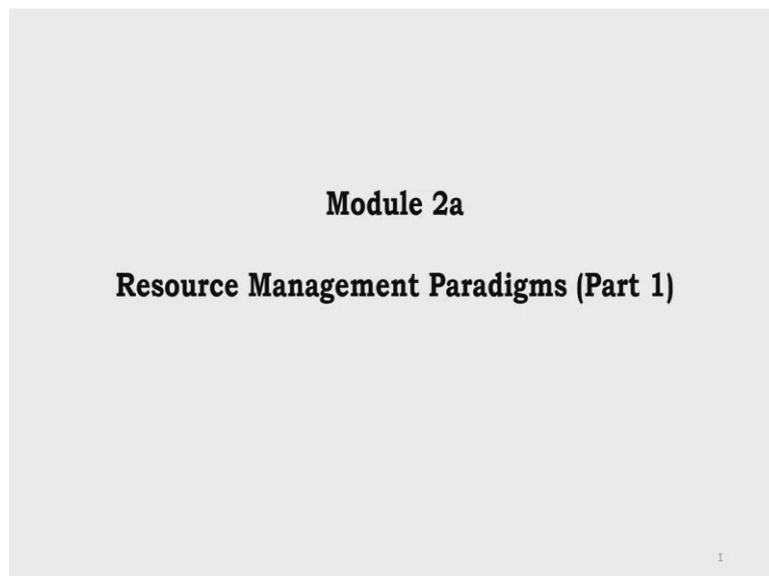


Natural Resources Management (NRM)
Professor Sudip Mitra, PhD
Centre for Disaster Management & Research (CDMR)
Head, School of Agro & Rural Technology (SART)
Discipline - Agriculture Engineering
Indian Institute of Technology, Guwahati, Assam, India
Week - 01
Lecture - 05
Resource Management Paradigms (Part 1)

So, welcome to the next module following our previous lecture, where we were talking about that interrelationships between various natural resources and how each natural resources are dependent on other and also that, any compartmental approach for natural resource management will not provide us the anticipated or expected outcomes.

(Refer Slide Time: 1:03)



Resource Management

- Resource Management is a process of decision making whereby resources are allocated over space and time according to the needs, aspirations and desires of man within the framework of his technological inventiveness, his political and social institutions and his legal and administrative framework (O'Riordan 1971).
- Resource Management in terms of the environment can be defined as the management of the interaction and impact of human societies on the environment. Its goal is to ensure that ecosystem services are protected and maintained for future generations and maintain ecosystem integrity by considering ethical, economic and ecological variables and aspects.
- Natural Resource Management (NRM) refers to sustainable utilization of major natural resources, such as land, water, air, minerals, forests, fisheries and wild flora and fauna (Muralikrishna and Manickam, 2017). These resources provide ecosystem services and fundamental life support in the form of both consumptive and public-good services.
- NRM focuses on scientific and technical understanding of the life supporting capacity of natural resources and how they can be managed for maximum benefits in terms of utilization, consumption and sustainable development.

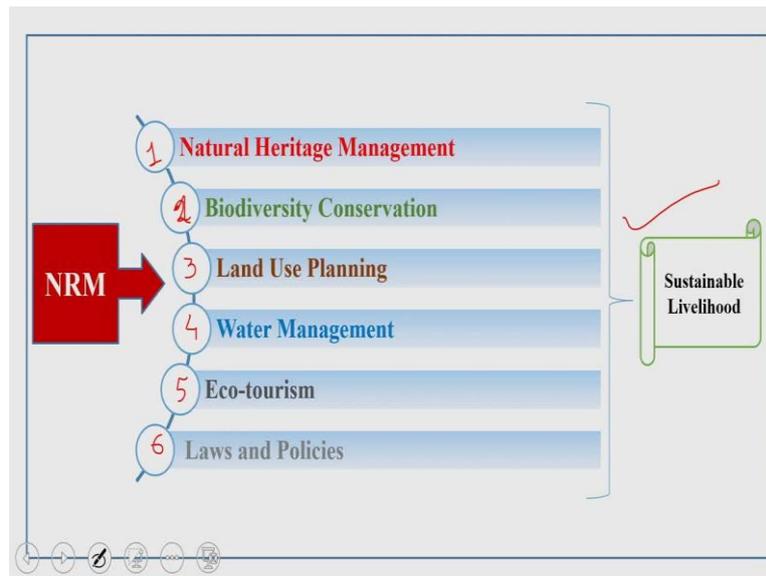
2

So, today we will discuss about the various natural resource management paradigms. So, if you look at this resource management is a process of decision making whereby the resources are allocated over space and time and it depends on the aspiration requirement of people. Resource management in terms of environment, it can also be defined as the management and interaction and impact of human societies on the environment because most of the natural resources which are utilized by us it is for our life, survival, livelihood generation, maintaining lifestyle, so, it is important, and it is a kind of a responsibility on us to manage these resources in an optimal manner with minimum effect on our environment.

Natural resource management or NRM, it actually refers to sustainable utilization of major natural resources such as air, water, land, forest, mineral resources, so and so forth. Biodiversity, flora and fauna around us, each one of these has a role to play in our life. Now, it is our duty and also for our own interest to manage these resources in a sustainable manner.

Now, NRM it focuses on scientific and also technical understanding of the life supporting capacity of these natural resources, and how these resources can be or should be managed for the benefit of us, because it is we the mankind are actually utilizing these resources for our own benefit; for our own well-being.

(Refer Slide Time: 2:56)



Now, if you look at NRM, Natural Resource Management, if it is done in an appropriate manner, then basically, it leads to your sustainable livelihood. Now, how you can actually achieve sustainable livelihood, what are the different way of natural resource management that we should actually follow to achieve a sustainable livelihood.

Natural heritage management, a very important aspect of NRM. Biodiversity conservation, over the last couple of classes, we have already discussed that how important biodiversity is for our own survival. Land use planning, proper land use planning like where you would have agriculture and in which land you should have forest, in which land you should have for some other development activities.

So, land use activities, these are important, but it requires good planning, good planning, so that you can maximize the utilization of natural resources without harming its base or regenerative capacity.

number 4, Water Management, number 5, Ecotourism and 6 Laws and Policy, because we need helpful laws and policies which allow us to protect, preserve, conserve these resources, which are the very basis of our survival. So, these are the different approaches within natural resource management that would allow you to actually achieve sustainable livelihood.

(Refer Slide Time: 4:37)

Key concepts of Resource Management			
<p>✓ Resource Allocation:</p> <ul style="list-style-type: none"> • Temporal and spatial pattern of resource uses in a pattern that reflects the goals, priorities and aspirations of a community. (Mitchell 1989). • It should focus on production, consumption and distribution of resources considering local, regional and national development objectives. 	<p>✓ Resource development:</p> <ul style="list-style-type: none"> • It is the actual exploitation or use of a resource during its transformation from a neutral stuff to a commodity or service to meet human needs and aspirations. • Involves placing value, extraction and processing so that a neutral stuff becomes a resource. 	<p>✓ Resource Management:</p> <ul style="list-style-type: none"> • Involves control on the amount, quality, timing, availability and general direction of resource development. • Promotes exploitation, enhancement and restoration of resources. 	<p>✓ Resource Conservation:</p> <ul style="list-style-type: none"> • It is the management of the human use of natural resources to provide the maximum benefit to current generations while maintaining capacity to meet the needs of future generations. • Conservation includes both protection and rational use of natural resources.

Now, let us see few key concept or important concept with regard to resource management. First resource allocation, very important, where and how much resources should be allocated, that is a very, very important factor for resource management. Now, this resource allocation can be temporal or spatial over a period of time or over space, how much area or how long?

So, this temporal and spatial pattern of resource uses actually reflect the goal and the priorities and aspiration of a particular community or particular region or country. So, in resource allocation, we should focus on the production, consumption and also the distribution of resources and we must consider the local, the regional and the national development objectives, because without that, you cannot have a proper resource allocation policy.

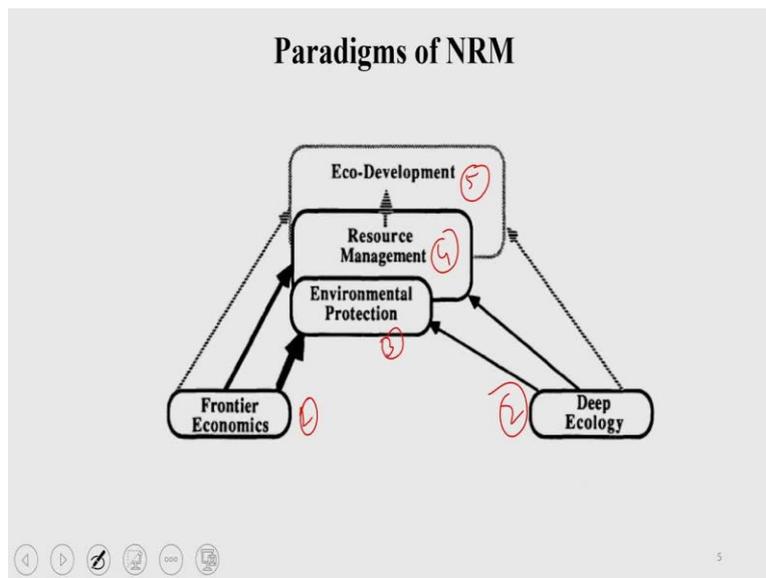
Second resource development, now, it is actually the exploitation or you can say the use of resources in the process of development, it involves putting a value on the natural resources, so, that a neutral thing becomes a resource. As an example, suppose forest, forest also has a value, every forest product has a value in fact, soil, water or any natural resources, you say, it has a economic ecological value. So, if we put those, if we attach somehow these values with natural resources, then that resource development process become much more efficient.

Third, resource management, which actually we are dealing in this course, it involves about the amount, quality, timing, availability, how much, where, when, so, all these aspect actually comes under resource management, it one side it promotes the utilization or exploitation of these resources, but on the other side, it also encourages restoration of resources, because it is for the benefit, for our own well-being, if we have good resource management, then only we

can use in the future. So, our own existence depends on a proper resource management policy or system.

Next, resource conservation. Very important and it is the most important aspect of NRM that, how you can actually conserve the resources that provide us the maximum benefit. But at the same time, we also need to think that those very resources must be available for our future generation as well. So, conservation has an important role to play. It not only allow us to utilize at present a certain natural resource, but also, it ensures that that particular natural resource is also available for the upcoming generation. So that is the very foundation of sustainable natural resource management.

(Refer Slide Time: 8:09)



Now, I will talk about few paradigm of natural resource management, if you look at natural resource management are basically working on 5 paradigms, different paradigms, and each one of them are having very different philosophy behind that. Now, starting from frontier economics, then you have deep ecology, Environment Protection, number 4 resource management, and then you have eco-development.

And if you look at these 5 paradigms, each one of them having some common, but they could be very different from each other. Now, I will discuss about each one of them and the differences among these paradigms, then it is up to you to choose that which one is appropriate for natural resource management at this context.

(Refer Slide Time: 9:11)

Table 1. Basic Distinctions Between Five Paradigms of Environmental Management in Development

Paradigm > Dimension	Frontier Economics	Environmental Protection	Resource Management	Eco-Development	Deep Ecology
Dominant Imperative:	"Progress," as infinite Economic Growth and Prosperity	"Tradeoffs," as in Ecology versus Economic Growth	"Sustainability" as necessary constraint for growth/development.	"Green Growth": Co-developing Humans and Nature, Redefine "Security"	"Eco-topia": Anti-Growth "Constrained Harmony with Nature"
Human-Nature Relationship:	Very Strong Anthropocentric	Strong Anthropocentric	Modified Anthropocentric	Eco-centric	Biocentric
Dominant Perceived Threats:	Hunger, Poverty, Disease, "Natural Disasters"	Health Impacts of Pollution, Endangered Species,	Resource Degradation: Poverty, Population growth	Ecological Uncertainty, Global Change	Ecosystem Collapse "Unnatural" Disasters
Main Themes:	Open Access/Free Goods Exploitation of Infinite Natural Resources	Remedial/Defensive "Legalize Ecology," as Economic Externalities	"Economic Ecology" Interdependence	Generative Restructuring "Ecologize Economy" Sophisticated Symbiosis	Back to Nature "Biocapacity Equality" Simple Symbiosis
Prevalent Property Regimes:	Privatization (Necessity) or Nationalization (Mark.) of all property	Privatization Dominant; Some Public Parks set aside	Global Commons Law for Conservation of: Oceans, Atmosphere, Climate, Biodiversity?	Recontractualize Private & Common Property regimes for Intra-Generational Equity & Stewardship	Private, plus Common Property set aside for Preservation
Who Pays?	Property Owners (Public at Large, etc. Poor)	Taxpayers (Public at Large)	"Polluter Pays" for Right (Poor bear impacts)	"Pollution Prevention Pays" Integrated Ecodevelopment	Avoid costs by foregoing development
Responsibility for Development and Management:	Property Owners: Individuals or State	Fragmentation: Development decentralized Management centralized	Toward integration across multiple levels of gov't. (e.g., fed./state/local)	Private/Public Institutional Innovations & Redefinition of Roles	Largely Decentralized but integrated design & mgmt.
Environmental Management Technologies and Strategies:	Industrial Agriculture: High Inputs of Energy, Stocks, & Water; Monocultures, Mechanized Production Fossil Energy Pollution Dispersal Unregulated Waste Disposal High Population Growth "Free Markets"	"End-of-the-Pipe" or "Business as Usual Plus a Treatment Plant" Clean-up "Command and Control" Market Regulation: Some Prohibition of Lint, Soap, & Salt-sides. Focus on Protection of Human Health: "Land Doctoring" Envir. Impact Statements	Impact Assessment & Risk Management, Pollution Reduction, Energy Efficiency, Renewable Resource Conservation Strategic Restoration Ecology, Population Stabilization & Technology-Enhanced Carrying Capacity, Some Structural Adjustment	Uncertainty (Resilience) Management, Eco-Technologies, e.g.: Renewable Energy, Waste/Resource Cycling for Throughout Scale Reduction, Agro-forestry, Low Input Agriculture, Extractive Forest Reserve Population Stabilization & Enhanced Capacity as PM	Stability Management Reduced Scale of Mkt Economy (inc. Trade) Low Technology Simple Material Needs Non-dominating Science Indigenous Tech. Systems "Intrinsic Values" Population Reduction
Analysis/ Modeling and Planning Methodologies:	Neoclassical OR Market Closed Economic Systems: Reversible Equilibria, Production Limited by Man-made Factors, Nature Factors not accounted for. Net Present Value Maximization Cost-Benefit Analysis of tangible goods & services	Neoclassical Plus: Environmental Impact Assessment after Design; Optimum Pollution Levels; Equations of Willingness to Pay & Compensation Principles	Biophysical-Economic Open Systems Dynamics: Include Natural Capital, True (Prideman) Income Maximization in S/Ws Increased, Free Trade Ecosystem & Social Health Monitoring; Linkages between Population, Poverty, & Environment	Socio-Technical: Ecosystem Process Planning & Design Integration of Social, Economic, & Ecological Criteria for Technology Participation & Autonomy Indigenous Goals & Management; Land Tenure & Income Distrib. (Equity) (Geophysiology)	Grassroots Bioregional Planning Multiple Cultural Systems Conservation of Cultural & Biological Diversity Autonomy
Fundamental Flaws:	Creative but Mechanistic; No awareness of reliance on biological balance	Defined by F.E. in reaction to D.E.; Lacka vision of abundance without scarcity	Still anthropocentric; Subtly mechanistic; Doesn't handle uncertainty	Magnitude of changes require new consciousness Doesn't manipulate fears	Defined in reaction to F.E.; Organic but not Creative; How reduce population?

M.L. Coley, M.Sc. in 1998

So, this is a lot of texts are here, so I am not going to just discuss it in this manner. We will move to the next slide, but yes, there are a lot of differences also among each one of these 5 natural resource management paradigms. When we discuss each one of them individually, you will automatically get then how they are different from each other.

(Refer Slide Time: 9:36)

1. Frontier Economics ✓

- Technology is the major driver of this paradigm.
- Natural resources and ecological services are considered as “free gifts” of nature.
- Nature is seen as a beneficial tool for humans that can be consumed, manipulated and changed for the betterment of human life quality.
- According to this paradigm, sustainability is not an important factor.
- It relies on “technological optimism” which advocates that technology is progressive and can treat any challenge it creates.

2. Deep Ecology ✓

- This paradigm puts man under nature.
- It advocates reduction in human population and promotion of cultural and biological diversity
- It favors adoption of a simple lifestyle requiring minimal raw natural resources as input.
- It also favors the use of simpler and crude technologies for resource management.

→ Nature ↓ Man

Encourage the 3R principle – ‘Reduce Reuse & Recycle’.

7

Let us start with frontier economics. From the name itself, we can understand that it means business. In case of frontier economics, technology is the main driver of this paradigm and technology is being used for the benefit of mankind to the maximum possible way utilizing the natural resources. And in this paradigm, the natural resources are considered as free gift from the nature.

So, that means you take out as much as possible. So, according to this paradigm, sustainability is not an important factor, the important factor is money. So, it largely relies on technological optimism. And also, it says that technology is progressive and can treat any challenge, it creates so very kind of economy or financial or profit, mind philosophy, without any care of the resources available, whether it will be there in future or not, no, it just care if it is there, use it.

So, next you come to deep ecology, exactly opposite of Frontier economics, this paradigm puts man under nature, so, it put nature on top and man, quite logically, below nature. So, that means, in this paradigm, nature has been given more importance. So, it says that reduction in population or promotion of cultural and biological diversity activities are actually important.

So, that means in this concept, it promotes conservation, it promotes also to take care of nature, it also favors the use of simple and crude and frugal technologies, it does not try to maximize the technological advancement for the extraction or exploitation of natural resources, it says that use some simple crude technology which will not impact environment negatively, but at the same time you can utilize the resource for your benefit. So, in deep ecology overall, in one line it can be summarized that it believes in the principle of 3 R reduce, reuse and recycle.

(Refer Slide Time: 12.02)

3. Environmental Protection

- An offshoot of eco-development.
- Also referred as “end of pipe”, “business as usual” or “clean-up” approach.
- This approach focuses on repairing and setting limits to harmful activities associated with the production of goods and services needed by a growing economy.
- Mitigation rather than prevention is emphasized by this approach. Technology is relied upon as a solution to mitigate the different type of pollution arising from human economic activities.
- Adherents of this approach are of the opinion that technology can find ways to emulate the ecological functions of nature.

4. Resource Management

- This approach advocates wise use of natural resources through regulation of human behavior and activities.
- Resource management focuses on the manner by which people use and combine resources to attain their goals according to their interests and values as individuals and as a community.

Contd.

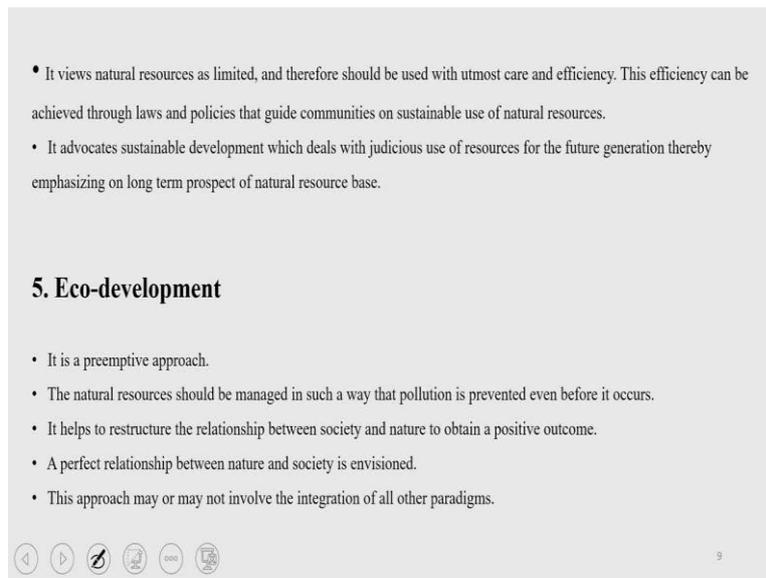
Next, Environment Protection. Now, Environment Protection, here it from the name itself, it clear that this paradigm talks about take care of environment you use resources, but you also look at the management maintenance or repairment of this environment, it limits some of the harmful activities that could be associated with the production of goods or extracting resources. So, it limits the amount of resources to be utilized. So, it also says that technology can find a way to emulate the ecological functions of nature.

So, that means, in this paradigm, it gives importance for the maintenance of environment. It also gives some limits that up to this you can utilize resources in this manner. So, some amount of restrictions are there.

Then the next paradigm comes resource management, this paradigm or this approach advocates wise use of natural resources through some regulation of human behavior and activities, very matured concept, where it relies on the human behavior quite significantly.

This also focuses on the manner by which people would like to use a combined resource to achieve their goals, according to their interest, according to their planning, whether it is individual level or in community level. So, resource management is not stopping you to utilize the resources, but it says; it expects, it anticipates that we as a human being will behave wisely and meaningfully we will be utilizing the resources that is available in the nature.

(Refer Slide Time: 13:57)



- It views natural resources as limited, and therefore should be used with utmost care and efficiency. This efficiency can be achieved through laws and policies that guide communities on sustainable use of natural resources.
- It advocates sustainable development which deals with judicious use of resources for the future generation thereby emphasizing on long term prospect of natural resource base.

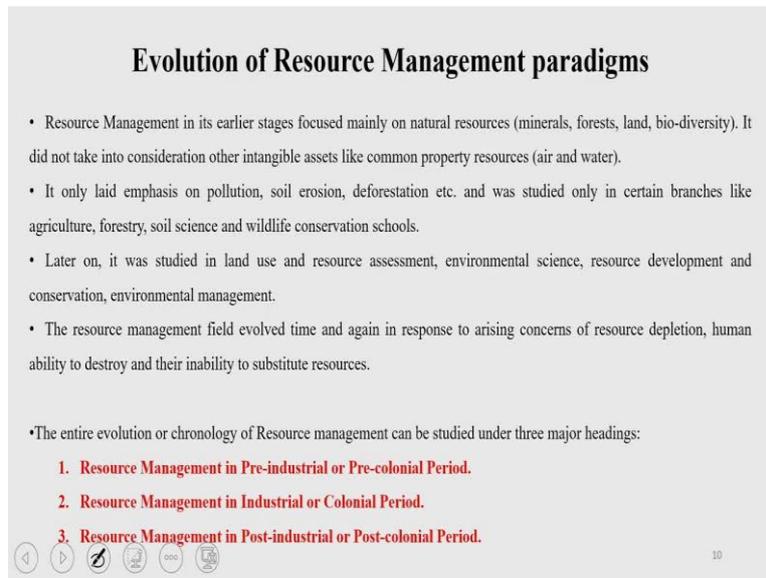
5. Eco-development

- It is a preemptive approach.
- The natural resources should be managed in such a way that pollution is prevented even before it occurs.
- It helps to restructure the relationship between society and nature to obtain a positive outcome.
- A perfect relationship between nature and society is envisioned.
- This approach may or may not involve the integration of all other paradigms.

The last paradigm is eco development. Eco development approach is a preemptive approach. Here the natural resources should be managed in such a way that pollution is prevented, even before it occurs, a anticipatory approach. So that means, here it says that okay, you are going to utilize a natural resource A, B and C, but you have to ensure that for the processes that you are going to use these resources A B and C, it must not lead to environment pollution, it must not lead to contaminate any other natural resources.

So, that means it helps to restructure the relationship between society and nature. Again, very matured concept. So, it also allows to develop a perfect relationship between man and nature or society and nature. And this approach may or may not involve integration of all other paradigms, all other 4 paradigms, it might involve or it may not involve. So, eco development approach as you see here that it looks like a very balanced, a very mature approach and it also has the scope of taking other 4 paradigm into it or it may not so, that means, it depends according to the situation, it can go individually or it can take the other 4 into it.

(Refer Slide Time: 15:38)



Evolution of Resource Management paradigms

- Resource Management in its earlier stages focused mainly on natural resources (minerals, forests, land, bio-diversity). It did not take into consideration other intangible assets like common property resources (air and water).
- It only laid emphasis on pollution, soil erosion, deforestation etc. and was studied only in certain branches like agriculture, forestry, soil science and wildlife conservation schools.
- Later on, it was studied in land use and resource assessment, environmental science, resource development and conservation, environmental management.
- The resource management field evolved time and again in response to arising concerns of resource depletion, human ability to destroy and their inability to substitute resources.

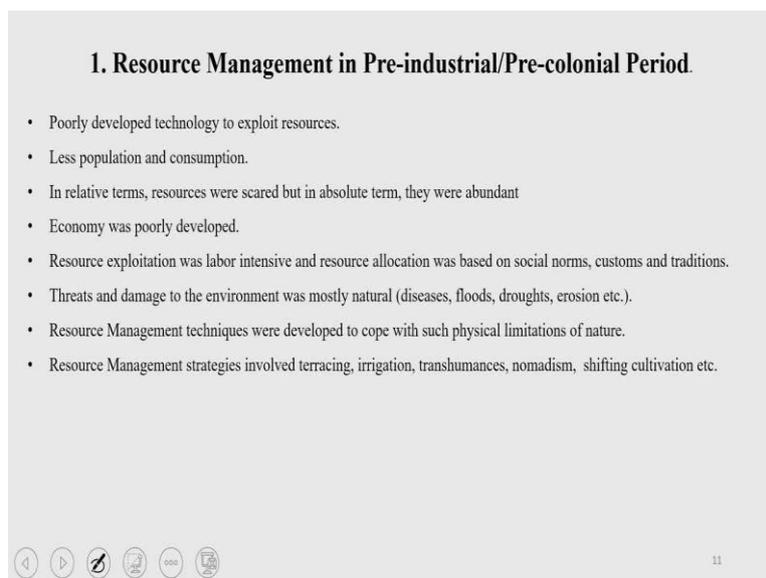
•The entire evolution or chronology of Resource management can be studied under three major headings:

1. Resource Management in Pre-industrial or Pre-colonial Period.
2. Resource Management in Industrial or Colonial Period.
3. Resource Management in Post-industrial or Post-colonial Period.

10

Now, if you look at the evolution of this resource management paradigms, it is very interesting. 3 times zone if we consider resource management, pre-industrial or pre-colonial period, during colonial period, and after colonial period, I am talking about here in the context of India a lot of differences you will find in the approach in the ideology. So, it is totally different from one to the other period, and that is why India as a country has gone through quite a lot of experiments during all these different time period.

(Refer Slide Time: 16:19)



1. Resource Management in Pre-industrial/Pre-colonial Period.

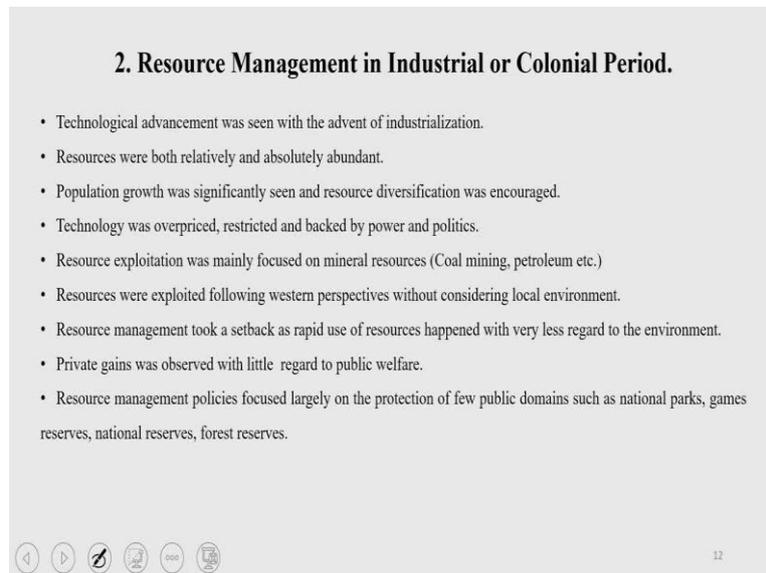
- Poorly developed technology to exploit resources.
- Less population and consumption.
- In relative terms, resources were scarce but in absolute term, they were abundant
- Economy was poorly developed.
- Resource exploitation was labor intensive and resource allocation was based on social norms, customs and traditions.
- Threats and damage to the environment was mostly natural (diseases, floods, droughts, erosion etc.).
- Resource Management techniques were developed to cope with such physical limitations of nature.
- Resource Management strategies involved terracing, irrigation, transhumances, nomadism, shifting cultivation etc.

11

If you look at during the pre-industrial pre-colonial period, there are very poorly developed technology, no technology itself you can say to exploit resources available in the country, and that is why India was full of resources, when British came here, this country was you know

you might have studied in history, full of natural resources. So, population was less consumption was low. So, resources were in plenty, unutilized, economy was very poorly managed, resource exploitation was not optimum. So, resources were available in excess and that has attracted others to come here in industrial or colonial period.

(Refer Slide Time: 17:04)



2. Resource Management in Industrial or Colonial Period.

- Technological advancement was seen with the advent of industrialization.
- Resources were both relatively and absolutely abundant.
- Population growth was significantly seen and resource diversification was encouraged.
- Technology was overpriced, restricted and backed by power and politics.
- Resource exploitation was mainly focused on mineral resources (Coal mining, petroleum etc.)
- Resources were exploited following western perspectives without considering local environment.
- Resource management took a setback as rapid use of resources happened with very less regard to the environment.
- Private gains was observed with little regard to public welfare.
- Resource management policies focused largely on the protection of few public domains such as national parks, games reserves, national reserves, forest reserves.

Navigation icons: back, forward, search, refresh, home, and a small number '12' in the bottom right corner.

So, technology advancement was definitely seen, because when colonial period starts, obviously, the invaders came here and found lots of resources there and majority of them are unutilized. So, definitely they brought in some technologies for their own benefit and they started utilizing those technologies for utilizing or exploiting the resources available in plenty.

Resources were both relatively an absolutely abundant on that period, but when this industrial period starts utilization of resources gone up. So, you see also a population increase, resource exploitation was mainly focused during that period of time on mineral resources, coal, gold, petroleum, you name it, and one thing was very clear at that period of time, most of the resources that has been utilized during colonial period, it was done with the Western perspectives without considering local environment.

So, Resource Management took a setback. So that concern with environment was less, interest was there more to utilize the resources for the economic benefit. So, the private gains were more than the public good. So, the resource management policies during this period of time focus largely on the protection of few public domains such as, national parks, games,

national reserves, forest reserves or some others which is purely from the viewpoint of recreations.

(Refer Slide Time: 18:41)

3. Resource Management in Post-industrial or Post-colonial Period.

- It was realized that resource exploitation needed to be sustainable and so its management strategies were broadened to various fields.
- Until 1970s, environmental concerns in developing nations were triggered by the fears of population growth, reducing agricultural productivity, soil erosion, inflation, unemployment and poverty.
- Currently, Resource Management strategies incorporate these issues as well as focus on raising and sustaining high level of productivity and development without environmental impairment.
- Private gains did not enhance public welfare, hence welfare economics was introduced as a part of it.
- Public participation began to play a vital role in Resource Management.
- Multidisciplinary projects were initiated including environmental quality and dignity of life.
- Sustainable development was greatly focused for protection and enhancement of environment.
- Concept of common property resources (CPR) was incorporated.
- Colonial rules and regulations were gradually modified.
- Investment in education and industry was significantly increased.

13

Third period is the period that we are going through now, post-industrial and post-colonial period at that period of time, it was realized that resource exploitation need to be sustainable. So, the concept of sustainability came into picture environment concerns across the developing nations went very, very high. There was also a fear of fast population growth, reducing in agricultural productivity, reducing in natural resource availability, soil erosion, unemployment, poverty, so all challenges started bothering.

So, a very smart strong resource management policy or strategy was the call for the day. So, forgetting private or individual games, the time came to think about public good. Public participation started playing an important role in resource management post-colonial period, because people felt it that the time has come, if we as a community do not try to address the natural resource management aspect. We are not going to survive for long term. So, it was important that public participation in a very multidisciplinary, so sustainable development was greatly focused for protection and enhancement of environment, concept of common property.

Common property right on resources also came into picture investment in education and industry was significantly increased. So, overall, you see a very matured policy and governance came into picture, post-colonial period to take care of these resources, whichever is remaining there and utilize them in the best possible way. So, you see a very clear-cut

change in these 3 time period, pre-colonial, colonial and postcolonial period. It is very important for all of us to understand this history of natural resource management, how it actually changed over period of time.