| Higher 2 (9173) | Cluster 1: Development, Economy and Environment | TMJC |
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| Cluster 1<br>Lecture 7 | Natural Resources and Extractive Industries | 2025 |

## WHAT IS A RESOURCE?

A resource is anything that has a utility value. Natural resources refer to things with utility value that are derived from earth (atmosphere, lithosphere, hydrosphere, biosphere) and exist independently of human activities.

## WHAT ARE THE DIFFERENT WAYS OF CLASSIFYING RESOURCES?

Resources can be classified into 2 different categories (in this syllabus):

**Renewable Resources:**

Renewable resources are resources that are naturally renewed within a sufficiently short timespan to be of use to human society.

1. Refers to resources that can be depleted in the short run but can replace themselves in the long run e.g. water; fisheries; forestry
2. Some Renewable resources are **more renewable than others** and may always exist in relatively constant supply e.g. Solar; Wind; Tidal energy [These can also be seen as **Renewable Energy Resources**]

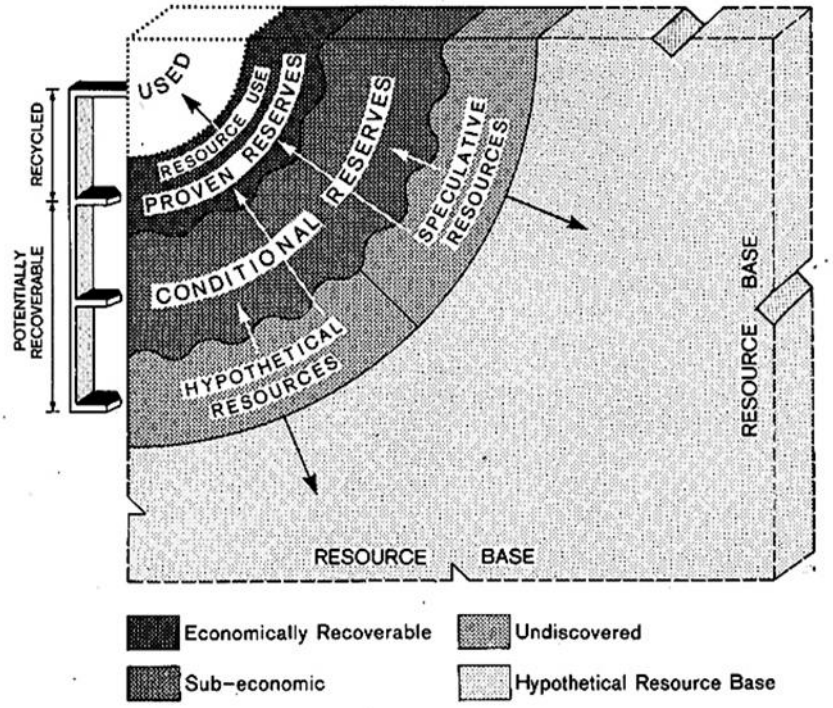
**Non-renewable resources**

Non-renewable resources are resources that have taken millions of years to form and so their availability is finite. There is no possibility of them being replenished on a timescale of relevance to human society.

3. Non-renewable resource (stock resource)
    - Refer to energy resources that exist in finite supply e.g. fossil fuels (Coal, Oil, Natural Gas)
    - Mineral resources that also exist in finite supply e.g. Gold, Silver, Lithium, Jade, Diamonds etc…

## WHAT ARE THE DIFFERENT WAYS OF CLASSIFYING RESOURCE AVAILABILITY?

Reserves refer to the known and estimated amount of resources for future use. The concept of reserves is used most frequently for minerals or petroleum.




**Resource Availability (Rees, 1985)**

| Types of resource | Definition (must know) | Example |
|---|---|---|
| Proven Resource<br><br>Boundary between proven and conditional reserves is dynamic and bi-directional (meaning resources that change from conditional to proven reserves can, if conditions change, revert to conditional status). | Deposits **already discovered** and known to be **extractable under current demand, price and technological conditions**.<br><br>Extent is of a proven reserve is dynamic and dependent on:<br>○ Availability of the technology and skills to exploit the resource,<br>○ Level of demand,<br>○ Cost of production and processing, | EG1: Oil is a proven resource which continues to be economically extractable at even greater depths.<br><br>Today's' technology is able to recover resources ion geological and environmental conditions that were previously uneconomic. In the Deepwater Horizon drilling to a vertical depth of 10683m.<br><br>EG2: Shale gas production, which relies on new technologies of drilling horizontal wells in shale rocks and hydraulic fracturing (or fracking) to release the natural gas trapped in shale deposits far below the ground at competitive cost. This has resulted in a dramatic surge in natural gas production in the U.S. |

| | | |
|---|---|---|
| | ○ Price it can command in the marketplace,<br>○ Availability and price of substitutes, and<br>○ The environmental and social costs of developing the resource. | EG3: Extraction of oil and gas extraction in the North Sea is done in a physically challenging environment. This was made possible by advances in offshore drilling and production technologies. |
| Conditional Reserve | Deposits that have already **been discovered but are not economic to work at** prevailing price levels using currently available extraction and production technologies.<br><br>Boundary between proven and conditional reserves is dynamic and bi-directional (meaning resources that change from conditional to proven reserves can, if conditions change, revert to conditional status). | EG1: Canadian oil sands have high production costs and need an oil price of at least $65/barrel to be profitable. High oil prices in the 2000s have promoted to growth of oil production from Canadian oil sands. However, falling oil prices to $50/barrel in 2017 have made it not profitable and some companies have downscaled their production of oil. Despite that, Alberta's oil sands still remain an large and lucrative industry in Canada and there are about 120 oil sands project that produce 2.6million barrels of oil every day.<br><br>EG2: In the early 1900s, copper ores with less than 10% metal content could not be use in most smelters and therefore virtually useless. However, 40 years later, technological changes coupled with major demand increases, had allowed deposits with only 1% metal to be defined as proven reserves. |
| Hypothetical reserves | Resources that that are **not known deposits** but those that we may **expect to find in the future in areas** that have only been partially surveyed and developed. | The Arctic and Antarctica are area of hypothetical reserves. Due to the harsh cold conditions, many of the oil and gas reserves still remain unexplored. The USGS estimates that 13% of undiscovered oil and 30% of undiscovered gas could be found in the Arctic. |
| Speculative reserves | Resources that might be found in unexplored areas which are thought to have favourable geological conditions. | In the early 1900s, when there was a rush to explore for oil, gas and mineral resource, the Arctic and North Sea was an area where only speculative resources might exist. However, with technology improvements, the area is assumed to have hypothetical resources which will be located in time. |

Evaluation:

(+) The strength of the classification is that it stresses on the highly dynamic nature of resource reserve.

(-) The danger 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.

Our Earth now faces the additional problem that consuming resources, such as fossil fuels, is threatening the ecosystem. Hence, other than thinking about resource availability, it should also take into account the ecological cost of our current reliance on fossil fuels.

## WHEN ARE RESOURCES (IN)SUFFICIENT?

**Resource Scarcity** refer to the insufficiency of resources and can be either seen as:

1. **Absolute Scarcity**
    - Refers to supplies of resources that are insufficient to meet present and future demands

2. **Relative Scarcity**
    - Refers to uneven spatial distribution of resources resulting in insufficient resources in some places while surplus in others

Yet, whether resources face absolute or relative scarcity changes over time and depends on the scale of analysis or scarcity of resource.

For example, food tends to be a resource in **relative scarcity**. We are currently producing enough food to feed the world. As of 2012, a report by Food First (an Institute for Food and Development Policy), showed that are already producing enough food for 10 billion people. However, 21,000 people are dying everyday due to hunger or hunger related cause. The food supply and distribution of food is unequal, causing a relative scarcity of this resource. This food resource is mainly concentrated in the developed world which also experiences a large amount of food wastage a day. Therefore, relative scarcity occurs when one group is able to control the ownership or distribution of resources at the expense of another group. Africa is a net exporter of food when many people in Africa are going hungry each day. This is because the ownership and distribution of food is controlled by companies and corporation from the developed world.

**Resource scarcity can also change over the long-term**. For example, the energy (oil) crisis in 1970s result in oil being in absolute scarcity in the US and Europe. This resulted in high oil prices. However, new technology in discovery and extraction of oil, coupled with energy efficient technology to reduce demand, reduced the scarcity considerably, and resulted in lower oil prices.

**HOW ARE MOST OF THE NATURAL RESROUCES REMOVED FROM THE ENVIRONMENT?**

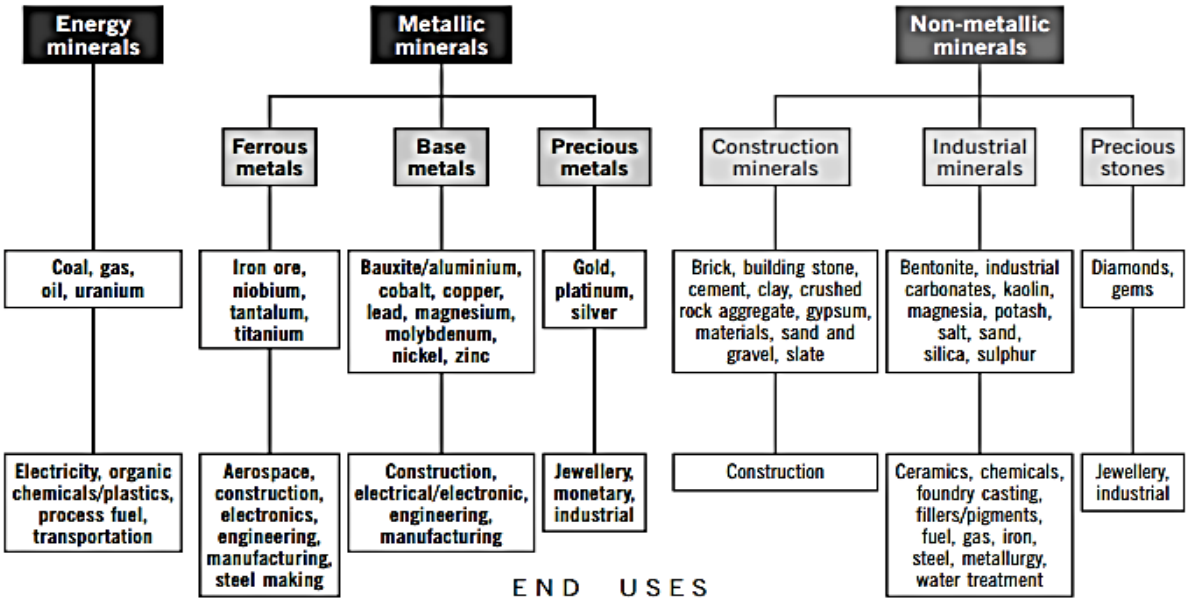
Natural resources are mainly removed from the environment via **Extractive Industries**

**Extractive industries represent** the initial stage in the basic production circuit and global production networks. The extractive industries fall into three broad categories based upon the kind of minerals involved – energy minerals, metallic minerals and non-metallic minerals.

According to the World Bank: "About 3.5 billion people live in countries rich in oil, gas or minerals, but all too often, these resources have become a source of conflict rather than opportunity. Many of these countries also suffer from poverty, corruption and conflict stemming from weak governance. This must change, especially as some of the world's lowest-income countries have abundant resources. Non-renewable mineral resources play a dominant role in 81 countries, which collectively account for a quarter of world GDP, half of the world's population and nearly 70% of those in extreme poverty. Africa is home to about 30% of the world's mineral reserves, 10% of the world's oil, and 8% of the world's natural gas"

Extractive industries can play an important role in dictating development in various countries, it can also affect the environment and habitats in various ways. Therefore, it is important for us to take a closer look at the characteristics, development, impacts and strategies to mitigate the impact of these extractive.

One of the ways to classify extractive industries is proposed by Dickens (2011) who state that extractive industries can be classified into three types:



## 2. WHAT ARE THE CHARACTERISTICS OF EXTRACTIVE INDUSTRIES?

There are 3 key characteristics of extractive industries:

### 1. Location Specific

This means that **location of extractive industries is relative to where the resources are found**. e.g. minerals and oil are found in very specific places.

Such is in contrast to some flexibility and human influence for non-extractive industry. For example, agricultural crops or forestry can be cultivated wherever appropriate soil and climate conditions exist. We can even create artificial environment like greenhouse to extract these crops. But in many cases, the location of a commodity/resource such as a coal seam underground, a fishing ground at sea, or a climate appropriate to tropical fruits, cannot easily be moved or modified.

In essence, **resource extraction activities** must generally **locate in situ** or where resources are to be found.

### 2. Capital and Technology Intensive

Due to the difficulty in extracting these natural resources, machinery and technology is required to harvest them. These processes require skilled labour and hence overall the use of technology and human resource to extract resources is capital intensive. As a result, governments have often been central to the emergence of resource-based economies. For mining, agricultural or forestry activities to develop, it is usually governments that provide the infrastructure that enables them to happen in far-flung places. A further development would be the arrival of TNCs with the resources and capabilities to create extractive industries as well (e.g. SHELL, British Petroleum, Nestle).

### 3. Involvement of a mixture of large private and state-owned firms

Ownership of natural resources can be by private firms, state-owned firms or a partnership of both.

One of the main reasons why the state is so heavily involved in extractive industries is due to the unique *territorial embeddedness* of resources. Access to such resources is ultimately controlled by the state in which is located at. (Recall one of the key feature of extractive industry)

Therefore, the state can act as a **regulator** (of access, taxation, health and safety) and an **operator** (an actual producer). This enables the state to have huge power over how such resources are exploited. How effective that power is and how it is exercised would then depend on the nature of the state. The nature of the state depends on its strength (both domestically and internationally) and its political orientation.

Different states have different political orientation and ideology and this would determine whether it is **welcoming** or **hostile** towards private companies (especially TNCs) regarding the extraction of resources.

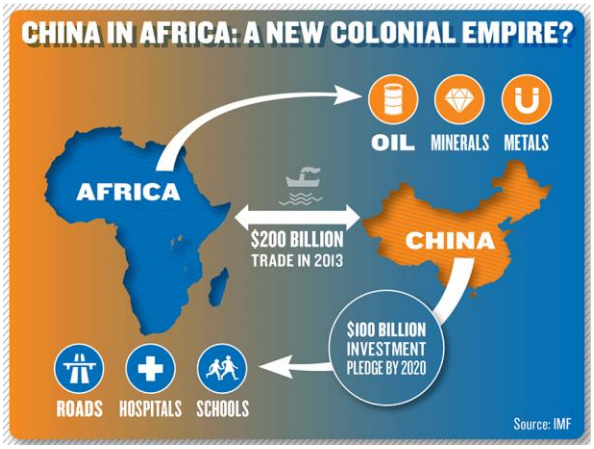
There has also been an expansion of role of large government linked corporations in seeking control of natural resources. In several emerging economies around the world, such enterprises dominate natural resource sectors.

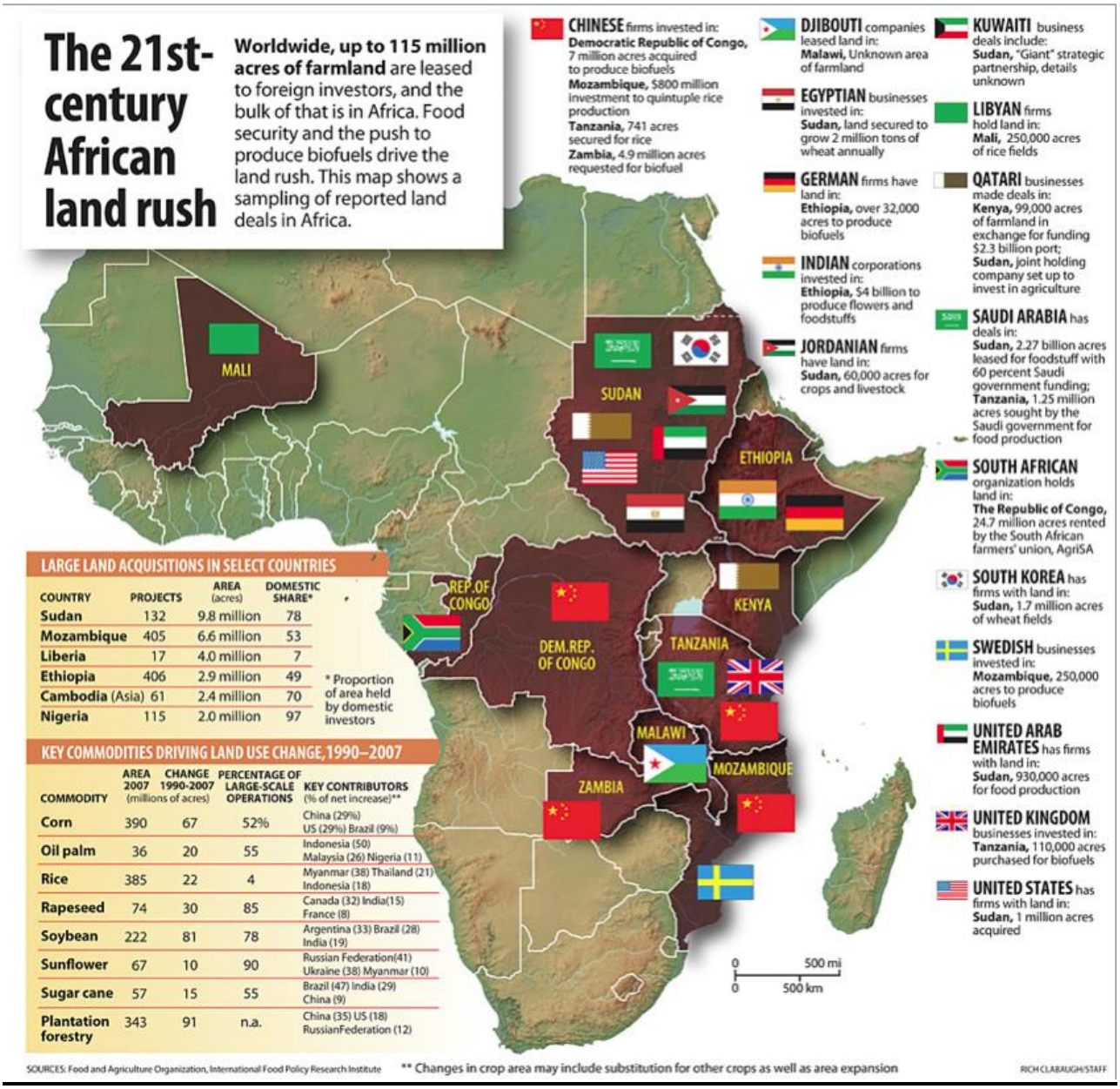
In Russia, for example, where state-owned enterprises from the communist era were privatized in the 1990s, a process of amalgation (consolidation of companies) has more recently recreated massive conglomerates with control over key resources and close links with political leaders. **Gazprom,** is the world largest natural gas producer and is linked to Russia's political leadership in complex ways. Oil extraction in the Middle East is also carried out almost exclusively under the auspices of state-owned companies.

Indeed, all of the world's ten largest oil and gas corporations, measured in terms of the reserves they have access to, are government linked companies located in Iran, Saudi Arabia, Venezuela, Russia, Qatar, UAR, Iraq, Turkey and Libya.

State-linked companies are also expanding globally and are seeking to secure access to resources wherever they are to be found. China has been particularly active in using development aid, foreign policy and market power to gain access to resources from around the world to fuel its rapid economic growth. This has led Chinese government-linked enterprises into deals with various countries in the Middle East, Africa, and elsewhere.

The China National Petroleum Corporation (CNPC) is one example of a national resource company. The Chinese typically offer loads and funding for infrastructure in exchange for guaranteed supplies of oil, natural gas, and other resource commodities. The CNPC has investments in over 30 countries in Africa. A recent area of concern has been the role of state-linked companies in gaining access to land in areas where land markets and titling are not well established. Some have called this a global land grab where countries are buying land in other countries in other to extract their resources or for agricultural purposes. One such example is the heavy investment by China in African countries.






**Investment by various states and TNCs in Africa**

Ownership of extractive industries are overlapping and increasingly blurred due to **three emerging trends**

i. Private ownership are expanding into contexts where it was previously not applied, thereby erasing communal or open access resources and replacing them with privatized access.
ii. The second trend involves the increasing importance of some state-linked corporations as key players in global resource industries, especially in the developing world.
iii. The third trend is the privatization of formerly state-controlled resource industries or markets.

## 3. Extractive Industries impact on the environment

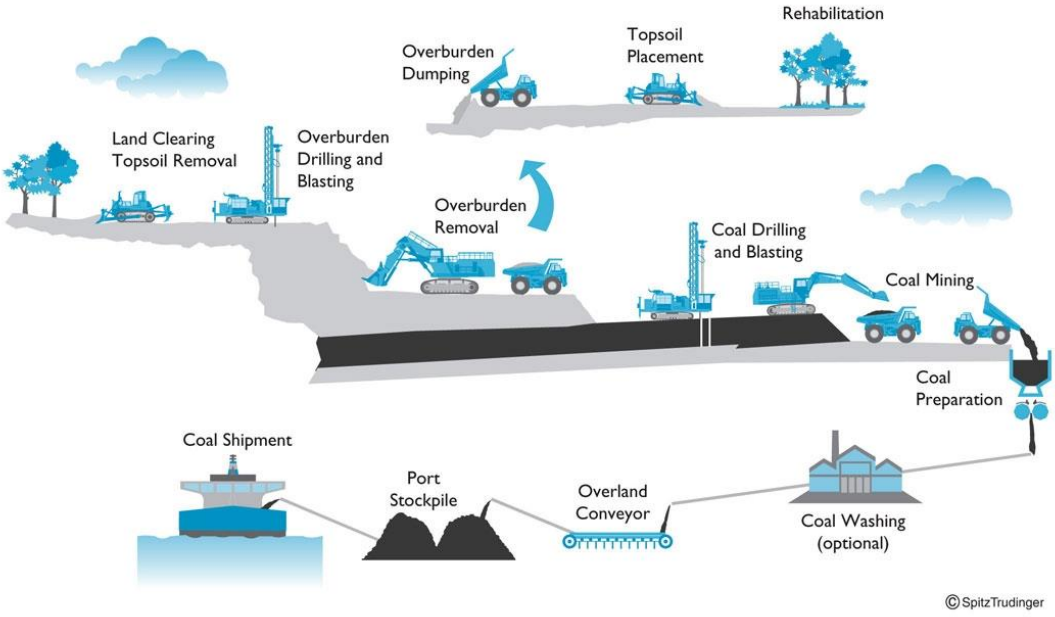
In this section, we will explore how extractive industries can impact the environment. Extractive industries can impact the environment in ways which are mainly negative. These environmental impacts can occur at different phase of the extractive industries production process. We will consider three case studies to examine the impact of extractive industries on the environment. Students should try to classify them and think about which phase of the extraction these environmental damages occurs. **We should think of how to classify these damages: Environmental, Economic, Social**. **We should think about whether these damage affects the regenerative capability of the resource, especially in environmental sensitive areas.**

Before we examine the impacts of extractive industries, we will take a quick look at how extractive industries operate and the type of impacts such operations can bring about

### Mining: Mineral Extraction Process

The most common form of mineral extraction is surface mining which uses a number of different techniques such as open-pit mining which involves the extraction of minerals from a hole. The surface layers need to be stripped to reveal the mineral ores underneath (Strip Mining)

Another way of mining is through mountain-top mining, where vegetation is cleared from high-elevation areas, stripping away topsoil and using explosives to break up rock and access the buried minerals. Excess rocks, so-called mine spoil, is deposited in nearby valleys, with an overall levelling effect on the landscape. Mountain top mining is widely practiced by coal-mining companies in the Appalachian region in the USA.



*Impacts:* Spoil

Almost all large mines produce large amount of waste because the ore is only a small fraction of the total volume of the mined material. Disposing of this spoil often degrades areas of natural ecosystem beyond the immediate zone of impact of the open-cast or strip mine.

Deposition of spoil during mountain top mining can bury streams and rivers. Piles of mining waste rock can create geomorphological hazards, particularly landslides. A **Catastrophic landslide** was one that hit the Gyama copper gold mine in Tibet in March 2013 which killed 83 workers.

Deposition of mining materials can also raise the river beds leading to **floods or disruption of livelihood (social impact)** (See case study below on OK Tedi Mine disatster)

*Impact:* Pollution

Water contamination is the most widespread form of pollution associated with mining. A particularly serious issue associated with major coal mining and metal mining areas all over the world is acid mine drainage, in which any deposit containing sulphide reacts with air and water to produce sulphuric acid. If sulphuric acid reaches rivers, the damage to plants and animals can be very serious.

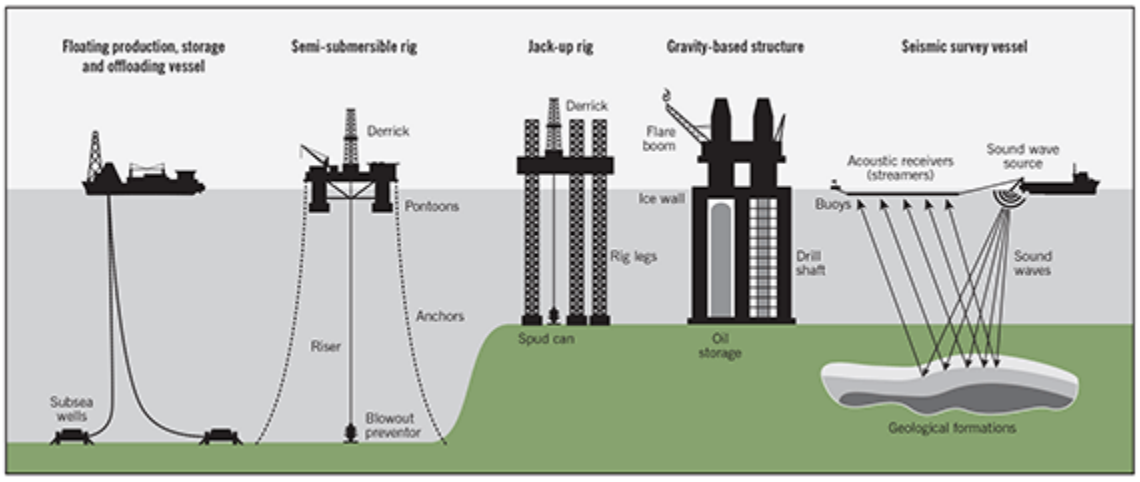
Acid mine drainage is not just a problem for operational mines, but may continue as a pollution source for some years after mine closure. An example is the Sao Domingos mine in Southern Portugal, one of Europe's Biggest mines which produced copper and sulphur for more than 100 years. Sao Domingos was closed in 1966 but it still continues to pollute rivers that flow into the largest drinking water reservoir in the province of Huelva

*Managing the impacts*

Physical geographers are often involved in helping to manage spoil heaps, modifying slope angles and monitoring moisture content to maintain their stability. Responsible mining operations also plan for environmental rehabilitation after the mine has closed. This frequently involves filling in holes left by mining, reshaping undisturbed areas to make them consistent with the surrounding landscape, and ensuring the site has proper drainage to minimise erosion.

Extracting crude oil usually starts with drilling wells into the underground reservoir. A crude oil well is created by drilling a hole into the earth. The first step of the process involves drilling into the ground in the exact location where the oil is located. Once a steady flow has been identified at a particular depth beneath the ground a perforating gun is lowered into the well. A perforating gun has explosive charges within it that allow for oil to flow through holes in the casing. Once the casing is properly perforated a tube is run into the hole allowing the oil and gas to flow up the well. To seal the tubing a device called a packer is run along the outside of the tube. The last step involves the placement of a structure called a Christmas tree which allows oil workers to control the flow of oil from the well.

**Oil Extraction Process**




Furthermore, when oil is extracted and natural gas is released, extractors use control burning methods such as flaring and venting to release the gas into the atmosphere, which creates problem as wellAmongst all these steps any problems may occur which leads to undesirable impacts. Errors in the drilling processes or faulty equipment will lead to problems, Crude oil can also be extracted from Tar Sands (which is extracted in a manner similar to mining)

*Extracting from Oil Sands*

Oil can also be extracted from oil sands, often called tar sands. Oils sands are typically sand or clay mixed with water and a very viscous form of crude oil known as bitumen. The extraction process for oil sands is quite different from drilling due to the high viscosity of this extra-heavy oil. Rather than using drills, crude oil is extracted from oil sands through strip mining or a variety of other techniques used to reduce the viscosity of the oil. This process can be far more expensive than traditional drilling and is found in high abundance only in Canada and Venezuela. As oil demand continues to rise, and reserves become depleted, oil sands could provide one of the last viable methods for extracting crude oil from the Earth.

The impacts of oil extraction will be elaborated on in the two case studies below, think about how the process of disposing waste or pipe leaks can lead to irreversible impact on the environment.

**Let's recap on the impacts of extractive industries**

**Positive economic impact**

When managed well, extractive industries can generate great wealth to the country that has the resource. Countries like Saudi Arabia have **state owned corporation like Saudi Aramco** which is one of the 10 largest companies in the world. It was founded in 1933 and owned by the Government of Saudi Arabia (90% of its shares). It has 66,800 employees and is considered a high income country under the world bank classification.

Similarly, having extractive industries allow countries to **utilise their resource wealth to diversify other aspects of their economy and also invest in human capital.** This could bring about additional positive economic impact and also positive social impacts as well. For example, Dubai and Qatar are also oil rich countries and they have utilised their resource wealth to develop other global corporations such as *Emirates Airlines (owned partly by the Emirates Group and Investment Corporation of Dubai)* and *Qatar Airways* allowing these countries to venture into tourism and investing in their population to move onto the service/tertiary sector.

Similarly, Botswana have **partnered with the TNC – De Beers Diamonds** to form Debswana which ensured 50/50 profit sharing for them to capitalise on its resource wealth and to develop. Its GDP per capita have rose from US$59 per capita in 1960 to $US7738 in 2022, and classified as upper middle income country.

**Negative Economic Impact**

However, having natural resources does not naturally guarantee positive economic benefits. Three conditions make having extractive industry not lucrative or profitable for the country with the resource.

Firstly, as extractive industries are capital and technology intensive, if the country does not have the capital and technology to harness the resource, they end up letting foreign TNCs extract the resources and this results in **repatriation of revenue earned from the resource**. The country merely loan the land to the TNCs and majority of the profits earned from the resource is not kept within the country. For instance, Nigeria despite being oil rich, does not profit much from its resource, even though it is Africa's largest exporter of crude oil, it imports even more refined oil, which meant that they are worst off and cannot profit from their own resources.

Secondly, If a country over rely on the resources, as commodity prices are volatile and can fluctuate- they risk going bankrupt and have nothing to sustain their economy. Such as in the Case of Nauru, whose phosphate deposit is totally drained but have no alternative economic generators. Similarly, Venezuela is oil rich, but oil for them is a conditional resources now and it is too costly to extract and they have no other way to sustain their economy. Both countries were at one time top five richest countries in the world in the past.

Thirdly, when there are accidents such as the BP Deepwater Horizon Oil Spill. Aside from the money that flowed from cleanup and containment efforts, the National Oceanic and Atmospheric Administration

estimated that between $527 million and $859 million was lost in recreational opportunities, including boating, fishing, and beach visits, because of the spill.

**Social impacts**

Positive social impacts can be deduced from page 1 where usually positive economic impact leads to social impact as well.

Yet in terms of negative social impacts

*As extractive industries* alter the natural environment → it can reduce shear strength of slopes which lead to mining accidents which is very common and cause loss of lives. On 16 August 2023, there was a landslide at Myanmar jade mine which killed at least 32 people.

The normal operations of extractive industries also creates air pollution through flaring and venting which cause respiratory problems, asthma, and premature deaths.

The oil spills in the Niger delta also make the land no longer suitable for farming or fishing which disrupt livelihoods and other sectors of the economy.

**Environmental Impacts**

Extractive industries have a negative impact on the environment due to destruction of ecosystem which affects the biodiversity and the environment ability to restore itself.

Mining operations for copper, bauxite, jade etc requires deforestation first in order to set up a mine. Trees are cleared so that the land can be excavated to dig up the minerals. Slope gradient is also altered to create roads for the transport of machineries and transport of excavated minerals. Continuous mining into deeper layers of the soil will disrupt the natural soil profile. By removing the fertile topsoil, the mined land will not be able to return to its original state or regain its original biodiversity even when mines closed down.

- E.g. Unregulated and indiscriminate bauxite mining in Pahang have led to reduction in air quality is also reduced as the bauxite dust have spread widely and made the air appear red. These thick layers of bauxite dust settled onto trees and caused them to die. Widespread mining of bauxite has also left gaping holes in the surface that resembles a bare, moon-like surface.
- E.g. Extensive diamond mining in Kimberley, South Africa have led to the permanent large deep hole on the surface permanently changes the ground profile. The Big Hole in the Kimberley Mine has a depth of 240m and is the said to be the deepest hole excavated by hand. It is evident of the diamond rush in the 1870s.

Extractive industries have a negative impact on the environment due **to water pollution and land contamination.**

- Mine tailings are a by-product of mining and is discarded after the wanted commodity has been extracted. Mine tailings, toxic runoff and waste products can flow into rivers and degrade the water quality.

- Oil spills slather a thick layer of oil above water and soil, which is costly to remove. Unscrupulous oil company operators may deny their role in the spill and delay cleaning up of the oil spill, causing the problem to be prolonged. Oil spills on water is exceptionally devastating because ocean currents can spread the oil over long distances.
    - E.g. Nigeria Oil Spills in the Niger Delta
    - E.g. British Petroleum's 2010 Deepwater Horizon Oil Spill in Gulf of Mexico
    - E.g. Gold mining requires the use of mercury to separate gold from soil. In illegal gold mines in Canaa dos Carajas, Brazil, poor management of the operations result in high concentration of mercury being found in rivers. This can poison fish and marine life.

Extractive industries have a **negative impact on the environment especially in the long term as it directly contributes to climate change**

- Extraction of resources can involve deforestation before mining → loss of carbon sinks
- Majority of resources mined are fossil fuel (oil, coal, natural gas), which when utilised → contributes to the enhanced greenhouse effect
    - Mining sector is responsible for 4 to 7 percent of greenhouse gas (GHG) emissions globally
    - Demand for FF is rising due to urbanisation (household usage, transportation), economic globalisation (trading via sea freight and air cargo) and industries (manufacturing of goods and services) etc

**Strategies to Manage Extractive Industries**

According to the UNDP:

Historically, extractive industries have been a major driver of economic growth, particularly for now-advance economies that benefitted during and after the industrial revolution. While Europe and North America once played a dominant role in the production of metals and other commodities, the extraction of resources has increasingly moved to developing countries, including China.

Currently, mineral resource extraction plays a dominant role in the economies of 81 countries that account for a quarter of global GDP, half of the world's population and nearly 70 per cent of those living in extreme poverty. Extractive industries have immense potential to drive growth, support sustainable development, and reduce poverty in developing countries. Yet, the actual contribution of extractive industries to sustainable development in countries rich in raw materials has often been mired by financial, economic, governance, social and environmental concerns, leading to the so-called resource curse or paradox of plenty.

We explore three strategies to manage extractive industries

1. Legislation and Regulation
2. Environmental Restoration
3. Good Governance and ownership over extractive industries

## 1. Legislation and Regulation

Extractive Industries can be managed through strict governance and legislation. Legislation refers to the setting of laws which TNCs operating in the extractive industry sector has to abide by. Governmental regulation also provide oversight on how extractive industries operate. There can be regulations on drillings, extraction, waste disposal, transportation and equipment (blowout preventers) could all contribute to reducing the environmental impact. **However, regulations would not be successful if there is no strict enforcement or penalties imposed on companies.**

**For regulation to work, there must be constant checks and monitoring to ensure that regulations are adhered to.**

For instance, the BP Deepwater Horizon Oil Spill was partly due to inadequate enforcement of the regulations by the US government which allowed BP to flout many of the regulations leading to the disaster of the Oil Spill in the Gulf of Mexico.

Here's a list of the federal regulation violations that helped lead to the Deepwater Horizon disaster:

BP failed to protect health, safety, property, and the environment by (1) performing all operations in a safe and workmanlike manner; and (2) maintaining all equipment and work areas in a safe condition.

BP, Transocean, and Halliburton (Sperry Sun) failed to take measures to prevent the unauthorized release of hydrocarbons into the Gulf of Mexico and creating conditions that posed unreasonable risk to public health, life, property, aquatic life, wildlife, recreation, navigation, commercial fishing, or other uses of the ocean

BP, Transocean, and Halliburton (Sperry Sun) failed to take necessary precautions to keep the well under control at all times.

BP and Halliburton failed to cement the well in a manner that would properly control formation pressures and fluids and prevent the release of fluids from any stratum through the wellbore into offshore waters.

BP failed to use pressure integrity test and related hole-behaviour observations, such as pore pressure test results, gas-cut drilling fluid, and well kicks to adjust the drilling fluid program and the setting depth of the next casing string.

**Thankfully? There is legislation in place which can be enforced** – BP pled guilty in 2012 to 14 felony counts and was fined a record $4.5 billion. Which at least half was used for cleanup efforts. Subsequently as investigations continued more charges and fines were brought up and it paid over US$60 billion in fines to resolve nearly all claims from the spills.

The Nigerian Government have created an environmental regulatory framework to regulate oil companies. Environmental Assessment Officers must visit the oil facilities regularly to carry out inspections. **Oil spills** are dealt with directly by **the National Oil Spill Detection and Response agency.** If the host is near a host

community, an estimated volume for the spill is worked out by an agreed formula and signed off by all parties. The form relating to the spill needs to be agreed and signed before the company can move ahead to recover oil in order to limit the amount that goes into the environment. Oil companies are also required to **undertake Environmental Impacts Assessments (EIAs).** Such regulations and procedures are required to be in place to facilitate efficient responses and cleanup when there is an oil spill or leakage during the extraction process. **However, it is not often successful** if the officials **are easily bribed** and when actions are taken only after disasters and oil spill occurred- it would not be as effective.

**Successful examples**

Chile is rich in copper and have established the regulatory and institutional basis for the development of the mining sector in the 1980s. Till today, copper still accounts for around 10% of its GDP. To ensure it can maximise the positive effects of its extractive industry, it has set up a *Ministry of Mining* to dictates and evaluates the national mining policy in Chile.

it fosters the development of the mining industry by supporting investment and promoting the collaboration between the private and public sectors and by reducing regulatory uncertainty. It is responsible for the inspection and enforcement of mining regulations in terms of safety, property and closure plans, the provision of technical advice to the Courts of Justice in matters related to mining rights and offers technical opinions on projects that have an environmental impact, and the generation, maintenance and spreading geological information of the country.

It also conducts Environmental Assessment Service or Environmental Impact Assessment to determine if resource extraction can/should be carried out. Usually an EIA is required if it can potentially generate one of the following impact

- Health risk for the population due to the quantity and quality of the emissions and residues.
- Significant adverse effects on the quantity and quality of the renewable natural resources, including soil, water and air.
- Resettlement of human communities or significant modification to the life systems and customs of human groups.
- Located in or next to populations, resources and protected areas, priority areas for conservation, protected wetlands, glaciers, susceptible to impacts, as well as the environmental value of the area where the project would be located.
- Significant alteration, in terms of magnitude or duration, of the landscape or tourist value of an area.
- Alteration of monuments, areas with anthropological, archaeological, historical and cultural value.

**China** which also have many natural resources and rare earth minerals, have suffered greatly from its highly pollutive mining sector, this is acknowledged by the Ministry of Environmental protection in 2016. **It thus plans to raise environmental standards** for all segments/parts of the mining process, by declaring war on polluters and have drawn up new laws, standards and punishments.

Including: more than 85 percent of wastewater from mines must be treated and companies must find ways to achieve comprehensive utilization of tailings and other solid waste. It will also police the entire supply chain all the way up to exports. Firms will also be forced to implement measures to remediate land and minimize emissions while mines are still in operation, rather than treating soil and water long after it has been contaminated.

As much as 16 percent of China's soil exceeds state pollution limits, according to environment ministry data published in 2015, and farming on 3.3 million hectares (8.15 million acres) of contaminated land across the country has been banned indefinitely.

**Malaysia**

In 2016, Malaysia imposed a 3 year ban on bauxite mining to stop and reverse the water pollution of rivers and streams caused by bauxite mining. This was in response to public outcry in 2015 when bauxite mining was blamed for turning the waters red on a stretch of coastline and surrounding rivers in eastern peninsula Malaysia after heavy rains. This ban was extended to 2019, when Malaysia decided to resume bauxite mining in order to profit from the strong global demand for it to make aluminium. Stricter guidelines are in place such as using specific lorries to transport bauxite, and now allow unprocessed bauxite to be transported to prevent air pollution from bauxite dust. High fines are also in place deter illegal bauxite mining.

**El Salvador**

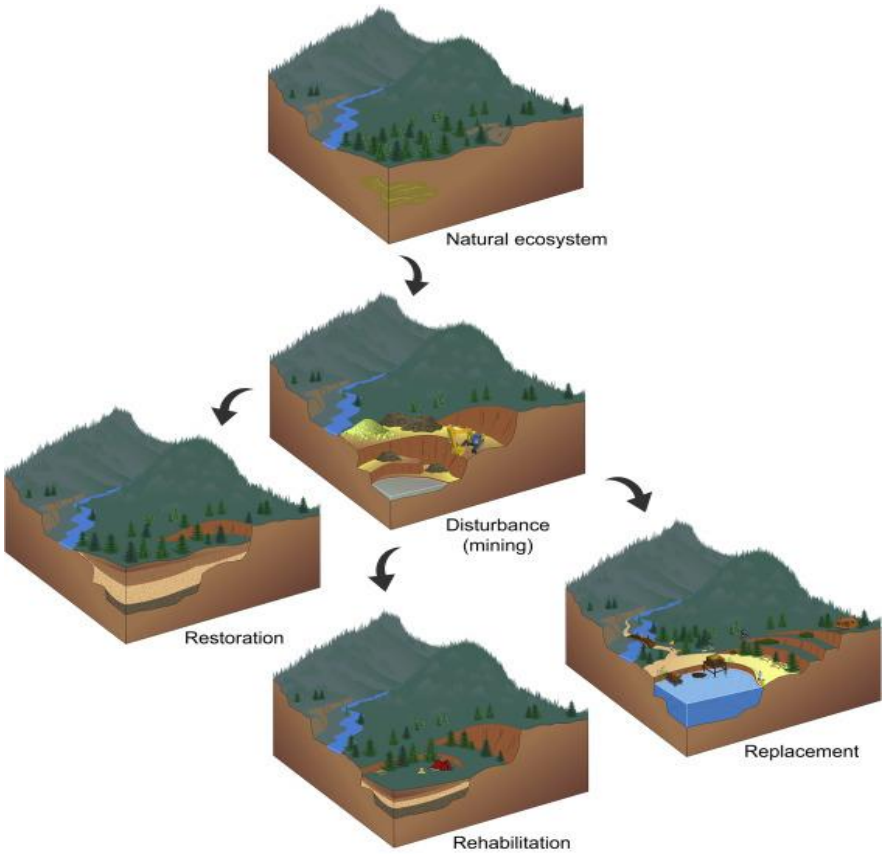
Another landmark event was in 2017, when El Salvador becomes the first country to ban metals mining. "Prizing Water over Gold, Bans all Metals Mining" according to the New York Times. As the lawmakers deem that its fragile environment could not sustain metal mining operations- they chose it over gold and decide to prioritise their country's dwindling supply of clean water.

But they can still mine coal, salt and other nonmetallic substances…

**2. Environmental/Ecological Restoration**

Ecological restoration of mining areas refers to restoring the degraded mining area ecosystems' ecological balance caused by some mining activities through adopting suitable land utilizing method.

In 2016, China issued the "Opinions on Establishing a Uniform and Standard National Ecological Civilization Pilot Area" document to specify the specific implementation plan for the construction of an ecological civilization system. The pace of ecological restoration in the mining area should not be allowed to stagnate. Mining land reclamation has played an important role in ecological restoration. In the past 10 years, some model restoration projects have achieved great successes, such as the Hubei Huangshi National Mine Geological Park, the Shanghai Chenshan Botanical Garden Pit Garden, and the Xuzhou Panan Lake Wetland Company. The success of the demonstration project and the desire of local government's indicators for land use have greatly stimulated the government's recovery activities of mining sites.




As seen from the picture there are various types of environmental restoration. It may not always be possible to restore it to the original state. So there is also a need to rehabilitate the area or replace it for alternative uses.

**The National Park Service of the US government highlights that:**

Scars on the land may last thousands of years even if mined areas stabilize and the vegetation recovers. Carefully planned reclamation can restore natural processes and greatly speed site recovery. Reclamation in the National Park System focuses on reestablishing landscapes and environments that mimic the surrounding undisturbed lands. Mine structures such as mills, shops, headframes, and others of historic value are stabilized and preserved. Otherwise, the pre-mine condition is restored wherever possible. Reshaping the surface stabilizes slopes and drainages, waste rock piles, tailings ponds, highwalls, and access roads.

The restoration of stream channels also provides for the reintroduction of plants and animals that were lost because of mining. The same type of earthmovers that created the mineral extraction scars are often the best suited to remove them. Road corridors are restored to original contours, which stabilizes the slope and reestablishes the natural drainage pattern, Redwood National Park, California.

Appropriate cleanup or treatment of hazardous waste prevents further impacts to natural and cultural resources. Small quantities of mining related materials, such as chemicals or fuels used in mining and milling, are completely removed. Large quantities of naturally occurring materials such as acid-generating waste rock may be treated on-site. Applications of lime may provide a buffer to prevent the generation

of acids. In more severe cases, limestone drains or artificial wetlands filter heavy metals and reduce acidity. In worst-case scenarios, active water treatment systems may be necessary.

The goals for revegetation of mine sites in the National Park System are the restoration of native plant populations and patterns. The first consideration is the suitability of the soil for revegetation. In harsh conditions, topsoils, compost, or specific nutrients can be added. Specialized nurseries may be needed to propagate suitable plant materials. Sometimes, revegetation work is focused on establishing pioneering species to allow for natural succession. Time and nature then restore the natural productivity in the site.

**Parts of the Appalachain forest have been successfully restored after it was operated as coal mines, research shown that forests could be returned to these mined land and the ecosystem can recover gradually as well.**

Similarly, the Eden project in the UK converted an abandoned clay quarry that is 60m deep into the ground with no soil into a biome and opened as a botanic garden which helped earned revenue for tourism and reflect that with proper planning, funding and technical expertise, mine restoration can be successful that has generated over 2 billion pounds of revenue for the local economy.

**However,** for environmental restoration projects to be successful, government must be willing to dedicate economic resources, manpower and commitment to the site- they must also have plans for the sites post reclamation

The main obstacle is costs, for example, the price tag for cleaning up modern coal mines in Appalachia is between US$7.5billion and USS9.8 billion – government may not have the means to fund it- for USA- they only budgeted about $3.8 billion for it. Without proper legislation and planning for the government – it is difficult to execute. Currently, government such as the UK is mandating that the TNCs are the one who needs to close the mines and restore the surface back to its original state. But what if the TNC refuses to or have gone bankrupt? Mines can cost up to $1 billion to close and TNCs may also decide that lawsuits or fines might be cheaper. Mine Closure and restoration are also complex and the technical challenges are starkly different to those experienced building and operating a mine. For example, the Mary Kathleen Uranium Mine was rehabilitated and relinquished in 1986 winning an award for technical excellence at the time. However, the waste encapsulation dump has subsequently failed with the liablity and associated costs now residing with the Queensland Government. Critics have also lamented that even if it is restored, it may not regain the normal biodiversity or ecological benefits- the mine restoration in Appalachian mountains look more like grassland and forests and the groundwater contamination and loss of streams are irreversible after mining activity.

### 3. Good Governance and ownership over extractive industries

Having ownership over the extractive industries operating in the country creates a better possibility that the negative impacts are reduced compared to it being operated by foreign TNCs.

This is because if the extractive industries are state-owned corporation, it will be easier to regulate it and to ensure it adheres to the environmental regulations set by their own government. Poor regulation and control over state-owned corporations could also reflect poorly on the government which could make

citizens turn against it (or vote the government out). They can then leverage on the extractive industry to provide employment and to invest in public goods and services within their own country.

Good governance also meant the ability to enforce laws and to punish TNCs or their own corporations if required to minimise the negative impacts of extractive industries. Subsequently there must be good foresight to invest and diversify the economy using the wealth of the extractive industries, so that they are not overly reliant on foreign TNCs or have no alternative if the resource runs out from the extractive industries.

If governments are accountable to the public, most of the dealings are transparent and there is minimal corruption. It is possible to convert the revenue earned from resource into significant public projects that well improve the economy as a whole. In Nigeria, the country's own corruption agency estimates between $300 Billion to $400 Billion of Oil money has been stolen or wasted over the last 50 years.

**Contrastingly,** Botswana is considered one of the most stable countries in Africa. It manages to stamp out corruption and utilizes a three prong approach to use its income from diamonds to develop. Botswana is the world's largest producer of diamonds, a status its held the 1970s. In marked contrast to many other African countries, which are resource rich and prone to conflict and corruption, Given that minerals account for three-quarters of its exports and over 40 percent of its GDP, this is a remarkable feat. The sub-Saharan country has **managed to greatly diversify its economy** (which is still prone to market swings; 40 percent is a lot) and is one of the least corrupt countries on the continent. Rather remarkably, the country has also remained conflict-free, an aspect which along with stable governance has encouraged business growth, regional investment and FDI.

Botswana has – unlike many African nations – managed to avoid the resource curse via what the African Development Bank characterizes as a 'three pronged' approach: First, with foresight, the country pursued economic diversification. Second, it divested revenues, seeking to make the economy less susceptible to global markets. Third, it invested surplus revenues. **[Other countries who have successfully preserved their resource wealth are also examples you can use.]**

**Evidently,** being able to beat corruption and having good governance and plans to rebuild the economy is one viable strategy to **manage impacts of extractive industries**. However, in reality it is not so easy to eradicate corruption in countries. We need help from International Organisations as well For example, the World Bank's International Finance Corporation (IFC) stipulates the social, environmental, and governance requirements for all World Bank investments in private-sector projects. In 2011 the IFC made revisions that included strong improvements mandating contract and revenue transparency. However, the IFC rules do not affect bilateral loans. This loophole permits donor countries to continue lending money to companies that collude with unsavoury officials while keeping the terms of billion-dollar oil and mining deals secret from the public.

**In conclusion**, in thinking about how to **manage the impacts of extractive industries**, it is important to note that all countries want to maximise the positive impacts but minimise the negatives. Good governance is a crucial element to ensure that the extraction of resources can (sort of) bring about at least maximise the good while minimising the bad (through laws and environmental restoration).

## Case Study 1: Shell in Nigeria

Oil has been an important part of the Nigerian economy since vast reserves of petroleum were discovered in Nigeria in the 1950s. Shell Oil operates many of its oil facilities in the oil-rich Delta region of Nigeria. The social and environmental costs of oil production have been extensive. They include destruction of wildlife and biodiversity, loss of fertile soil, pollution of air and drinking water, degradation of farmland and damage to aquatic ecosystems, all of which have caused serious health problems for the inhabitants of areas surrounding oil production. Pollution is caused by gas flaring, above ground pipeline leakage, oil waste dumping and oil spills. Approximately 75% of gas produced is flared annually causing considerable ecological and physical damage to other resources such as land/soil, water and vegetation. Gas flares, which are often times situated close to villages, produce soot which is deposited on building roofs of neighbouring villages. Whenever it rains, the soot is washed off and the black ink-like water running from the roofs is believed to contain chemicals which adversely effect the fertility of the soil. Gas pipelines have also caused irreparable damage to lands once used for agricultural purposes. This greatly reduce the regenerative capacity of land. These pipes should be buried to reduce risk of fracture and spillage. However, they are often laid above ground and run directly through villages, where oil leaks have rendered the land economically useless.

Oil spills and the dumping oil into waterways has been extensive, often poisoning drinking water and destroying vegetation. According to an independent record of Shell's spills from 1982 to 1992, 1,626,000 gallons were spilt from the company's Nigerian operations in 27 separate incidences. Of the number of spills recorded from Shell - a company which operates in more than 100 countries - 40% were in Nigeria.

Shell is also being accused of engaging in "widespread ecological disturbances, including explosions from seismic surveys, pollution from pipe-line leaks, blowouts, drilling fluids and refinery effluents, and land alienation and disruption of the natural terrain from construction of industry infrastructure and installations". For example, oil spill contamination of the top soil has rendered the soil in the surrounding areas "unsuitable for plant growth by reducing the availability of nutrients or by increasing toxic contents in the soil" [link to THEME 1]

Gas flaring, on the other hand, "has been associated with reduced crop yield and plant growth on nearby farms, and disruption of wildlife in the immediate vicinity". Shell and other oil companies have developed an easy and inexpensive way to deal with by-products from oil drilling: "indiscriminate dumping".

## Case Study 2: British Petroleum (BP) Deepwater Horizon Oil Spill

Another significant disaster is the BP oil spill where a deepwater oil well exploded on 20 April 2010 in the Gulf of Mexico.

The immediate effect was that it killed 11 people and injured 17 others. Oil leaked at a high rate which is difficult to calculate. Some estimates are around 40,000 barrels a day. The oil spill posed risks to the environment and affected local industry.

The spill was by far the largest in US history, almost 20 times greater than the usual estimate of the Exxon Valdez oil spill. Factors such as petroleum toxicity, oxygen depletion and the use of Corexit are expected to be the main causes of damage

***Impact on Marine Species***

Most of the impact was on the marine species. Eight U.S. national parks were threatened and more than 400 species that live in the Gulf islands and marshlands are at risk, including the endangered Kemp's ridley turtle, the green turtle, the loggerhead turtle, the hawksbill turtle, and the leatherback turtle. In the national refuges most at risk, about 34,000 birds were counted, including gulls, pelicans, roseate spoonbills, egrets, terns, and blue herons. A comprehensive 2009 inventory of offshore Gulf species counted 15,700. The area of the spill includes 8,332 species, including more than 1,200 fish, 200 birds, 1,400 molluscs, 1,500 crustaceans, 4 sea turtles, and 29 marine mammals. In a 2011 paper in the journal BioScience, researchers from the University of New Hampshire reported that the spill threatened 39 marine species in addition to the 14 currently under federal protection. Threatened species, the report found, ranged from 'whale sharks to seagrass".

Harry Roberts, a professor of Coastal Studies at Louisiana State University, has stated that 4 million barrels (640,000 m3) of oil would be enough to "wipe out marine life deep at sea near the leak and elsewhere in the Gulf" as well as "along hundreds of miles of coastline

***Impact on Beaches***

A 2012 study of the sands of the contaminated beaches and marshes showed that the variety of organisms, one of the lowest links in the food chain, had dropped dramatically since the spill. The remaining species are believed to be those that favor polluted conditions and that consume hydrocarbons. This could result in long-lasting effects to the ecosystem. Trace minerals and metals such as mercury and arsenic deposited by the oil may cause harm to both wildlife and humans. The use of dispersant to help cleanup made oil sink faster and more deeply into the beaches, and possibly groundwater supplies.

**Case Study 3: Environmental Damage by Mining: OK Tedi Mine in Papua New Guinea**

The environmental impact of mining includes erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater, surface water by chemicals from mining processes. In some cases, additional forest logging is done in the vicinity of mines to increase the available room for the storage of the created debris and soil. In areas of wilderness mining may cause destruction and disturbance of ecosystems and habitats, and in areas of farming it may disturb or destroy productive grazing and croplands. In urbanised environments mining may produce noise pollution, dust pollution and visual pollution.

The Ok Tedi environmental disaster caused severe harm to the environment along 1,000 kilometres (620 mi) of the Ok Tedi River and the Fly River in the Western Province of Papua New Guinea between about 1984 and 2013. The lives of 50,000 people have been disrupted. One of the worst environmental disasters caused by humans, it is a consequence of the discharge of about two billion tons of untreated mining waste into the Ok Tedi from the Ok Tedi Mine, an open pit mine in the Western Province of Papua New Guinea.

This mining pollution, due to the collapse of the Ok Tedi tailings dam system in 1984 and the lack of a proper waste retention facility, was the subject of class action litigation, naming Ok Tedi Mining Limited and BHP Billiton and brought by local landowners. In 1999, BHP reported that 90 million tons of mine waste was annually discharged into the river for more than ten years and destroyed downstream villages, agriculture and fisheries. Mine wastes were deposited along 1,000 kilometres (620 mi) of the Ok Tedi and the Fly River below its confluence with the Ok Tedi, and over an area of 100 square kilometres (39 sq mi).

Following heavy rainfall, mine tailings are swept into the surrounding rain forest, swamps and creeks, and have left behind 30 square kilometers of dead forest. Thick gray sludge from the mine is visible throughout the Fly River system, although its effects downriver are not as severe. Chemicals from the tailings killed or contaminated fish, although they are still eaten by the people of the surrounding villages. However, fish counts decrease closer to the mine. The massive amount of mine-derived waste dumped into the river exceeded its carrying capacity.

This dumping resulted in the river bed being raised 10 m, causing a relatively deep and slow river to become shallower and develop rapids, thereby disrupting indigenous transportation routes. Flooding, caused by the raised riverbed, left a thick layer of contaminated mud on the flood plain among plantations of taro, bananas and sago palm that are the staples of the local diet. About 1300 square kilometers were damaged in this way. The concentration of copper in the water is about 30 times above the standard level, but it is below the World Health Organisation (WHO) standards.

## Change in power relationship between State and TNC

The power relationships between states and firms are highly dynamic and depends on the bargaining power between the state and the TNC. The term 'obsolescing bargain', which refers to the situation in which, once private capital is 'sunk' in a fixed form, the advantage tends to move away from the investor to the state which controls access to the resource. This is especially so for extractive industries.

A recent detailed study of the development of the oil industry in Kazakhstan provides evidence of how a state can learn how to renegotiate contracts with a foreign investor; showing how the balance of power can shift over time.

Kazakhstan achieved independence from being a Soviet republic in 1991. It was rich in oil but lacked the technology to develop its resource, requiring foreign investors to develop the industry. Like many other former Soviet republics and allies, Kazakhstan rushed into the wholesale privatization of its assets, primarily its resource extraction activities. By 2002, around half of the FDI entering Kazakhstan was concentrated in the petroleum industry. ¼ of the country's oil production originates from the Tengiz oilfield in the west. It is a rich field, but difficult to exploit due the high pressure nature and the need to remove poisonous hydrogen sulphide from the oil.

Such a challenging field required very sophisticated technology. The US company Chevron had started negotiations with the Soviet government in 1990. After independence in 1991, the negotiations shifted to Kazakhstan, a state with absolutely no experience in such complex political bargaining. In contrast, Chevron, one of the world's biggest and oldest oil companies, was a very old hand at this game. Ten years after the contract was signed, Kazakhstan attempted to renegotiate the terms, based on the kinds of circumstances implied in the obsolescing bargain concept: the agreement had been made, the investments were sunk, the oil was beginning to turn a profit for the corporation, and the state started to feel that the distribution of benefits were too much in favor of the TNC. The country called for renegotiations.

In such an event, the renegotiations in question were not a simple affair and likely did not progress as Kazakhstan had predicted. The renegotiations involved the financing arrangements for major gas processing and recycling projects designed to reduce pollution as well as for projects to increase production at the TengizChevroil venture.

Chevron initially shut down its operation to protest the renegotiation but after recalculating its costs, expected value, and strategic play, and given the strategy revealed by the State's move, Chevron reversed its decision after just two months. TengizChevroil's operations were resumed in January of 2003, with Chevron agreeing to some revisions in the contractual terms.

On the basis of this learning experience, Kazakhstan subsequently managed to introduce a series of regulatory measures for its oil industry as a whole: renegotiations with other companies; more stringent rules for foreign investors; a reversal of over-generous VAT exemptions; power to cancel a contract that did not meet its economic expectations; introduction of a new oil export duty; and better environmental provisions, including the banning of all gas flaring. Eventually, in 2002, the state set up its own National Oil Company to ensure a more active role in its extractive sector.