Lecture 5

Environment and Resources (II): Classification of Resources

KEY QUESTION:

Will our supply of provisioning services ever be depleted?

With the completion of this lecture, attached readings and tutorial, you should be able to discuss:
- the classification of resources based on renewability
- the impact on supply of resources when their regenerative capacity is exceeded
- the classification of provisioning services based on availability

Lecture Outline

5.1 Classification of Resources based on their Renewability
(a) Renewable resources **(b)** Non-renewable resources

5.2 Impact on supply of renewable resources when their regenerative capacity is exceeded

5.3 Classification of Provisioning services based on their Availability
(a) Proven reserves **(b)** Conditional reserves
(c) Hypothetical reserves **(d)** Speculative reserves

Reading 1: How overfishing threatens the world's oceans – and why it could end in catastrophe

BLUEFIN TUNA, MEDITERRANEAN
Fishermen haul in a bluefin tuna caught in the old Mattanza method. The giant bluefin used to surge through the Straits of Gibraltar each spring, fanning out across the Mediterranean to spawn. Over millennia, fishermen devised a method of extending nets from shore to intercept the fish and funnel them into chambers, where they were slaughtered. Today, all but a dozen or so of the trap fisheries have closed, primarily due to lack of fish, but also because of coastal development and pollution.

(Source: National Geographic)

5.1 Classification of Resources based on their <u>Renewability</u>

(a) Renewable resources

- Resources that can be **depleted in the short run but that replace themselves in the long run** are called *renewable resources*. They naturally regenerate to provide new supplies of those resources to be of use to human society (see **Fig. 1**).
- Forests, most groundwater, and fisheries are good examples. Although they can be depleted by harvesting in excess of the replacement rate, if given sufficient time and the right conditions, natural processes will replace them.

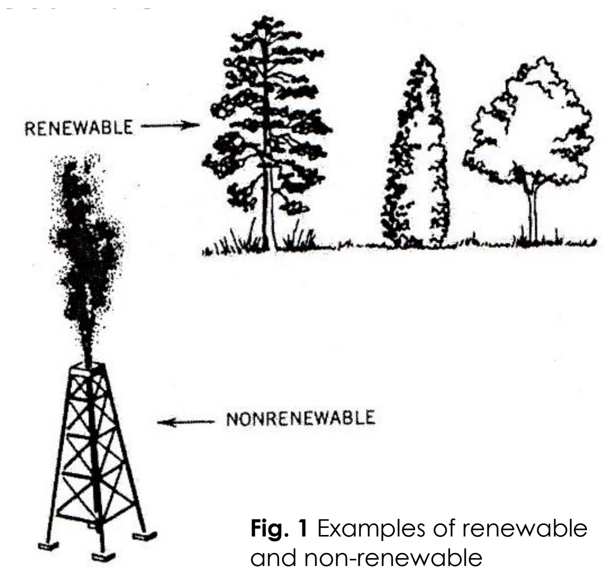

Fig. 1 Examples of renewable and non-renewable

- The key to maintaining the availability of renewable resources is keeping our rate of use at or below the rate of natural replacement (recall the Daly Rules from **Lect 1**).

(b) Non-renewable resources

- Non-renewable resources are resources that have taken millions of years to form and so **exist in finite supply. They are not being generated at a significant rate in comparison to our use of them**. Once they are used up, that is the end of them.
- Most geologic resources, such as fossil fuels and mineral ores, are of this type (see **Fig. 1**).

5.2 Impact on Supply of Renewable Resources when their Regenerative Capacity is Exceeded

- In reality, however, the distinction between renewable and non-renewables in **Section 5.1** is not as clear cut.
- Resources are increasingly being classified in terms of **degree of renewability** within a 'use-renewability continuum' (see **Fig. 2**).
  - At one extreme of the continuum (on the right) are **infinitely renewable resources**, irrespective of how it is used by humans, e.g. solar energy and tidal power.
  - At the other extreme (on the left) are resources which, as they are used, **cannot be replaced**, e.g. fossil fuels.
  - In between these two extremes are resources, the renewal of which **depends on the rate at which they are used and how they are managed** (including concern for the rate at which the biological ones, such as the soil and plants, regenerate) and **the extent to which recycling or substitution of them can occur** (e.g. metallic minerals).

- The question we need to ask is, "What would happen should the regenerative capacity of renewable resources be exceeded?" In other words, what if resources such as forests, fish populations, water etc not be able to regenerate themselves?

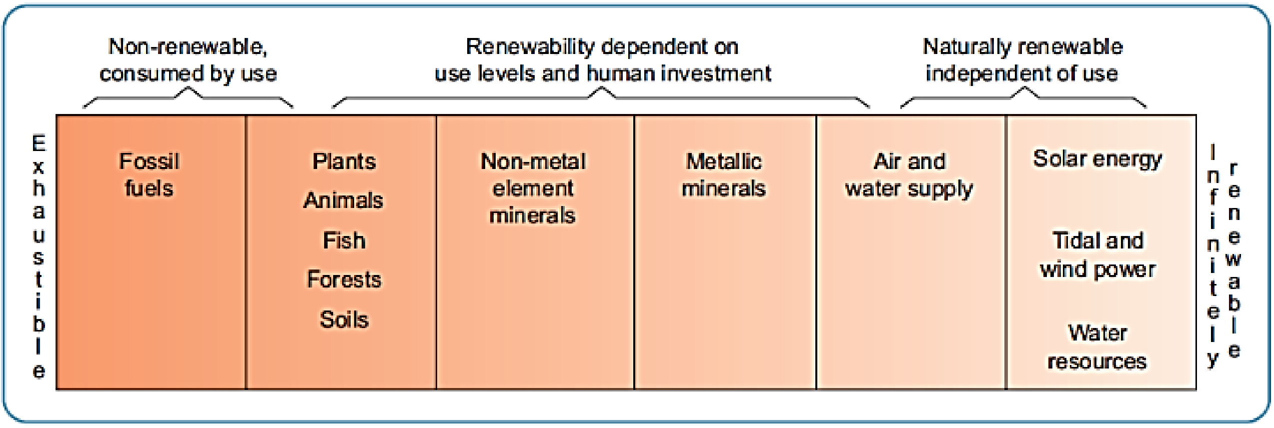

Fig. 2 The resource continuum.

- When the **regenerative capacity of a renewable resource is exceeded**, it means that **the rate of consumption is greater than the rate of replenishment**.
  - For example, when forests are harvested faster than they can regrow, the supply of timber decreases. Similarly, when fish are caught faster than they can reproduce, the supply of fish decreases.
- The impact on the supply of renewable resources are:

  (i) In the short to medium term, **scarcity**, will result. We are already seeing this in the cases of:
  - the continued **loss of forests** (please refer to **Lect 4 Section 4.4.1(a)**)
  - the **rapidly dwindling fish population** (see **Reading 1**)
  - the **lack of sufficient available freshwater** to meet the demands for it (see **Fig. 3**).

  (ii) If the trends seen in forest, fish population and freshwater are not reversed, in the long term, **depletion** can occur and worsen to the extent of **exhaustion**.

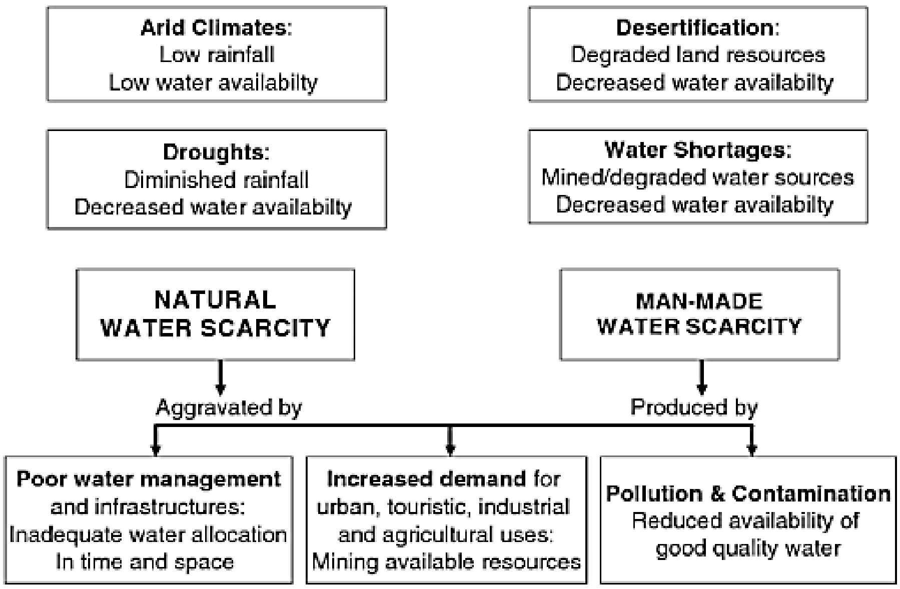

Fig. 3 Natural and man-made water scarcity

5.3 Classification of Provisioning services based on their Availability

- At any moment in time there is a finite stock of natural resources on the planet, the resource base. Each resource has in turn its own **resource base** (i.e. the total quantity of a substance or property on the planet; for example, the total amount of oil in existence today). However, that total resource base is **not** the amount available for human exploitation.
- **Fig. 4** illustrates the relationship between the resource base and the various sub-divisions of resource availability.

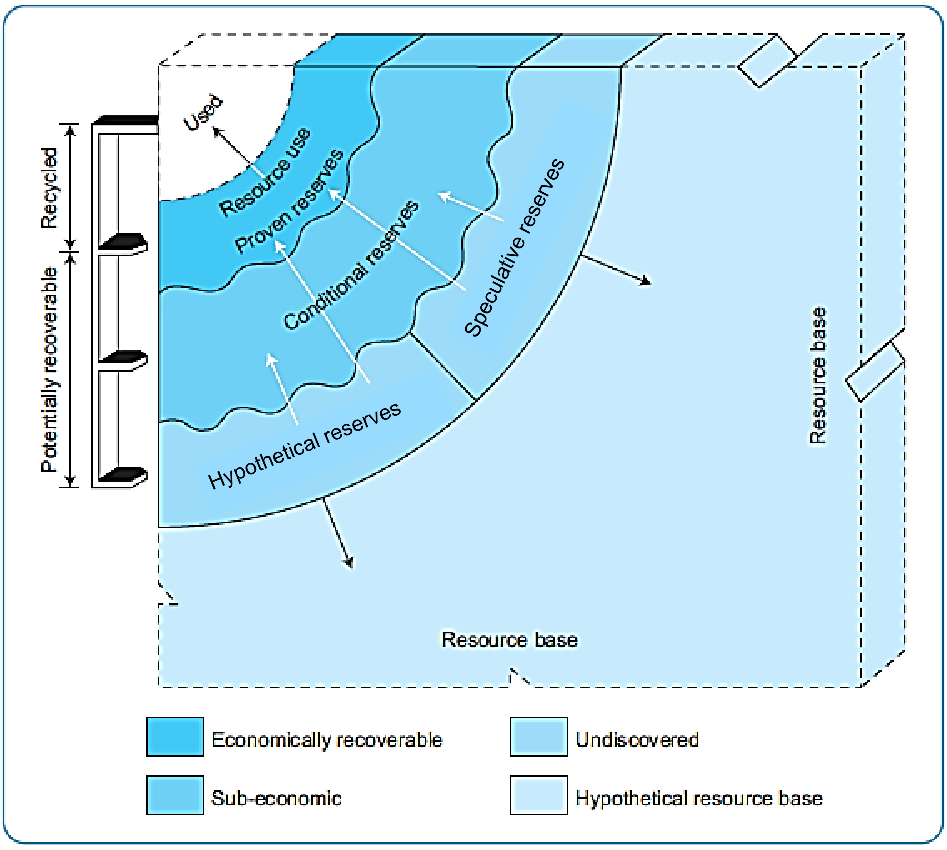

Fig. 4 Resource availability.

(a) Proven reserves

- The term *proven reserve* is applied **to those deposits that have already been discovered and are known to be economically extractable under current demand, price and technological conditions**. (See **Lect 4 Section 4.3**) Thus, the extent of the proven reserves of a particular resource is highly *dynamic* and dependent upon a host of partly interlinked factors.
- These include the availability of the technology and skills to exploit the resource, the level of demand, the cost of production and processing, the price it can command in the marketplace, the availability and price of substitutes, and the environmental and social costs of developing the resource.
- These factors determine whether or not a particular resource will be exploited in a particular place and the global level of supply of that resource. The extent to which each of these factors influences resource development also varies across space and time.

- Today we have the technological ability to recover resources in geological and environmental conditions that were previously uneconomic. For example, the exploitation of shale gas in a physically challenging environment has been made possible by advances in drilling technology, specifically hydraulic fracturing.

(b) Conditional reserves

- The category of conditional reserve refers to **deposits that have already been discovered but that are not economic to work at present-day price levels with the currently available extraction and production technologies**.

Proven* vs *conditional reserves

- The *boundary* between proven and conditional reserves is dynamic and bi-directional (that is, resources that change from conditional to proven reserves can, if conditions change, revert to conditional status).

(c) Hypothetical reserves

- Hypothetical reserves are those that **we may expect to find in the future**.
- They are in areas that have only been *partially surveyed and developed*. They may be in regions, such as Antarctica, where the international community has placed a moratorium (a temporary prohibition of an activity) on resource development, for the time being at least.

(d) Speculative reserves

- Speculative reserves are those that **<u>might</u> be found in unexplored areas which are thought to have favourable geological conditions**. There remains a large part of the earth about which we have *no information* on its potential resource base.
- The <u>strength</u> of this classification is that *it stresses the highly dynamic nature of the concept of resource reserve*. The <u>danger</u> is that it leads to the view that *society will never run out of resources* because there are always more to discover and technological progress will continue to make new resources available for exploitation. (See **Lect 6** for the Boserupian perspective)

Reading 1

How overfishing threatens the world's oceans – and why it could end in catastrophe

Decades of harvesting the seas have disrupted the delicate balance of marine ecosystems—despite global efforts to mitigate the damage.

BY AMY MCKEEVER AND NATIONAL GEOGRAPHIC STAFF
PUBLISHED FEBRUARY 8, 2022

Scientists have long been sounding the alarm about a looming catastrophe of ocean overfishing—the harvesting of wildlife from the sea at rates too high for species to replace themselves. Yet for two decades, global leaders have been at an impasse in their efforts to reverse the damage that has been done.

Marine scientists know when widespread overfishing of the seas began. And they have a pretty good idea when, if left unaddressed, it will end badly. Here's a look at the critical issues in overfishing—from its effects on biodiversity to the limited successes of mitigation efforts.

Why overfishing occurs

The earliest overfishing occurred in the early 1800s when humans, seeking blubber for lamp oil, decimated the whale population around Stellwegen Bank, off the coast of Cape Cod. Some fish consumed in the United States, including Atlantic cod, herring, and California's sardines, were also harvested to the brink of extinction by the mid-1900s. These isolated, regional depletions were highly disruptive to the food chain—which only became more precarious in the late 20th century.

In the mid-20th century, countries around the world worked to build their fishing capacities to ensure the availability and affordability of protein-rich foods. Favorable policies, loans, and subsidies spawned a rapid rise of big industrial fishing operations, which quickly supplanted local fishers as the world's main source of seafood.

These large, profit-seeking commercial fleets were aggressive, scouring the world's oceans and developing ever more sophisticated methods and technologies for finding, extracting, and processing their target species. Consumers soon grew accustomed to having access to a wide selection of fish at affordable prices.

But by 1989, when about 90 million tonnes (metric tons) of fish were taken from the ocean, the industry had hit its high point, and yields have declined or stagnated ever since. Fisheries for the most sought-after species, like orange roughy, Chilean sea bass, and bluefin tuna, have collapsed for lack of fish. In 2003, a scientific report estimated that industrial fishing had reduced the number of large ocean fish to just 10 percent of their pre-industrial population.

How overfishing affects biodiversity

Faced with the collapse of large-fish populations, commercial fleets began traveling deeper in the ocean and farther down the food chain for viable catches. This so-called "fishing down" has triggered a chain reaction that is upsetting the ancient and delicate balance of the sea's biologic system.

Coral reefs, for example, are particularly vulnerable to overfishing. Plant-eating fish keep these ecosystems in balance by eating algae, keeping the coral clean and healthy so that it can grow. Fishing out too many herbivores—whether intentionally or as bycatch—can weaken reefs and make them more susceptible to being ravaged by extreme weather events and climate change. Fishing equipment and debris can also physically destroy the fragile corals that make up the reef foundations.

Overfishing can also harm other marine species. Trawling, a method in which boats pull massive nets behind them in the water, pulls in more than just shrimp and bluefin tuna—it captures just about anything in its path. Sea turtles, dolphins, sea birds, sharks, and other animals have all faced existential threats as bycatch.

Efforts to prevent overfishing

Over the years, as fisheries have caught less and less, humans have begun to understand that the oceans, assumed to be unendingly vast and rich, are in fact highly vulnerable. In 2006, a study of catch data published in the journal Science grimly predicted that if such unsustainable fishing rates continue, all the world's fisheries will collapse by 2048.

Many scientists say most fish populations could be restored with aggressive fisheries management and better enforcement of laws governing catches, including instituting catch limits. An increased use of aquaculture, the farming of seafood, would also help. And in many regions, there is reason for hope.

The United Nations Food and Agriculture Organization (FAO)—which lays out international standards for fisheries management—pointed out in its 2020 report that there has been a slight increase in the percentage of stocks that are sustainably producing the most food possible, which is the goal of fisheries management.

Still, many challenges remain. About a third of global stocks are overfished—and the overall proportion of fish stocks at sustainable levels has continued to decline. The FAO report says this deterioration of fish stocks can particularly be seen "in places where fisheries management is not in place, or is ineffective." Of the areas the organization monitors, the Mediterranean and Black Sea had the highest percentage of stocks—62.5 percent—fished at unsustainable levels.

Can we stop overfishing?

Government subsidies to the fishing industry remain a significant challenge to reversing this troubling trend. One global survey found that in 2018 nations spent $22 billion on so-called harmful subsidies that fuel overfishing—a 6 percent rise from 2009.

As National Geographic reported at the time, harmful subsidies are those that fund practices that would not otherwise be profitable, such as for industrial trawlers' fuel costs. China, for example, has increased its harmful subsidies by 105 percent over the past decade.

World Trade Organization members have been discussing how to limit these subsidies since 2001—with little progress. And despite a pledge by members of the United Nations to forge an agreement by 2020, that deadline has passed with no resolution.

In 2021, WTO Director-General Ngozi Okonjo-Iweala called on members to reach an agreement, arguing that a "failure to do so would jeopardize the ocean's biodiversity and the sustainability of the fish stocks on which so many depend for food and income."

It's unclear whether countries will muster the political will to follow through. But what is clear to scientists is that it is one of many measures that's critical to saving the world's oceans.