CHAPTER 5

OCEAN AND FISHERIES

Oceans are very important part of life on Earth. They are sources of:

- **Food:** fish that includes true fish, finfish, shellfish and other sea animals that can be eaten.
- The main fisheries are located on the continental shelves because the water is shallow there, so light can penetrate and there is more oxygen as well as nutrients are abundant on the shelf.
- **Chemicals and building materials:** many materials in the oceans have been eroded from the land, where rain and wind break down rocks, and are carried into the oceans via rivers.
- Some substances can be extracted directly e.g. salt, magnesium, tin, gold, titanium, diamonds.
 - **Salt**: seawater that is left behind over many weeks in the hot sun.
 - **Diamonds**: found in greater numbers in ocean floor than on land.

• Much harder to mine ocean floor as it must be dredged, then the sediment silted.

- **Sand, gravel and crushed rock:** mined for the construction industry.

• Physical damage can be caused to seabed and associated habitats if care is not taken.

- Fine particle clouds that are produced resettle and interfere with photosynthesis, they also act as a source of heavy metals that can enter food chains.
- **Oil:** chemical that is extracted by offshore drilling rigs.
- **Wave energy:** an enormous amount of energy in the waves is estimated to produce twice the present world energy production if harnessed.

- **Tidal energy**: due to varying gravitational pull of the sun and moon, water in the sea moves up and down on a twice-daily basis. This causes it to come onto land and later recede, which can be harnessed to generate electricity.
- **Tourism:** seaside is a major tourist attraction. People of MEDCs are attracted to marine sites of great natural beauty, especially coral reefs.
- Diving, snorkeling, windsurfing, jet skiing and deep-sea fishing or simply sunbathing on the beach are some adventurous activities.
- There's business in boat trips to view sea creatures, especially whales and dolphins.
- Transport: ships are important to transport people and goods; however, shipping is less common to transport people now due to the advent of aviation.
- Pleasure cruises are still an important economic sector and bulk freight is best transported from country to country on ships.

SHIP TYPE	LOAD OR PURPOSE
Bulk carriers	Transport of food such as rice and wheat.
Container ships	Entire load is carried in lorry-sized containers, known as containerisation.
Tankers	 Transport of fluids, especially liquefied petroleum gas and liquefied natural gas. Transport of vegetable oils and wine.
Refrigerated ships	Transport of perishable items such as vegetables, fruits, fish and dairy products.
Roll-on/roll-off ships	Transport of vehicles, together with their loads, that can be driven on and off the ship.

• Types of merchant (goods carrying) ships:

Coastal trading vessels	Used for trade between places that are close together, especially in island
	groups.
Ferries	Used for mainly for the movement of
	foot passengers, sometimes with their
	cars, mainly between islands or
	between mainland and islands.
Cruise ships	Used for pleasure voyages where the
	facilities on the ship are a crucial part
	of the trip.
Ocean liner	Used to transport people from one port
	to another.

- **Potential for safe drinking water:** only small proportion of water is safe to drink.
- Salty water is unsafe as your body must remove the salt, requiring more water.
- Purification of water is possible by desalination.

Assessment: text book p. 116 qu. 5.1-5.3

World fisheries

Major ocean currents:

- **Surface currents**: movement of the surface water of the sea in a constant direction.
- **Prevailing wind**: the direction from which the wind nearly always blows in a particular area.
- Currents in the southern hemisphere are generally anticlockwise as the winds blow from the south-east and force the western Australian, Benguela, and Peruvian current northwards.
 - **Cold currents**: come from the poles.
 - **Warm currents**: come from the tropics or either side of the equator.



Currents of the world

Finding fish

• Main fisheries are located on continental shelves where water is shallow (<150m below sea level), allowing light to penetrate with plentiful oxygen than further below.



The continental shelf

- Herbivorous fish rely on primary producers, mainly green algae called phytoplankton. Carnivorous fish eat the herbivorous ones or other carnivores.
- There're parts of the food web, starting with the phytoplankton. Thus, fish are found where there are plentiful phytoplankton.
- Phytoplankton produce their own food by photosynthesis which requires light, water and carbon dioxide (CO2).
- Water is abundant in the oceans and CO2 dissolves in the water from the atmosphere, therefore light is likely to be the limiting factor for photosynthesis.

• Most ocean water has absorbed all the sunlight by a depth of only 200m. This 200m deep zone is called the **euphotic zone**, below which photosynthesis will not take place.

Not all areas with continental shelves have significant fisheries because:

- Phytoplankton need not just light, CO2 and water, which allow it to make carbohydrates such as sugars, but they also require mineral nutrients to make proteins.
- Making proteins requires a source of nitrogen and sulfur.
- Nucleic acids, which form the genes of living things, also require phosphorus.
- The green pigment chlorophyll, which is essential for photosynthesis, requires magnesium.
- The most important fisheries of the world are where the current system stirs up decaying material from the seabed, which is rich in nutrients.
- **Upwelling**: areas where minerals at the ocean floor are brought up to the surface by currents.
- An example is the Peruvian anchovy off the west coast of South America.



This graphic shows how displaced surface waters are replaced by cold, nutrient-rich water that "wells up" from below. Conditions are optimal for upwelling along the coast when winds blow along the shore.

- This upwelling is distured once every 10-15 years by an event called **El Nino Southern Oscillation (ENSO).**
- **El Niño Southern Oscillation (ENSO):** the change in the prevailing winds that leads to change in the pattern of currents in the oceans of the South Pacific.
- Warm nutrient-poor water comes into the region from the equator.
- Results in no upwelling of the cold, nutrient rich water that supports the anchovy fishery.
- No nutrients mean the phytoplankton do not grow well, so there's less food for the fish.
- Much of the production of the anchovy fishery was used for fishmeal which is used to feed farmed fish, thus countries where this is important, are affected by a crash in the anchovy fishery.

Assessment: text book, page 121, qu. 5.4 -

5.6 Impact of exploitation of the oceans

• Causes of overfishing of marine fish species:

- Demand for fish as food due to increasing world population;
- Much bigger boats, which can work a long way from a port for many weeks;
- Finding fish easily by using SONAR and detailed weather data;
- Creation of huge nets that scoop up everything in an area, often half of which is discarded as bycatch (animals caught by fishers that are not the intended target of their fishing effort).

• Impact of overfishing of marine fish species:

- Lack of growth in fish caught globally since 1990s, leading to loss of job and reduction in food supply;
- Size of fish gets progressively smaller, increasing demand for food;
- Harvest of untargeted/protected/endangered marine species that are discarded at the sea or shore;
- Reduction in marine biodiversity, causing a disruption in food chain.
- Nets;
- **TRAWL NET** (INCLUDING BOTTOM TRAWL NETS): Catch all types of unwanted species and damage the seabed during their use.



- **DRIFT NET:** Drift with the current and are not anchored. Often used in coastal waters.



- **SEINE NET (INCLUDING PURSE SEINE):** Hang like a curtain in the water. A variant called the surrounding net is often used.



- **DREDGE NET:** Dragged along the seabed, mainly to catch shellfish and other types of fish living in the mud. Thus, they dig into the seabed with teeth or water jets.



- Farming marine species (Mariculture) reduces the exploitation of fisheries:
 - Due to the increasing human population, the increase in demand for fish as food is above the production capacity of oceans and seas;
 - Overexploitation of the fisheries leads to a decline in wild fish populations;
 - So, fish are farmed in controlled environments.
 - Aquaculture: farming fresh water fish.

- **Mariculture**: aquaculture practised in marine environments e.g. closed section of an ocean, tanks, ponds and raceways filled with seawater.
 - It reduces the pressure on wild population, allowing their population to increase;
 - Production is constant;
 - No bycatch, as non-interest species are unlikely to be present in the farm;
 - No erosion of seabed, that is usually caused by trawl nets.

Strategies for managing the harvesting of marine species

Every country with coastline has a zone of 200 nautical miles designed by UN convention on the law of the sea as **economic exclusion zone.** A variety of strategies to do this are:

- Net types and mesh size and shape:
 - If mesh size is too small, juvenile fish will be caught, reduces the number of fish that grow to maturity and reproduce.
 - A diamond-shaped mesh catches fish more easily, thus a square mesh panel is often included in an otherwise diamond net.

• Other methods of fishing:

- Many fish species naturally congregate near objects floating in the ocean.
- Many fishers use fish aggregation devices (FADs) for tuna fisheries.

• includes the usage of a log suspended below the surface of the sea

- this attracts the tuna together with other species, including tuna predators.
- once a good aggregation of fish is collected, they are gathered in a giant net.

• this will take all other species and younger tuna fish with it, leading to a large bycatch.

- **Solution:** Use pole and line method for catching the tuna. Done right, this method is highly selective with very little or no bycatch.



Pole and line method for catching the tuna

• Quotas:

- Legislators e.g. government set limits on how many and what type of fish can be caught;
- The limits are set according to the information gathered from networks across the world about fish populations;
- These limits ensure enough fish are left to reproduce and replenish the fishery for the following season.
- Closed seasons:
 - Governments and other legislation bodies can pass laws that can close fisheries down for part of the year, most commonly in the breeding season.
- Protected areas and reserves:
 - some fisheries are protected by preventing fishing in certain areas, often where the target species is known to breed.
- International agreements (implementing and monitoring): Some fisheries are protected by conservation laws, e.g:

Magnuson-Stevens Fishery Conservation and Management Act:

• Main law governing marine fisheries in the USA; It aims to control the country's terrestrial waters, conserve fishery resources, enforce international fishing agreements, develop underused fisheries and protect fish habitats.

- Economic exclusion zone:

• Every country with a coastline has a zone of 200 nautical miles around it inside which the country responsible must attempt to manage its fisheries so that they're sustainable.

- **International agreements**: needed to regulate fisheries in international waters, leading to the UN Convention on the Law of the Sea (UNCLOS).
- • Such an agreement is needed in the Mediterranean where a 200 nautical mile exclusion zone has no meaning.
- **Monitoring:** a model system is operated by the African country of Namibia.

• Larger vessels in its waters have onboard observers and air patrols detect and deter unlicensed vessels;

All landings are monitored at the country's two fishing ports;

• In addition, all vessels in the exclusion zone must keep daily logs of their catches.

Effectiveness of these strategies:

• Because of the vastness of the oceans, it is difficult to monitor fishery laws and agreements. Monitoring organisations based in ports have more success;

• Due to fishing being important for both income and food for many people, there is a huge incentive for illegal activities;

• Quotas can easily be avoided by simply not declaring how many fish are being caught;

• Overstretched authorities may not be able to check every boat, and fishers may be willing to risk under- declaring the size of their catch and not being checked;

• Usage of net with an illegally small mesh size, and in areas where patrols are inadequate;

• Fishers frequently trespass in areas where they are not supposed to fish.

Key Terms

Surface currents: movement of the surface water pf the sea in a constant direction.

Prevailing wind: the direction from which the wind nearly always blows in a particular area.

Limiting factor: of all the factors that might affect a process, the one that is in shortest supply.

Euphotic zone: the top 200 m or so of seawater through which light can penetrate and in which photosynthesis can happen.

Upwelling: areas where minerals at the ocean floor are brought to the surface by currents.

Overfishing: when the number of fish that caught is greater than the rate at which the fish reproduce, leading to a fall in fish number in an area.