **importing** and **exporting** goods
- **Resources**
  - It is a very **biodiverse** environment
  - There is a bounty of fish in this area. Roughly 12% of the world's fishing takes place here
  - This brings **food security** and **economic growth** to the surrounding areas

- The area could also be a huge **deposit** of oil and gas, yet to be explored

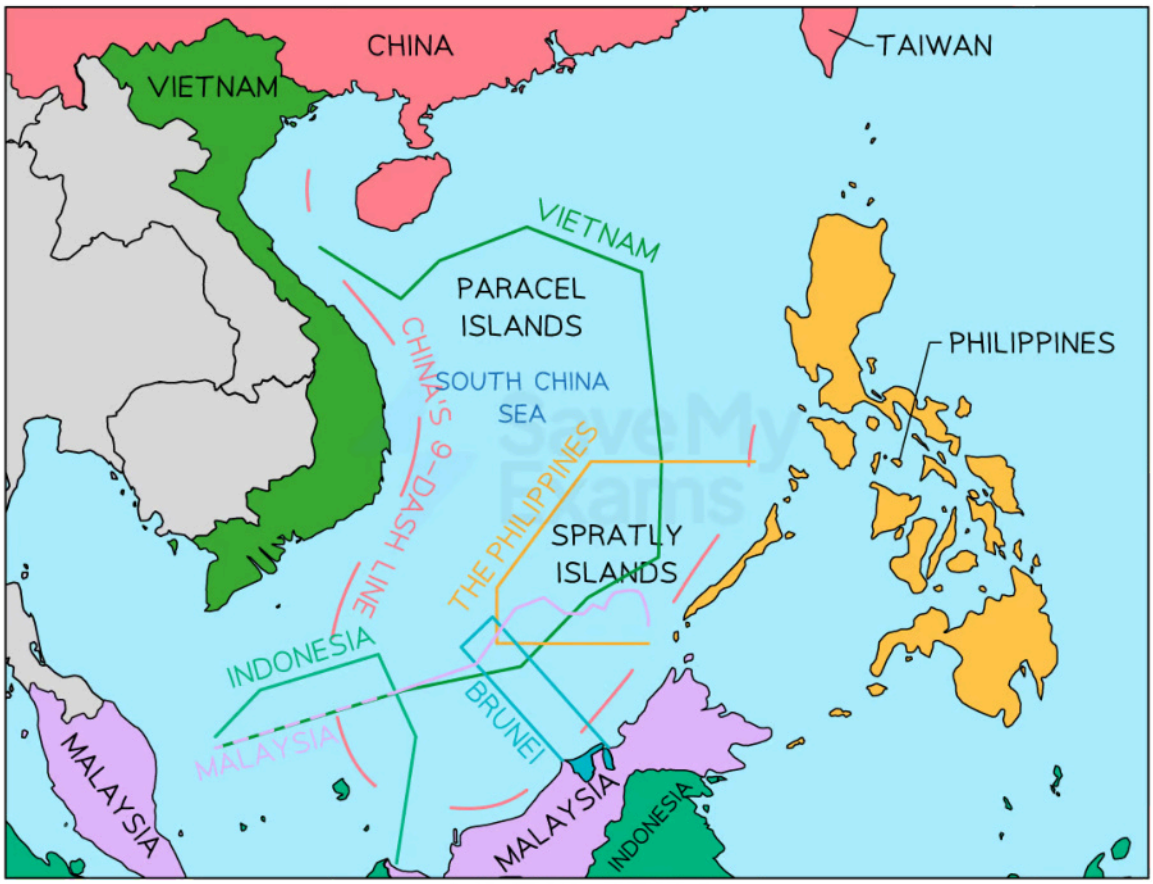
Competition

- There are major **sovereignty** conflicts over the Islands in the South China Sea e.g. the Spratly Islands and the Paracel Islands
- Ownership of these islands belongs to Taiwan, China, Vietnam, Malaysia, The Philippines and Brunei
- Troops are stationed in these islands from all countries except Brunei
- Much of China's land lies under the water:
  - To combat this, China is **building islands** on coral reefs for military bases
  - China are also increasing their **military presence** around the islands
  - This poses a threat to superpowers like the US:
    - **Sea Lines of Communication (SLOCs)** run through the South China Sea
    - These are used for trade and naval movement – it is a vital area for the US
  - The US is increasing its military presence, as China poses a **threat**
  - China's military presence in the South China Sea is still **dominant**
  - Although war could occur, both sides value the **importance** of the area
- The states all claim different areas, **overlapping** each other. This, combined with the so-called 9-dash line, creates a very complicated map

Competing claims in the South China Sea


Your notes

Your notes



Competing claims in the South China Sea

- Despite their being a **tribunal**, which gave other states the power to claim territory, China continues to reject it
- As China is a member of the **UN Security Council**, the country would have the ability to get rid of any sanctions posed upon it for ignoring the tribunal
- **Future conflicts** could occur as China continues to mark its sovereignty of the area, whilst surrounding states use the waters for resource exploitation