“Earth provides enough to satisfy every man’s needs, but not every man’s greed.”

-Mahatma Gandhi
Natural resources are gifts of nature that the mankind uses or can potentially use to create material wealth, to ensure its existence and increase in welfare.

Sustainable use of resources can be ensured by good management, preservation of resources or a slower exploitation of resources so that nature can reproduce them.

Over a considerable period of time, the mankind has not been able to manage natural resources effectively due to the population growth, reduced access to a number of resources and over use of the rest of natural resources.
CLASSIFICATION OF NATURAL RESOURCES

❖ On the basis of origin, natural resources may be divided into two types:

➢ **Biotic** – Biotic resources are obtained from the biosphere (living and organic material), such as forests, animals etc. Fossil fuels such as coal and petroleum are also included in this category because they are formed from decayed organic matter.

➢ **Abiotic** – Abiotic resources are those that come from non-living, inorganic material. Examples of abiotic resources include land, fresh water, air and heavy metals including ores such as gold, iron, copper, silver, etc.
On the basis of their stage of development, natural resources may be classified as:

- **Potential resources** — Potential resources are those that exist in a region and may be used in the future. For example, petroleum occurs with sedimentary rocks in various regions, but until the time it is actually drilled out and put into use, it remains a potential resource.

- **Actual resources** — Actual resources are those that have been surveyed, their quantity and quality have been determined and are being used in present times.
 Reserve resources — The part of an actual resource which can be developed profitably in the future is called a reserve resource.

 Stock resources — Stock resources are those that have been surveyed but cannot be used due to lack of technology. For example: oxygen

 Many natural resources can be categorized as either renewable or non-renewable:

 Renewable resources— Renewable resources can be replenished naturally. Some of these resources like sunlight, air, wind, water, etc are continuously available and their quantity is not noticeably affected by human consumption. Though many renewable resources do not have such a rapid recovery rate, these resources are susceptible to depletion by over-use.
• Resources from a human use perspective are classified as renewable so long as the rate of replenishment/recovery exceeds that of the rate of consumption. They replenish easily compared to Non-renewable resources.

• **Non-renewable resources**— Non-renewable resources are either formed slowly or do not naturally form in the environment. Minerals are the most common resource included in this category. By the human perspective, resources are non-renewable when their rate of consumption exceeds the rate of replenishment/recovery; a good example of this are fossil fuels, which are in this category because their rate of formation is extremely slow (potentially millions of years), meaning they are considered non-renewable.
USE OF THE NATURAL RESOURCES

- As the provision of natural resources decreases, prices go up, unemployment climbs, and it is the availability of natural resources that largely dictates the migration of population, formation of new settlements and the abandonment of inhabited places in the world.

- Historically, the world society has responded to a decrease in the availability of resources with replacement of one resource with another.

- For example, in Great Britain, around 1800, in response to total deforestation people started using coal instead of firewood, while a century later oil became the main energy resource, cheap and widely available.
The availability of all the Earth’s resources is limited in a way, either due to insufficient reserves, complicated extraction or transportation, inadequate technology of extraction and processing.

Thus, a moment comes when the demand for certain resources exceeds that of their extraction. Society responds to this by an attempt to develop the research and extraction of mineral deposits and to improve extraction technologies.
One of the most important renewable natural resources is soil – the biologically active upper layer of land with a unique property – **fertility**.

To provide the world’s population with food, it is imperative that land degradation be reduced.

Reasons for soil degradation:

- Deforestation, overgrazing, inadequate management of land, growth of human population
- Overpopulation, land ownership,
USE OF LAND FOR AGRICULTURE IN THE WORLD
TERRITORIES, WHERE POPULATION EXCEED SOIL CAPACITY FOR FOOD PRODUCTION
What is calling for our attention?

- India as a country is blessed with rich natural resources. But from research on the usage of natural resources in our country, it has been found that the resources are depleting every day. For example:
  - Forest and arable land is being depleted due to urbanization, overpopulation and overconsumption.
  - Water resources are being contaminated and are drying up due to industrialization.
  - Wild life resources are being lost due to illegal poaching, hunting and industrialization.
  - Therefore, it’s high time that there should be natural resource accounting and effective management.
To explain the procedural step followed in the methodology of natural resource accounting

To describe in detail the management, planning & policies of water resources in India
NATURAL RESOURCE ACCOUNTING

- Residual emissions in excess of the assimilative capacity of the ecosystem raise the likelihood of natural and environmental resource degradation.
- **Rapid depletion of exhaustible resources, overexploitation of renewable resources and residual emissions in excess** of assimilative capacity generally indicate that the economy has become too large relative to the ecosystem.
- Traditional measures of economic performance do not account for changes in natural and environmental resource capacity, they are poor indicators of the economy’s long term sustainability.
DEFICIENCIES OF TRADITIONAL MEASURES OF ECONOMIC PERFORMANCE

- Different deficiencies of traditional measures are inappropriate treatment or total disregard of defensive expenditures, resource capacity and residual pollution damages.

- Natural and environmental resource accounting (NERA) rectified certain deficiencies in traditional measures by taking into account the natural and environmental resource capacity.

- Three alternative accounting methods are: Physical, monetary and satellite accounts.
DEFENSIVE EXPENDITURES

- Defensive expenditures are the expenditures made to reduce the adverse welfare effects of resource depletion and environmental degradation.
- Examples of defensive expenditures include expenditures to clean up an oil spill and to decontaminate soil polluted by a hazardous waste.
- As defensive expenditures made by firms are treated as intermediate expenditures in national income accounts, they are excluded from GNP.
- Expenditures made by government to reduce the adverse effects of environmental pollution are included in GNP. As defensive expenditures do not increase economic welfare, they should be subtracted from and not added to aggregate measures of economic welfare.
PROBLEMS WITH DEFENSIVE EXPENDITURE

There is ambiguity as to what constitutes a defensive expenditure.

Defensive expenditures can be double counted.
Changes in natural and environmental resource capacity are not considered in national income accounts.

The term capacity is more appropriate than degradation because it allows for both appreciation and depreciation of natural and environmental resources.

Examples of reduced capacity include high soil erosion, impairment of the carrying capacity of range land due to over grazing, depletion of fossil fuels, deforestation, air pollution and water pollution.
Many resource costs are excluded from national income accounts because they are unpriced.

For example, if the grazing fee for public rangeland is set below the full resource cost of grazing, then resource users shift livestock grazing from private to public rangeland, which results in overgrazing and reduced capacity of public rangeland.

As a result the retail price of meat products is lower and consumption of meat products is higher than they would be if grazing fee reflected the full resource cost of grazing.
As the cost of reduced capacity on public rangeland due to overgrazing is not reflected in retail meat prices and consumption, national income accounts are overstated.

Ignoring changes in resource capacity in national income accounts has negative consequences.
• First, not adjusting NNP for decreases (increases) in capacity inflates (deflate) NNP and overstates (understates) economic progress.

• In cases where capacity is decreasing, failure to adjust NNP, inflates the growth rate, which overstates economic progress.

• Secondly, failure to adjust NNP for changes in resource or environmental capacity, combined with the goal of unlimited growth, accelerates exploitation of natural and environmental resources.

✓ During the period when frontier areas were being developed, competition between the environment and the economy was limited because natural resources were abundant relative to the scale of the economy and technology was not natural resource intensive.

✓ Rapid growth in population and resource-intensive technologies increased per capita use of natural resources and caused the capacity of several natural systems to be exceeded
CONTD…

- Thirdly, because national income accounts do not reflect depletion in natural resource capacity, there is little incentive to consider ecological carrying capacity in developing and evaluating economic policies.

- As long as changes in natural capital are excluded from national income accounts, there will continue to be under investment in technologies and products that protect natural resources and the environment.
According to a report of World bank, Environmental degradation in India, costing 5.7% of GDP each year, can be reduced significantly.

This would allow India to maintain a high pace of economic growth.
Residual pollution damages are human related damages from environmental degradation that are not alleviated by defensive expenditures.

E.g. – Uncompensated environmentally related property damage. Residents of Times Beach, Missouri, were evacuated from their community in 1983 after it was discovered that a highly toxic substance was used in making roads. While the Superfund compensated the residents for the loss of their homes and the cost of relocation, the evacuation caused damages in the form of social and psychological hardships for which compensation was not received.

These are not reflected in market transactions.
RESOURCE ACCOUNTING
METHODS

1. Physical accounts
2. Monetary accounts
3. Satellite accounts
Physical accounts of natural and environmental resources enumerate changes in resource quantity and quality in physical units such as barrels of oil or tons of carbon dioxide emissions.

The stock at the end of a period should equal the stock at the beginning of a period plus net additions.

*Physical accounting systems were first introduced by the Norwegian govt. in 1974.*

The Norwegian govt. classifies resources into two broad categories: material and environmental resources.
Material resources include minerals (oil and natural gas), hydrocarbons (coal and forests), stone, gravel, sand.

Material resources are reported in stock and flow accounts. Stock accounts include developed reserves, undeveloped reserves. Flow accounts monitor extraction and imports by households, industry and government.

Direct comparison is not possible because the economic benefits are in monetary terms and the environmental losses are in physical terms.
French water accounts for water tabulates changes in the stock of water including snow, glaciers, ground water, lakes, ponds etc.

The agent account for water shows expenditure made and income earned on water related activities such as drainage, development of drinking water supplies, irrigation, flood control etc.

Placing a monetary value on environmental losses makes it possible to calculate and compare the economic benefits.
The monetary approach to natural resource accounting is found on the premise that income aggregates, such as GNP and NNP, give a distorted view of economic progress. Distortion results from inappropriate or lack of treatment of defensive expenditures, depletion in resource capacity and residual pollution damages. Incorporating these elements into national income accounts yields a resource-inclusive measure that can be used to determine whether or not the economy is developing in a sustainable manner.
Several monetary indicators of economic welfare have been developed. One of the earliest indicators is **Net National Welfare** which was proposed by Nordhaus and Tobin.

NNW is GNP minus the cost of pollution and other factors that degrade the quality of life, plus the value of uncompensated household services such as cleaning, cooking and repairing.

Household services are included in NNW because they increase the quality of life.

There are three ways to calculate defensive expenditures, net changes in resource capacity and residual pollution damages.
The first method is the balance sheet method. It gives a national balance sheet presentation of national resource accounts.

In this method, net changes in value of stocks are the difference between the ending and beginning values of the stock.

The second method is based on the value of depletion. In this method, the value of extraction or production in the current period is subtracted from NNP.
The third method is adjusting GNP for changes in resource capacity is the net price method.

This method subtracts from NNP the value of total net change in the resource, not just the value of depletion.

The net price method is different from the balance sheet method because it does not consider the changes in the value of the beginning stock due to either inflation or deflation of resource prices.

Procedures for depreciating manufactured capital (structures and equipment) are based on the book value of the asset not on its replacement cost.
Book value does not reflect changes in asset values due to inflation or deflation.

Therefore, the balance sheet method is inconsistent, whereas the net price method is consistent with current methods for depreciating manufactured capital in national income accounts.
Satellite accounts are natural resource accounts that are kept separate from the core national income accounts. They can be reported in either physical or monetary units.

These accounts include satellite accounts that track changes in the value of reproducible tangible assets such as forests and non-reproducible tangible assets used in commercial production.

Publicly owned natural resources such as national parks are excluded from the satellite accounts because SNAs only cover transactions involving assets in the private market economy.
Deterioration of the freshwater quality and depletion of its resources in certain regions of the world may become one of the most topical problems of society in the 21st century.

According to the UN prognosis, 2.8 billion people in 48 countries will suffer from the shortage of freshwater by 2025; 40 of these countries are in western Asia, northern Africa and the Sahel zone in Africa.

Ground water polluted with oil products, *Denmark*
India attained its independence from the British rule in August 1947. With independence came partition of India and loss of large productive irrigated lands to Pakistan. The slow pace of irrigation development during the last decades of colonial regime had also aggravated to the current problem situation of food shortage.

To overcome the food grain shortage, huge investment in large-scale irrigation project was considered to be the best option to redress all these problems. And this was apparent from the Five Year Plans (FYPs), which started in 1951.
LARGE SCALE IRRIGATION SCHEMES

- Investment in the large scale surface irrigation was targeted under the first two plans and giant projects like Bhakra-Nangal, the Damodar Valley and Hirakud projects were undertaken during that time.

- The large-scale irrigation schemes were multi-purpose and depended on reservoirs unlike the run-of-the-river irrigation schemes of the colonial India.

- More than 90 percent of public investments in agriculture were allocated for large-scale projects during the first 40 years after independence.
Fall of water rates, squeezing of the budgets corresponding to the fall of the salary levels of the Irrigation Department (ID) staff further added to the mismanagement and poor performance of big irrigation projects.

For a long time Irrigation Department (ID) professed that the main problems of water management is because of the farmers and the need of the hour was to educate farmers about how to use water effectively and properly.

Thus, in 1974-75 Central Government initiated the Command Area Development Programme (CADP) for water management in the command areas, but the programme did not take into account studying the vital central issues of system design and management practice.
Furthermore in regard to community participation in irrigation management, Government of India had also launched National Water Policy (NWP) of 1987 putting emphasis on farmer’s participation in the management of irrigation systems especially in water distribution and collection of water charges.

The National Water Policy (NWP) of 2002 emphasizes on participatory approach for the management of the water by having cooperation between various governmental agencies and other stakeholders including women participation in various aspects of planning, design, development and management of the water resources schemes.
• With the expansion of modern groundwater extraction technology along with Green Revolution in 1960-70s acted as key factors in the dysfunctioning of the tanks.

• The micro-watershed based approach to natural resource management has been hampered due to compartmentalization of various government programmes and the centralization of various programmes meant for the water development.

• **Indian watershed projects started spreading widely in the late 1980s and 1990s.**
The mechanized lift irrigation from groundwater started in mid 1960s with the advent of new pumping technology, which made possible to bore deep wells and extract water in large quantities.

Although the wells were individually-owned and direct government involvement in tubewell management was through incentives and disincentives, only with the exceptional cases of Eastern Floodplains, like Eastern Uttar Pradesh, Bihar, West Bengal where State Irrigation Department (SID) were actively engaged in installing deep tubewells.
The main objective behind public tube well projects was to encourage the use of tube well.

The expansion of groundwater irrigation has been effective due to improved drilling and lifting technologies along with liberal credit provision; lower per unit cost of water pumping, enormous rural electricity program with subsidized supply of electricity.

The absence of effective institutional control measures and checks has led to severe over-exploitation of the groundwater.
Central Ground Water Authority (CGWA) was constituted under Environment (Protection) Act, 1986 for the purpose of groundwater development.

The existing institutional arrangement for water resource management in the country is fragmented with a number of independent organizations dealing with water at the centre and state levels.

Groundwater, on the contrary, is purely a private good having rights linked with land ownership. However, regulations through indirect means via the National Bank for Agricultural and Rural Development (NABARD) and State Electricity Boards have been adopted.
In view of the existing status of water resources and increasing demands of water for meeting the requirements of the rapidly growing population of the country as well as the problems that are likely to arise in future, a holistic, well planned long-term strategy is needed for sustainable water resources management in India.

Data monitoring, processing, storage, retrieval and dissemination constitute the very important aspects of the water resources management.

These data may be utilized not only for management but also for the planning and design of the water resources structures.
GROUNDWATER MANAGEMENT

- Overexploitation of groundwater should be avoided, especially near the coasts to prevent ingress of seawater into freshwater aquifers.
- In critically overexploited areas, bore-well drilling should be regulated till the water table attains the desired elevation.
- Due to declining water table, the cost of extraction of groundwater has been increasing over time and wells often go dry. Role of government will have to switch from that of a controller of groundwater development to that of a facilitator of equitable and sustainable development.
In western India’s unconfined alluvial aquifers, it is being increasingly realized that groundwater depletion can be countered only by importing surface water.

Similarly, one of the major uses Gujarat has found for water of the Sardar Sarovar Project on Narmada river is to recharge the depleted aquifers of North Gujarat and Kachchh.
Currently, many programmes, campaigns and projects are underway in different parts of India to spread mass awareness and mobilize the general population in managing water resources.

**Hariyali** (meaning ‘greenery’) is a watershed management project, launched by the Central Government, which aims at enabling the rural population to conserve water for drinking, irrigation, fisheries and afforestation as well as generate employment opportunities.

TBS is an NGO which promotes sustainable water management through rainwater harvesting in Rajasthan.
Rainwater harvesting is the process to capture and store rainfall for its efficient utilization and conservation to control its runoff, evaporation and seepage.

**Kuhl (diversion channels)** irrigation system which carries water from glaciers to villages is practiced in Himachal Pradesh.

In the arid regions of Rajasthan, rainwater harvesting structures locally known as **Kund (a covered underground tank)**, are constructed near the house or a village to tackle drinking water problem.

In Meghalaya, **Bamboo Rainwater Harvesting** for tapping of stream and spring water through bamboo pipes to irrigate plantations is widely prevalent.

Harvesting rain water not only reduces the possibility of flooding, but also decreases the community’s dependence on groundwater for domestic uses.
Rain water harvesting
avoid drought
INTERBASIN WATER TRANSFER

- The transfer of water from **surplus areas to deficit areas** is known as inter basin water transfer.
- Inter-basin transfer of water in India is a long-term option to partly overcome the spatial and temporal imbalance of availability and demand of water resources.
- In India, projects like the Periyar–Vaigai system, Indira Gandhi canal stand as classic examples of inter-basin water transfer.
Provision of legal restrictions on proper utilization of groundwater resources has been advocated at various regions in the country.

In fact, **Gujarat has already enacted such legislation and other states may also follow the suit.**

Provision of legal restrictions should be carefully thought of and need mobilization of qualified water specialists to explore effective solutions.
DESALINATION OF WATER

- There has been significant commercial development using various desalination technologies, including distillation, reverse osmosis.
- **This technology is suitable for use in areas where freshwater is scarce, but saline water is available and energy is cheap**
- Compared to water recycling technologies, desalination presents fewer health risks.
- Solar and wind energy are available in abundance in India and may be explored as alternative sources for this purpose in the coastal states.
- **National water Mission:**
  The objective was to conserve water through minimizing wastage and ensuring equitable distribution of water across and within states through integrated water resource development and management.

- **National Water Policy:**
  The objective was to conserve water by taking into account the changes in economic, social, climatic and demographic situation of the country.

- **Accelerated water supply programme:**
  It was a national level policy framework for water supply in rural areas.
Uttar Pradesh Water Management and Regulatory Commission Act:

Major objective is depoliticization of the regulation of water resources by establishing institution where govt. has no control. It mainly deals with water allocation.
Water management has been a contentious and tricky affair in India due to socio-economic-political and ecological reasons.

Factors like caste-class differences, heterogeneity of farmers, rural–urban dichotomy, and extreme different ecological conditions have influenced the water management.

Lack of coordination between irrigation bureaucracy, policy making and various sectoral departments carrying out their own water programmes, have affected water management in a diverse manner to people.

In this diverse regime, India has been embracing water management in its water policies, but they remain a mere proposition.
SUGGESTIONS ...

- As long as changes in natural capital are excluded from national income accounts, there will continue to be underinvestment in technologies and products that protect natural resources and the environment. So, natural resource accounting should be mandatory.
- Private wells should be banned or public water supply should be improved.
- Regulating final users is impossible; we can facilitate mediating agencies to emerge, and regulate them.
- Rain-water can be captured and recharged.
- The irrigation needs for fulfilling crop water requirements should be satisfied by judicious utilization of available canal water in conjunction with groundwater so as to keep the water table within the acceptable range.