

**Czech University of Life Sciences Prague**

**Faculty of Economics and Management**

**Department of Economics**



**Bachelor Thesis**

**Natural resources – case study of India**

**Malikov Dilmurod**

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**CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE**

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# **BACHELOR THESIS ASSIGNMENT**

**Dilmurod Malikov**

Economics and Management  
Economics and Management

Thesis title

**Natural resources – Case study of India**

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## **Objectives of thesis**

This thesis focuses on the study of resources conditions as well as the usage of natural resources and its management, using India as a case study. Main issues in management for the most important resources will be discussed, in order to consider potential changes and improvements for the situation.

## **Methodology**

Develop a literature review on key issues in natural resources management in general. Collect data from websites, articles and books to identify what problems India has been facing in resources management. Gathering proposed management plans for India from many sources along with giving author's viewpoints.

## **The proposed extent of the thesis**

35 – 40 pages

## **Keywords**

natural resources, sustainable management, policies, environmental problems.

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## **Recommended information sources**

United Nations. (2003, March 16). World Water Forum: Final Report Report. World Water Council. Soil conservation | Fao soils Portal | Food and agriculture organization of the United Nations. Home | Food and Agriculture Organization of the United Nations. World natural resources distribution, India natural resources, India natural resource, distribution of resources, natural resources India maps. Civil Services | Civil Service Eligibility| Indian Civil Service Exam Tips | Civil Services Exam | Civil Services Examination UPSC IAS. The causes and effects of soil erosion, and how to prevent it. (2020, February 7). World Resources Institute. Department of Land Resources (Ministry of Rural Development; Government of India). (2013, July). National Land Utilisation Policy framework for land use planning & management.

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Prague on 10. 03. 2021

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## Declaration

I declare that I have worked on my bachelor thesis titled " Natural resources – Case study of India" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 15.03.2021

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Malikov Dilmurod

## Acknowledgement

I would like to thank Ing. Zdeněk Toušek, Ph.D. and all other persons, for their advice and support during my work on this thesis.

# Natural resources – case study of India

## Abstract

Based on the topic, which was given, this thesis aims to give an overview of India's natural resources which are land/soils, water, and forest resources. There are many types of natural resources, however, the linkages between these 3 resources are strong, using one resource will affect the other two directly, causing instant consequences. For this reason, I decided to choose these resources to write in this thesis.

In the Literature Review part, a general view of natural resources will be given. This part has 2 main sections. The first section provides brief understandings of types of natural resources as well as the meaning them. The second part will focus on the common problems with using these three resources.

In the Practical Part, India will be used as a case study. This part is divided into three sections, each section will present the situation of land/soils, water, and forest resources in India as well as the conservations for these resources.

In the Conclusion and Suggestions part, using information gathered from previous sections, this part will give a concise reason for the problems associated with three types of natural resources, at the same time I will suggest some ideas for conservation from my personal understanding and perspectives.

**Keywords:** Natural resources, sustainable management, policies, environmental problems.

# Přírodní zdroje - případová studie Indie

## Abstraktní

Na základě zadaného tématu si tato práce klade za cíl poskytnout přehled indických přírodních zdrojů, kterými jsou půda / půda, voda a lesní zdroje. Existuje mnoho druhů přírodních zdrojů, avšak vazby mezi těmito 3 zdroji jsou silné, přičemž použití jednoho zdroje přímo ovlivní další dva, což má okamžité důsledky. Z tohoto důvodu jsem se rozhodl vybrat tyto zdroje pro psaní v této práci.

V části Literature Review bude podán obecný pohled na přírodní zdroje. Tato část má 2 hlavní sekce. První část poskytuje stručné pochopení typů přírodních zdrojů a jejich významu. Druhá část se zaměří na běžné problémy s používáním těchto tří zdrojů.

V praktické části bude jako případová studie použita Indie. Tato část je rozdělena do tří částí, přičemž každá část bude představovat situaci pozemních / půdních, vodních a lesních zdrojů v Indii a také ochranu těchto zdrojů.

V části Závěr a návrhy, s využitím informací shromážděných z předchozích oddílů, bude tato část stručně vysvětlovat problémy spojené se třemi typy přírodních zdrojů, zároveň navrhu některé nápady pro ochranu z mého osobního porozumění a perspektiv.

**Klíčová slova:** přírodní zdroje, udržitelné řízení, politiky, problémy životního prostředí.



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## **1 Introduction**

Natural resources are those resources that are naturally available on our planet. We do not need any human intervention to achieve them. These resources are essential for the survival of living beings. While some natural resources such as air, water, and sunlight are used directly; others serve as raw materials to produce various items of need.

Many natural resources exist in abundance and are renewable. However, there are many others that are non-renewable or take thousands of years to refill. Many natural resources are depleting rapidly. This is due to several reasons. One of the main reasons is the increase in population. Consumption of natural resources is continuously increasing due to rapid population growth.

India is not an exception to these problems. Since this developing country is still being haunted by poverty, I believe that depleting/damage on natural resources has created more issues not only for the environment but also for the citizen's life.

## **2 Objectives and Methodology**

### **2.1 Objectives**

This thesis aims to present the current status of three specific resources which are forests, land and water resources of India as well as the possible conservations for them. Some suggestions are also given by the author.

### **2.2 Methodology**

Develop a literature review on key issues in natural resources management in general. Collect data from websites, articles and books to identify what problems India has been facing in resources management. Gathering proposed management plans for India from many sources along with giving author's viewpoints.

### **3 Literature Review**

#### **3.1 An overview about natural resources**

##### **3.1.1 Definition**

The life of all creatures in general and of humans in particular is always associated with nature. The relationship between man and nature is a visible manifestation in everyday life. Man is born from nature, nature determines human life and man determines its fate. Human is both the product and the subject of natural resources and the environment because humans survival is required by the resources provided by the environment, besides that people in their activities have a strong impact on changing the environment in return. Generally, natural resources can be briefly described as “material and constituent formed within environment or any matter or energy that are resulting from environment, used by living things that humans use for food, fuel, clothing, and shelter. These comprise of water, soil, minerals, vegetation, animals, air, and sunlight. People require resources to survive and succeed. Everything which happens naturally on earth are natural resources that are minerals, land, water, soil, wind that can be used in many ways by human beings.”<sup>1</sup>

##### **3.1.2 Classification of natural resources**

Resources are located all around the world and change in value over time depends on what is considered most valuable to society. Some resources can be renewed after being used multiple times, some cannot. Based on the quantity, physical characteristics of resources themselves and human activities; natural resources are often classified into two types: Inexhaustible and Exhaustible resources.

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<sup>1</sup> *World natural resources distribution, India natural resources, India natural resource, distribution of resources, natural resources India maps.* Civil Services | Civil Service Eligibility| Indian Civil Service Exam Tips | Civil Services Exam | Civil Services Examination UPSC IAS. Available at: [https://www.civilserviceindia.com/subject/General-Studies/notes/distribution-of-key-natural-resources-across-the-world.html?fbclid=IwAR1y9B9oG9J8pFaFvILwDMF6WIEjKyjWnLioZ55XI5C3RaqCYG\\_MI7zs2U](https://www.civilserviceindia.com/subject/General-Studies/notes/distribution-of-key-natural-resources-across-the-world.html?fbclid=IwAR1y9B9oG9J8pFaFvILwDMF6WIEjKyjWnLioZ55XI5C3RaqCYG_MI7zs2U)

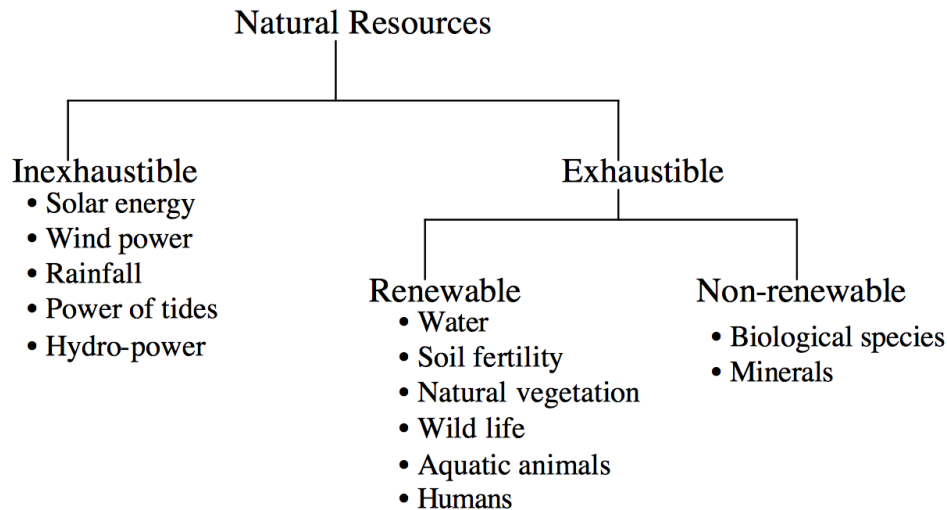


Figure 1 Types of natural resources

### Inexhaustible resources

Inexhaustible resources are types of resources that have unlimited quantity and can't be influenced by human activities, however, the quality might be affected. "Resources like solar energy, wind power, tide power, rainfall, and even atomic energy, cannot be exhausted significantly at global level due to human activities. Such resources may sometimes be locally affected by human activities; for example, pollution may change the quality of air."<sup>2</sup>

### Exhaustible resources

Resources with a certain limit on reserves that decrease with the process of exploitation by humans are exhaustible resources, and can be divided into renewable resources and non-renewable resources, described as below<sup>3</sup>:

Renewable resources: "Most biotic resources are renewable. The growth and reproduction of such resources can be successfully managed so that these resources are continuously regenerated. However, if the consumption of these resources continues to exceed their rate of renewal not only their quality becomes affected, they may even get totally exhausted."

<sup>2</sup> Id.

<sup>3</sup> Id.

Non-renewable resources: “Some biotic resources are non-renewable, i.e. they cannot be regained or reconstructed once they are used up. Biological species, which have evolved in nature during the course of millions of years, are considered non-renewable. Once a biological species becomes extinct from the earth, it cannot be recreated by man. Many abiotic resources are also non-renewable. For instance, fossil fuels (coal, petroleum and gas) and metals once extracted cannot be regenerated at the place of extraction. After unlimited extraction and use, the fossil fuels will certainly get exhausted.”

### **3.2 Problems associated with natural resources**

We all know Mother Nature has given us the most beautiful planet to live on, filled with a huge amount of species and natural treasures. We have created our human zone but it was just a small piece of this big planet, so far we are still being nurtured by the Nature. Thus, natural resources have a great influence on the earth and the life of humans and other organisms.

Differences in natural resources explain some of the differences in national living standards. Countries with rich natural resources often offer engaging policies to exploit and export comparative resources in order to collect foreign currency for economic development. “Natural resources such as oil, gas, minerals and timber are expected to continue to play a significant role in resource abundant economies, as demand from rapidly growing economies increases, and as supplies of non-renewable resources decline and renewable resource harvests approach maximum sustained yield levels. Not surprisingly, countries richly endowed with natural capital have the potential to derive significant current income from resources.”<sup>4</sup>

The exploitation of natural resources also creates jobs for workers, especially in remote areas, and improves people's incomes. However, the exploitation of natural resources, especially non-renewable resources, will quickly deplete natural resources, pollute the air/water environment and change the ecological environment of the creatures. Especially when the process of economic development gearing increases the demand for

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<sup>4</sup> OECD. (2011). *THE ECONOMIC SIGNIFICANCE OF NATURAL RESOURCES: Key points for reformers in Eastern Europe, Caucasus and Central Asia*. OECD.org - OECD. Available at: [https://www.oecd.org/env/outreach/2011\\_AB\\_Economic%20significance%20of%20NR%20in%20EECCA\\_ENG.pdf](https://www.oecd.org/env/outreach/2011_AB_Economic%20significance%20of%20NR%20in%20EECCA_ENG.pdf)

natural resources, the exploitation in natural resources for the sake of short-term profit becomes urgent and critical. In my opinion; land, forest, water and mineral resources are the main ones that account for the majority of the contribution to our lives, thus, in this section, issues in these resources will be reviewed.

### 3.2.1 Land and soils

According to research by scientists, the topsoil is in danger of partially disappearing in the future. The United Nations also warned that about one third of the planet's land resources are being degraded due to erosion, pollution, acidification and nutrient depletion.<sup>5</sup> “The soil covering the surface of the earth has taken millions of years to form and we must learn to respect it. Soil is formed at a rate of only 1 cm every 100 to 400 years and it takes 3 000 to 12 000 years to build enough soil to form productive land. This means that soil is a non-renewable resource and once destroyed it is gone forever. If we disregard this, a time will come when there would not be enough soil left to sustain life on earth, because the soil is a necessary growth medium for plants, a home for certain insects and animals, as well as a medium from which we get minerals, such as gold.”<sup>6</sup> Therefore, land resources for humans are extremely valuable and need to be protected for a long-term use plan.

#### Soil erosion and land degradation

Over the past decades, soil erosion<sup>7</sup> has had a negative effect on crop yield, productivity, soil quality, and reduced soil fertility. While proposing temporary solutions such as increasing the amount of fertilizer, partially compensating for the effect of erosion on productivity, it is not possible to replace the entire topsoil lost due to erosion. Erosion results in a gradual loss of topsoil - which is the best developed root soil layer - loss of major nutrients, and especially organic matter, resulting in a reduced useful water holding capacity, due to poor permeability, overflowing water. It also sends soil-filled water downstream, which can create heavy sediments that prevent rivers and streams from flowing, which can eventually lead to flooding.

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<sup>5</sup> *The state of the world's land and water resources for food and agriculture (SOLAW) launched at FAO headquarters / Land & water / Food and agriculture organization of the United Nations.* Home | Food and Agriculture Organization of the United Nations. <https://www.fao.org/land-water/news/news-details/es/c/267297/>

<sup>6</sup> National Department of Agriculture - Directorate Agricultural Land and Resources Management. *Soil erosion.* <https://www.nda.agric.za/docs/erosion/erosion.htm>

<sup>7</sup> Movement of water and air removes topsoil from the land by the process of erosion. Soil particles are loosened, washed down the slope of the land and either end up in the valley or are washed away out to sea by streams and rivers. Without soil and plants the land becomes desertlike and unable to support life. (Soil erosion. National Department of Agriculture - Landcare South Africa)



In addition, it also reduces the value of arable land, increasing the cost of leveling the field.<sup>8</sup> Deep soil cultivation is not feasible because the physical, chemical, and biological properties of this layer are not suitable for plants. Once soil erosion occurs, it is more likely to happen again. Erosion also brings critical damage to the economy, according to World Resources Institute: “global economic losses from soil erosion to be around \$8 billion, due to reduced soil fertility, decreased crop yields and increased water usage. The U.S. agricultural sector loses about \$44 billion per year from erosion. This value includes lost productivity, along with sedimentation and water pollution. Lost farm income is estimated at \$100 million per year. Soil erosion also costs European countries \$1.38 billion in annual agricultural productivity losses and \$171 million in lost GDP (about 1% of total GDP). South Asia loses \$10 billion annually due to soil erosion.”<sup>9</sup>

The main cause of this situation is due to the poor human management process. The biggest factor of this situation stems from the human “exhausted” work of the land for agricultural production. Growing food crops for biofuel production, climate change and simple farming practices are increasing the risk of food shortages in the future. Besides, there are other direct causes of land degradation including urbanization, infrastructure development, energy production, mining, etc. Furthermore, setting up buildings and roads also take account when it comes to soil erosion as they don’t allow for the normal circulation of water. Instead, it runs off to flood nearby lands, speeded up erosion in these areas.<sup>10</sup> An clear example for the cost of land degradation are demonstrated by a report prepared by UNDP, UNEP and FAO analyses the effects of various forms of land degradation on the economies in South Asia countries<sup>11</sup> :

- “Water erosion affecting 25 percent of agricultural land. Wind erosion affects 40 percent of the agricultural land in the dry zone.
- Land degradation is costing countries of the region at least US\$10 billion a year, simply in terms of lost agricultural production. This is equivalent to 7 percent of South Asia's agricultural gross domestic product.

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<sup>8</sup> *Soil erosion and degradation*. World Wildlife Fund. <https://www.worldwildlife.org/threats/soil-erosion-and-degradation>

<sup>9</sup> *The causes and effects of soil erosion, and how to prevent it*. (2020, February 7). World Resources Institute. <https://www.wri.org/blog/2020/01/causes-effects-how-to-prevent-soil-erosion>

<sup>10</sup> *Soil erosion and degradation: Simple definition, causes, consequences*. (2020, January 21). Youmatter. <https://youmatter.world/en/definition/soil-erosion-degradation-definition/>

<sup>11</sup> *The problem of land degradation*. Home | Food and Agriculture Organization of the United Nations. Available at: <https://www.fao.org/3/v9909e/v9909e02.htm>

- China's Loess Plateau - the 600 000 km<sup>2</sup> watershed of the Yellow River in Shaanxi, Shanxi, Gansu, Inner Mongolia, Ningxia-Hui, Qinghai and west Henan - is one of the most severely eroded in the world. Intensive cultivation on steeply sloping hillsides, using outdated techniques, has meant that an estimated 1600 million tonnes of fine yellow silt are washed away every year.”

## Desertification

Land is the foundation of our society. Land provides more than 50% of the total value of all ecosystem services, enabling economies to grow and prosper. Production land is the foundation for poverty reduction, energy, food security and environmental health. The world population is increasing, the quality of life is improving, the urban areas have expanded, followed by the demand for land for living, growing food for food, growing fiber crops for clothing, and animal food both increased. Climate change aggravates this situation, with many regions becoming drier, more frequent and more persistent in drought. This situation could lead to the loss of more arable land in the coming years, leaving millions of farmers in poverty, a source of increasing migration and conflicts around the world.

Each year, more than 12 million hectares of land are lost due to land degradation, desertification and recurring drought.<sup>12</sup> This is a process in which soil is inherently fertile, degraded by drought, deforestation or over-cultivation, or by climate change. During this process, the nutrients in the soil become so depleted that the soil is no longer fertile and eventually becomes arid. Without timely intervention, they will enter the desertification process and gradually lose the ability to produce. According to the United Nations, by 2030, the fashion industry is expected to use 35% more land, largely to grow ingredients for cheap fashion. The amount of food that we lose or waste every year equates to production capacity from 1.4 billion hectares of productive land.<sup>13</sup> And with current consumption, by 2030, we will need an additional 300 million hectares of land for food production to ensure food security for the global population. But in a reverse development, the finite resource - the land, is under serious threat of decline.

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<sup>12</sup> Id.

<sup>13</sup> *Land and drought* / UNCCD. United Nations Convention to Combat Desertification. <https://www.unccd.int/issues/land-and-drought>

## Management in soil and land resources

With a global population of up to 10 billion by the middle of this century, the way governments, industry and farmers manage land will play an important role in limiting or promoting climate change. Therefore, sustainable land management is considered a world mission, with the goal of regenerating the productive capacity of more than 2 billion hectares of degraded land and improving the living environment for more than 1.3 million people around the world. Below are the main concepts of soil resource management which I believe are right and feasible, collected by H. Eswaran, R. Lal and P. F. Reich in the study “Land degradation: an overview”<sup>14</sup>:

- Studies on long-term water needs (quality and quantity).
- A network of monitoring sites to detect changes in natural resource conditions.
- Working with farmers by understanding and incorporating indigenous knowledge.
- Including land degradation aspects in research on cropping and farming systems, and soil and water management.
- Convincing decision-makers that climate change, desertification, quality of life, and sustainability are all interlinked and addressing one helps the other.
- Initiating research on a new paradigm that is holistic and focuses on these issues.

Also FAO has provided some types of management for soil conservation<sup>15</sup>: “Reversing the degradation of soil, water and biological resources and enhancing crop and livestock production through appropriate land use and management practices are essential components in achieving food and livelihood security. [...] Efforts to restore productivity of a degraded soils must be coupled with other measures that affect the land use practices in particular conservation agriculture, good agricultural practices and irrigation management and integrated plant nutrient management.”

Although we are constantly giving warnings, the land situation in the world is still getting worse and worse. Currently, most of the land accessible to humans is used for farming or livestock. But current farming practices often lead to soil erosion and water waste resulting in

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<sup>14</sup> *Land degradation: An overview / NRCS soils*. NRCS.  
[https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2\\_054028](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_054028)

<sup>15</sup> *Soil conservation / Fao soils Portal / Food and agriculture organization of the United Nations. Home / Food and Agriculture Organization of the United Nations*. Available at: <https://www.fao.org/soils-portal/soil-management/soil-conservation/en/>

reduced crop yields. If we keep using the land this way, most of us in the future will not have any land to cultivate.

### 3.2.2 Forests

Forests are the most important component that makes up the biosphere. In addition to the meaning of plant and animal resources, forests are also an indispensable geographical factor in nature. It plays an extremely important role in creating landscape and has a strong impact on climatic and soil factors. Therefore, forests not only function in socio-economic development but also have special significance in environmental protection. Forests have an influence on air temperature, humidity, atmospheric composition and climate regulation. The forest not only blocks the wind but is also a giant dust filter that cleans the air and has a great effect on the circulation in nature. Forests also create a sub-climate that has good effects on human health. Forests also play a role in water protection, soil protection, erosion prevention, it is a repository of minerals and humus nutrients that greatly affect soil fertility.<sup>16</sup>

Knowing that forests play a vital role in our lives, however, the awareness about forest protection is still superficial. This is evident in the rapid rate of deforestation in recent years. According to the WWF organization, human impacts have caused the loss of around 40% of the forests in the world, at a rate of 10 million hectares/year.<sup>17</sup>

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<sup>16</sup> *The importance of forests*. WWF conserves our planet, habitats, & species like the Panda & Tiger | WWF. [https://wwf.panda.org/discover/our\\_focus/forests\\_practice/importance\\_forests/#:~:text=The%20importance%20of%20forests%20cannot,erosion%20and%20mitigate%20climate%20change](https://wwf.panda.org/discover/our_focus/forests_practice/importance_forests/#:~:text=The%20importance%20of%20forests%20cannot,erosion%20and%20mitigate%20climate%20change)

<sup>17</sup> WWF International. Forests. WWF. Available at: <https://explore.panda.org/forests#thousand-cuts>

## The loss of tropical primary forest between 2002 and 2019

Humid tropical primary forest loss (2002-19)

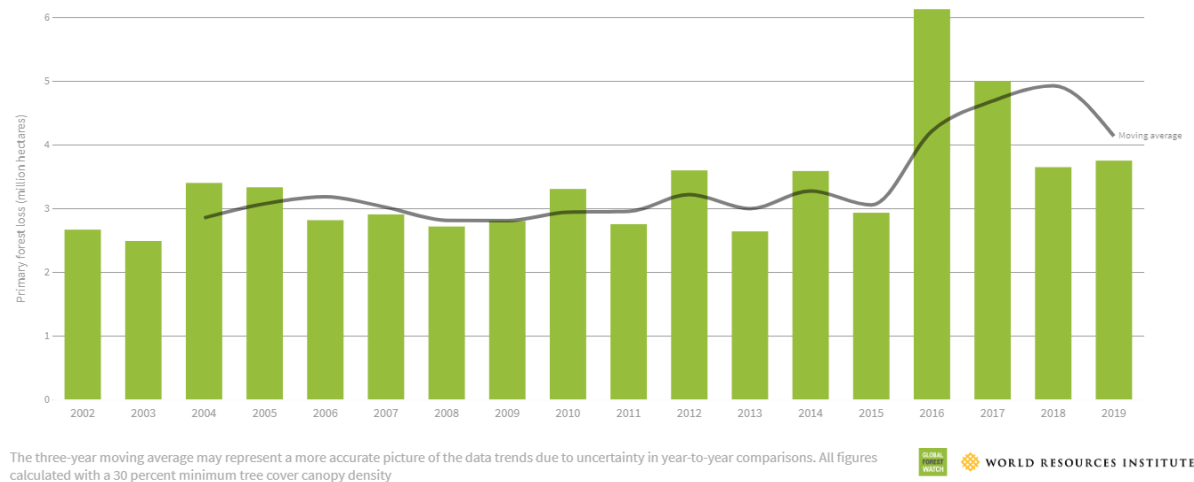


Figure 2 Tropical Primary Forest Loss, 2002-2019. (World Resources Institute)

There are many causes of deforestation in the world, focusing mainly on the following groups of cause:

- Land expansion: expanding agricultural land to meet food production needs, of which smallholder swidden cultivation is the most important reason. “Farmers often clear the land for cattle by using slash and burn techniques. Unfortunately, they will then use the property until the soil is completely degraded and repeat the process on a new patch of woodland.”<sup>18</sup> Rowe (1992) states that up to 60% of the annual deforestation is due to this reason.<sup>19</sup>
- The use of firewood: Cutting down forests for firewood is also an important cause of depletion of forest resources in many regions. Currently there are “more than two billion people still depend on wood energy for cooking and/or heating, particularly in households in developing countries.”<sup>20</sup>
- Exploitation of timber and forest products: The accelerated exploitation of timber and other forest resources for economic development and export is also the cause of the accelerated deforestation rate in many countries. Currently, the wood trade takes place strongly in Southeast Asia, accounting for nearly 50% of the wood trade in the world. In Malaysia, for example, primary forests covered most of the country in 1990, and by

<sup>18</sup> *Deforestation—Causes, effects, and solutions*. Futurism. <https://vocal.media/futurism/deforestation-causes-effects-and-solutions>

<sup>19</sup> *Managing the World's Forests - Looking For Balance Between Conservation and Development*. Documents & Reports - All Documents | The World Bank.

<https://documents1.worldbank.org/curated/en/714631488517243634/pdf/110215-PUBLIC-Box396328B-PUBLIC-Managing-The-Worlds-Forests-Looking-for-Balance-Between-Conservation-Development-1992.pdf>

<sup>20</sup> Food and Agriculture Organization of the United Nations. (2021, February 3). Wood energy. Home | Food and Agriculture Organization of the United Nations. <https://www.fao.org/forestry/energy/en/>

1960 more than half of the forest had been logged for export. In the Philippines, by 1980, forests were destroyed about 2/3 of the area, of which logging for export accounts for a large part.<sup>21</sup>

- Livestock ranching: The grazing of cattle and other cattle, requiring the expansion of grassland, is also the cause of the reduction of forest areas. In Latin America, about 40% of forests have been cleared by small farmers over the past 40 years.
- Forest fire: Forest fire is a fairly common cause in countries around the world and has the potential to rapidly deforest. For example, in 1977, in the US, The Marble Cone fire had burned about 178,000 acres in the Santa Lucia Mountains during three weeks.<sup>22</sup>

There are also many other causes that also directly or indirectly increase deforestation in the world. These are forest management policies, land policies, migration, settlement and other socio-economic policies. Socio-economic development projects such as the construction of roads, hydroelectric works, residential areas or industrial zones also significantly increase the rate of deforestation in many parts of the world.<sup>23</sup>

### 3.3.3 Water resource

Water resources include water sources that people use or can use for different purposes. Water is used in agricultural, industrial, civil, recreational and environmental activities. Most of the above activities require fresh water.

About 97% of the water on Earth is salt water, the remaining 3% is fresh water, but nearly two-thirds of it exists in the form of glaciers and polar ice caps. The unfrozen remains are found primarily in the form of groundwater, and only a small percentage exists on the ground and in the air.<sup>24</sup> Fresh water is a renewable resource, but the supply of fresh and clean water in the world is gradually decreasing. Water is not evenly distributed on the earth's surface. Rainfall in most deserts is less than 300mm a year, while in many tropics it can

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<sup>21</sup> FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. (2011). SOUTHEAST ASIAN FORESTS AND FORESTRY TO 2020. Knowledge Sharing Platform. [https://www.unclearn.org/wp-content/uploads/library/fao96\\_part1.pdf](https://www.unclearn.org/wp-content/uploads/library/fao96_part1.pdf)

<sup>22</sup> Looking back: Fighting fire in big sur, 1977. (2020, July 26). Monterey Herald. <https://www.montereyherald.com/2020/07/26/looking-back-fighting-fire-in-big-sur-1977/>

<sup>23</sup> *Deforestation—Causes, effects, and solutions*. Futurism. <https://vocal.media/futurism/deforestation-causes-effects-and-solutions>

<sup>24</sup> *How much water is there on earth?* (2018, June 6). USGS.gov | Science for a changing world. [https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science_center_objects=0#qt-science_center_objects)

reach over 2000mm a year.<sup>25</sup> Therefore, in some places, there is water shortage, drought, while in many areas it is flooded frequently. Many Middle Eastern countries have to build factories to store freshwater resources or buy fresh water from other countries.<sup>26</sup>

The table below includes the data that gives a clear explanation of the water resources distribution globally, from the data we can see more than 68% fresh water is being kept in ice caps and glaciers and the other 30% fresh water is in the ground.

Water source	Water volume, in cubic miles	Water volume, in cubic kilometers	Percent of freshwater	Percent of total water
Oceans, Seas, & Bays	321,000,000	1,338,000,000	--	96.54
Ice caps, Glaciers, & Permanent Snow	5,773,000	24,064,000	68.7	1.74
Groundwater	5,614,000	23,400,000	--	1.69
<i>Fresh</i>	<i>2,526,000</i>	<i>10,530,000</i>	<i>30.1</i>	<i>0.76</i>
<i>Saline</i>	<i>3,088,000</i>	<i>12,870,000</i>	--	<i>0.93</i>
Soil Moisture	3,959	16,500	0.05	0.001
Ground Ice & Permafrost	71,970	300,000	0.86	0.022
Lakes	42,320	176,400	--	0.013
<i>Fresh</i>	<i>21,830</i>	<i>91,000</i>	<i>0.26</i>	<i>0.007</i>
<i>Saline</i>	<i>20,490</i>	<i>85,400</i>	--	<i>0.006</i>
Atmosphere	3,095	12,900	0.04	0.001
Swamp Water	2,752	11,470	0.03	0.0008
Rivers	509	2,120	0.006	0.0002
Biological Water	269	1,120	0.003	0.0001

Figure 3 Global water distribution

Water demand has outstripped supply in some parts of the world, while the world population is continuing to increase causing water demand to increase. The awareness of the importance of water conservation for ecosystem needs has only recently been raised. During the 20th century, more than half of the world's wetlands disappeared, along with their

<sup>25</sup> Desert: Mission: Biomes. (2020, September 28). NASA Earth Observatory. <https://earthobservatory.nasa.gov/biome/biodesert.php#:~:text=In%20fact%2C%20the%20most%20important,ra in%20that%20a%20rainforest%20gets!>

<sup>26</sup> MIDDLE EAST AND NORTH AFRICA REGION - THE WORLD BANK. *Water in the Arab World - Management Perspectives and Innovations*. IPC Global Platform. [https://www.ipcinfo.org/fileadmin/user\\_upload/rome2007/docs/Water\\_Arab\\_World\\_full.pdf](https://www.ipcinfo.org/fileadmin/user_upload/rome2007/docs/Water_Arab_World_full.pdf)

valuable supporting environments. Biodiversity-rich freshwater resource ecosystems are declining faster than terrestrial and marine ecosystems.

### Drought

According to the researchers, the availability of freshwater is now a serious problem worldwide. There are at least 80 countries in desert and semi-desert regions (accounting for about 40% of the world's population) in two continents Asia and Africa often suffer from droughts and crop failures, they often do not provide enough food to feed their people.<sup>27</sup> In the 1970s, drought threatened millions of people and killed 100,000 people and lasted until 1980.<sup>28</sup> In 1985 more than 154 million people from 21 countries Africa fell into starvation due to drought, in addition to overpopulation and widespread warfare, on the other hand due to ineffective management and use of resources and agricultural development. In these countries, it takes poor people a long time to find water, often in polluted rivers and streams.<sup>29</sup>

“It’s been two and a half years since we had good rain.” - Rosita Chauque.<sup>30</sup>

“We pray hard for rain and then we must pray harder that it stops. Is there no end of extreme weather?” - Richard Kapenda (Malawian villager).<sup>31</sup>

### Flooding

In contrast, in other countries with relatively high rainfall, a large amount of rainfall is received within a short period of the year. In India, for example, 90% of the rainfall concentrated between June and September often causes flooding.<sup>32</sup> The cause of flooding is human deforestation, burning forests for farming land, mining ore, urban expansion, etc. The paradox of the floods is that although water is abundant, the lack of drinking water is aggravated due to epidemic concerns. Although flooding is considered a fatal natural disaster and damages crops and property of the people, after the floods, the deposition of silt increases soil fertility

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<sup>27</sup> M. Alimullah Miyan. (2015, March). *Droughts in Asian Least Developed Countries: Vulnerability and sustainability*. ScienceDirect.com | Science, health and medical journals, full text articles and books. <https://www.sciencedirect.com/science/article/pii/S2212094714000632>

<sup>28</sup> Doyle, A. (2015, June 1). *Climate change boosts rain in Africa's Sahel region: Study*. U.S. <https://www.reuters.com/article/us-climatechange-sahel-idUSKBN0OH2UY20150601>

<sup>29</sup> *Across Africa, the worst food crisis since 1985 looms for 50 million*. (2020, October 15). the Guardian. <https://www.theguardian.com/global-development/2016/may/22/africa-worst-famine-since-1985-looms-for-50-million>

<sup>30</sup> Id.

<sup>31</sup> Id.

<sup>32</sup> *Indian monsoon*. Climate Prediction Center. [https://www.cpc.ncep.noaa.gov/products/assessments/assess\\_96/india.html](https://www.cpc.ncep.noaa.gov/products/assessments/assess_96/india.html)



(Miller, 1988). To prevent and reduce the devastation of flooding in these countries, many measures have been taken such as shoveling drainage, building dams and reservoirs, planting forest trees on barren hills, and keeping forests in upstream.

### Water pollution

There are many objective and subjective causes leading to water pollution such as population growth, the downside of industrialization and modernization, poor infrastructure, and people's awareness about environmental issues are not high.

Notably, the inadequacy of management and environmental protection. Awareness of many management agencies, organizations and individuals responsible for the task of water environment protection is not deep and complete. In the process of daily life, water used in daily life is increasing rapidly, due to the population increase in urban areas. All types of wastewater are directly discharged into the environment without any treatment. Under the current rate of development, people accidentally pollute water sources with chemicals and wastes from industrial factories. The individual units use groundwater in the form of drilling wells, after using, they don't close the holes, causing dirty water to flow into and pollute the groundwater source. In addition, factories release industrial dust into the air and pollute the air, when it rains, these pollutants mix into the rainwater, this process plays a part in the contribution of water pollution.

Furthermore, the speed of industrialization and urbanization is quite fast and the population growth has put increasing pressure on water resources in the territory. The water environment in many cities, industrial parks and craft villages is increasingly polluted by wastewater, exhaust gas and solid waste. In big cities, the high density of domestic waste is also an important cause of water pollution. Water pollution caused by industrial production is very heavy. Water pollution in urban areas, wastewater and domestic waste do not have a centralized treatment system but directly discharge them into receiving sources (rivers, lakes, canals, ditches). On the other hand, there are many production facilities that do not treat wastewater, most hospitals and health facilities do not have wastewater treatment systems, and a large amount of solid waste in the city cannot be fully collected.

In conclusion, water depletion, pollution as well as water scarcity will be exacerbated without good water management practices. For that reason, it is said that the current water crisis is not only due to too little water being insufficient to satisfy human needs, but also due to poor water management, causing billions of people and the environment to bear the consequences.

According to the United Nations report published on March 5, 2003, discussed at the 3rd World Forum on Water, held in Kyoto (Japan) from March 16 to 23, 2003 shows that Global clean water is worryingly depleting due to population explosion, environmental pollution, and global warming, which will lose about a third of water use over the next 20 years. Currently, about 12,000 km<sup>3</sup> of clean water in the world is polluted, every year more than 2.2 million people die from diseases related to polluted water and poor sanitation.<sup>33</sup> In short, water scarcity and lack of water are a very serious threat to human survival in the future. Therefore, it is necessary to have solutions to well manage, exploit and protect water resources. In my opinion, it is necessary to consolidate and supplement the water resources survey and monitoring network, including both surface water and groundwater, both quantity and quality, to form a unified water resources survey and survey network within the for the whole country, conduct inventory and assessment of water resources in river basins, regions and the whole territory.

#### **4 Practical part**

India lies entirely within the Indian peninsula and part of the Asian continent. It borders Afghanistan, China, Nepal and Bhutan to the north, Bangladesh, Myanmar and the Bay of Bengal to the east, the Palk Strait to the south, the Mannar Bay and the Indian Ocean, and the Arab and Pakistan Sea to the west. India is also one of the leading countries in the world in terms of population growth and population density. Moreover, 3 sides of India are bordered by sea and land, including border lines with many countries, making India there are advantages in economic and cultural exchange with many countries in the world by sea. However, India's border is bordered with many other countries, so there are difficulties in territorial defense.

#### **4.1 Land resources**

In today's fast pace of development, many activities require the use of land for development such as the construction of roads, buildings and industrial parks. The lack of arable land will become a major problem for agriculture, causing great economic losses. Without effective land use management, the land will be increasingly scarce and exhausted.

India has a territory of 3.287 million sq. km. (328.73 million Ha) in which forest cover accounts for about 1/4 of the total land area. From the table below, it is clear to see the changes in land use over time from 1950 to 2015. As we can see, the net area sown has increased from

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<sup>33</sup> United Nations. (2003, March 16). *World Water Forum: Final Report Report*. World Water Council. [https://www.worldwatercouncil.org/fileadmin/world\\_water\\_council/documents/world\\_water\\_forum\\_3/3d\\_World\\_Water\\_Forum\\_FinalReport\\_BD.pdf](https://www.worldwatercouncil.org/fileadmin/world_water_council/documents/world_water_forum_3/3d_World_Water_Forum_FinalReport_BD.pdf)

36.1% to 42.6%, forest cover also increased from 12.3% to 21.8% in 2015, so is the increase by 6,5% in areas under non-agricultural uses such as mining, industrial complexes, transportation system, heritage sites.<sup>34</sup> The increase in land used in those areas above has caused a reduction in land used in other areas like “barren and unculturable land” and other uncultivated land excluding fallow lands, causing the percentage of land used in these other areas went down by half of the value in 2014 - 2015 comparing with 1950 - 1951.

With the rapid speed of urbanization and industrialization, the “increases of demands of land will require land to be taken away from other uses. So far, the land under “other areas” were being used. However, these lands may no further be usable as they may be under steep hills or other such terrains or uses that constrain their use for developmental purposes. In such cases, the demands for additional lands will be resorted to from agricultural uses or forests uses which would be detrimental.”<sup>35</sup>

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<sup>34</sup> Department of Land Resources (Ministry of Rural Development; Government of India). (2013, July). *National Land Utilisation Policy framework for land use planning & management*.

<sup>35</sup> Id.

Year Land unit	1950- 1951	1960- 1961	1970- 1971	1980- 1981	1990- 1991	2000- 2001	2010- 2011	2014- 2015
Geographical Area	328726	328726	328726	328726	328726	328726	328726	328726
Forests	40482 (12.3)	54052	63830	67460	67702	69843	71593	71794 (21.8)
<b>Not Available for Cultivation</b>								
Area ,under Non-agricultural, uses	9357 (2.8)	14840	16478	19596	21220	23752	26400	26883 (8.2)
Barren and unculturable Land	38160 (11.6)	35911	28128	19958	19509	17483	17175	16996 (5.1)
<b>Total</b>	<b>47517</b>	<b>50751</b>	<b>44606</b>	<b>39554</b>	<b>40728</b>	<b>41235</b>	<b>43575</b>	<b>43880</b>
<b>Other Uncultivated Land Excluding Fallow Land</b>								
Permanent Pastures & other Grazing Lands	6675 (2.0)	13966	13261	11989	11406	10528	10305	10258 (3.1)
Land under Misc. Tree Crops & Groves (not incl. In Net Area Sown)	19828 (6.0)	4459	4367	3578	3813	3442	3200	3104 (0.09)
Culturable Waste Land	22943 (7.0)	19212	17500	16744	15000	13520	12647	12469 (3.8)
<b>Total</b>	<b>49446</b>	<b>37637</b>	<b>35128</b>	<b>32311</b>	<b>30219</b>	<b>27489</b>	<b>26152</b>	<b>25832</b>
<b>Fallow Lands</b>								
Fallow Lands Other than Current Fallows	17445 (5.3)	11180	8728	9720	9663	10513	10323	11092 (3.4)
Current Fallows	10679 (3.2)	11639	10598	14826	13840	15343	14277	15091 (4.6)
<b>Total</b>	<b>28124</b>	<b>22819</b>	<b>19326</b>	<b>24546</b>	<b>23504</b>	<b>25856</b>	<b>24600</b>	<b>26182</b>
<b>Agricultural Lands</b>								
Net Area Sown	118746 (36.1)	133199	140863	140288	142870	141336	141563	140130 (42.6)
Total Cropped Area	131893 (40.1)	152772	165791	172630	185742	185340	197683	198360 (60.3)
Area Sown More than once	13147 (4.0)	19573	24928	32342	42872	44005	56120	58230 (17.7)
Net irrigated area	20853 (17.6) <sup>s</sup>	24661	31103	38720	48023	55205	63659	68100 (48.6) <sup>s</sup>
Gross irrigated area	22563 (17.1) <sup>#</sup>	27980	38195	49775	63204	76187	88933	95772 (48.3)
Cropping Intensity (%)	111.1	114.7	117.7	123.1	130	131.1	139.6	141.6

Table 1 Land Use Classification in India since Independence (in Million Hectares)

#### 4.4.1 Causes and costs of land degradation

In the paper “Soil Degradation in India: Causes, Major Threats, and Management Options”<sup>36</sup> of Milkha S. Aulakh and Gurjant S. Sidhu, causes that drive land and soils into degradation have been briefly explained:

<sup>36</sup> Milkha S. Aulakh and Gurjant S. Sidhu. *Soil Degradation in India: Causes, Major Threats, and Management Options*. [https://www.naro.affrc.go.jp/archive/niaes/marco/marco2015/text/ws3-2\\_m\\_s\\_aulakh.pdf](https://www.naro.affrc.go.jp/archive/niaes/marco/marco2015/text/ws3-2_m_s_aulakh.pdf)

“The land degradation is caused by excessive pressure on land to meet the competing demands of the growing population for food, fodder and fibre. Various human activities, such as the introduction of large scale irrigation canals, deforestation and faulty land use lead to accelerated soil degradation through salinization, flooding, drought, erosion and waterlogging. These processes, in turn, reduce agricultural productivity leading to social insecurity. Emission of greenhouse gases to the atmosphere resulting into the global warming could be the major reason for soil degradation. The causes of degradation due to direct/indirect human interventions are (a) deforestation and removal of natural vegetation, (b) overgrazing, (c) agriculture-related activities, and (e) over exploitation of the vegetation for domestic purposes.”

According to a study by Delhi-based The Energy and Resources Institute, the monetary losses from change of land use and land degradation during 2014-2015 period is 2.54 percent of India’s GDP or Rs. 3,177.39 billion ( 46.9 billion in US dollars), surprisingly, land degradation alone accounted for up to 82%.<sup>37</sup> Another data provided by the Department of Land Resources - Ministry of Rural Development of India, also showed the loss of reduced productivity of degraded lands is approximately Rs. 285,000 million, which is about 12% loss of total value of productivity of these lands.<sup>38</sup> In addition, a study published in 2017 has generated informative data from many sources to show how big the loss that erosion has been causing for the country: “the annual loss in output of main crops in India because of soil erosion has been estimated to be 7.2 million tonnes by UNDP, FAO and UNEP (1993) and 13.5 million tonnes or 3.1 per cent of total production of major crops by Bansil (1990) and 4 to 6.3 percent of annual agricultural production in a World Bank study by Brandon, Hommann, and Kishor (1995). [...] Reddy (2003) on the basis of analysis of various data estimated that the range of loss in terms of replacement cost range from 1 to 1.7 percent of GDP.”<sup>39</sup> From the information

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<sup>37</sup> *Why land degradation in India has increased and how to deal with it.* (2018, October 3). Mongabay Environmental News. <https://india.mongabay.com/2018/10/why-land-degradation-in-india-has-increased-and-how-to-deal-with-it/>

<sup>38</sup> Department of Land Resources (Ministry of Rural Development; Government of India). (2013, July). *National Land Utilisation Policy framework for land use planning & management.*

<sup>39</sup> Dr. Jitender Saroha, Associate Professor, Dr. B.R. Ambedkar College, University of Delhi, Delhi, India. (2017, November 4). *Soil Erosion: Causes, Extent and Management in India.* [www.ijcrt.org](http://www.ijcrt.org). <https://ijcrt.org/papers/IJCRT1704172.pdf>

above we can easily see how badly degradation of land resources has damaged the Indian's economy.

#### **4.4.2 Main threats to land resources**

There are plenty of threats which I believe not only India but every other country is also facing in land use management. The total degraded land estimated in 2010 in India is about 120.40 million Ha. and this leads to decline in soil fertility, causes problems of alkalinity/salinity/acidity and water logging etc.<sup>40</sup> Deeper soil analysis requires a combination of very deep knowledge in agriculture, physics, chemistry as well as biology and that exceeds the limitation in my own knowledge. Thus, I only selected two main issues as I have studied in the Literature Review section above, which are soil erosion and desertification.

##### Soil erosion effects

One of the crucial factors that takes account for the degradation of natural resources is erosion and this causes more severe problems in mountain areas than in flat areas. Soil erosion can be caused by natural factors or by humans improper management in land use through activities such as tilling along the slope, exploiting land productivity or lack of crop cover during heavy rainfall, etc.<sup>41</sup> Processes like “slaking and dispersion” have also lead to the collapse of soil structure and create degradation from one type of soil to another soil type.<sup>42</sup>

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<sup>40</sup> Department of Land Resources (Ministry of Rural Development; Government of India). (2013, July). *National Land Utilisation Policy framework for land use planning & management*.

<sup>41</sup> Milkha S. Aulakh and Gurjant S. Sidhu. *Soil Degradation in India: Causes, Major Threats, and Management Options*. [https://www.naro.affrc.go.jp/archive/niaes/marco/marco2015/text/ws3-2\\_m\\_s\\_aulakh.pdf](https://www.naro.affrc.go.jp/archive/niaes/marco/marco2015/text/ws3-2_m_s_aulakh.pdf)

<sup>42</sup> Id.

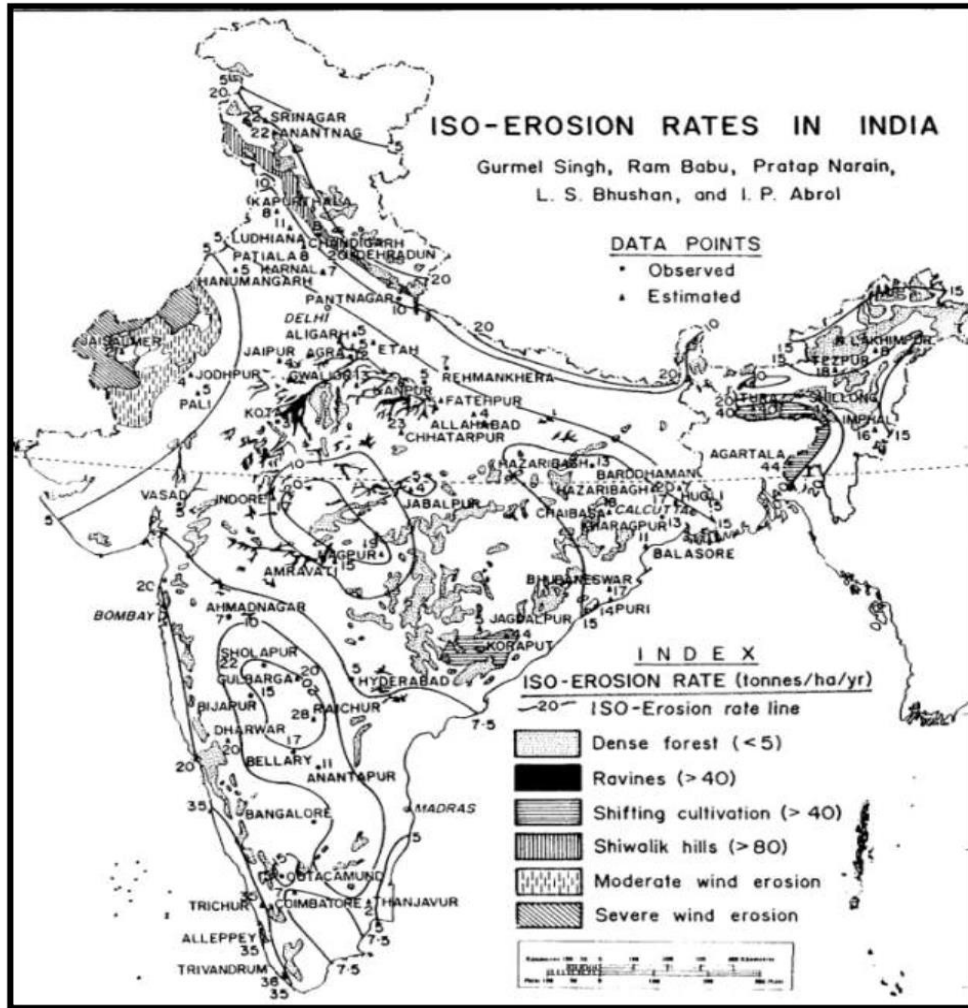


Figure 4 Erosion rates in India

“A survey of the soils of Sholapur district of Maharashtra showed that in a period of 75 years (1870 to 1945), nearly 17% of the land with a soil depth of more than 50 cm was converted into shallow soils with less than 50 cm depth.”

“The effect of surface soil depth on the yield of rainfed crops grown in Alfisols was evaluated. Yield losses expected to result from erosion, based on 56 years of rainfall data were 138, 84, and 51 kg ha<sup>-1</sup> cm<sup>-1</sup> of topsoil loss for sorghum, pearl millet and castor bean, respectively.”

Two examples above show that soil erosion by water has been a problem in India. When the water washes away the topsoil, this leads to the consequence of productivity loss. Since India is still a developing country, where people are still struggling with poverty

and hunger, problems caused by soil erosion by water makes it harder to maintain agriculture for the citizens, especially in mountain areas.

While water erosion is the main process in the semi-arid and dry sub-humid regions, wind erosion plays a role in leading the arid regions and semiarid regions of India to desertification such as Gujarat, Punjab, Rajasthan and Haryana.<sup>43</sup> “Removal of natural vegetative cover resulting from excessive grazing and the extension of agriculture to the marginal areas are the major human-induced factors leading to accelerated wind erosion.”<sup>44</sup> Wind erosion is an erosion caused by wind, displacing soil particles. This is an erosion that can occur anywhere under favorable conditions. One of the reasons contributing to faster wind erosion is the freedom of overgrazing and the expansion of agriculture, which also removes natural vegetation.<sup>45</sup> “NBSS & LUP and the Central Soil Water Conservation Research and Training Institute (CSWCRTI) have jointly initiated the preparation of soil erosion maps of different states using the components of Universal Soil Loss Equation obtained from field data available in soil resource maps generated by NBSS. Few of such works under this collaborative project carried out in states of Himachal Pradesh (representing Hills and Mountains) and Punjab (Indo-Gangetic Plains) revealed that Himachal Pradesh is highly affected by soil erosion while Punjab state is least affected.”<sup>46</sup>

#### Desertification effects

Desertification is not only a major environmental challenge of the world, but also a major obstacle in ensuring the minimum human needs in arid regions. It threatens the health and lives of billions of people in countries around the world, including India.

According to India's Desertification Status Mapping, at least a quarter of India's area - 81 million hectares, is deserted. This map is given by a number of Indian Space research organizations and some other scientific research institutions of this country. According to the

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<sup>43</sup> Gurmel Singh et al, Soil erosion rates in India, *Journal of Soil and Water Conservation* (Vol 47, No 1, 1992)

<sup>44</sup> Dr. Jitender Saroha, Associate Professor, Dr. B.R. Ambedkar College, University of Delhi, Delhi, India. (2017, November 4). *Soil Erosion: Causes, Extent and Management in India*. [www.ijcrt.org](http://www.ijcrt.org). <https://ijcrt.org/papers/IJCRT1704172.pdf>

<sup>45</sup> *Soil erosion and conservation in India*. *Geography and You – A Development and Environment Magazine*. <https://geographyandyou.com/soil-erosion-and-conservation-in-india/>

<sup>46</sup> Milkha S. Aulakh and Gurjant S. Sidhu. *Soil Degradation in India: Causes, Major Threats, and Management Options*. [https://www.naro.affrc.go.jp/archive/niaes/marco/marco2015/text/ws3-2\\_m\\_s\\_aulakh.pdf](https://www.naro.affrc.go.jp/archive/niaes/marco/marco2015/text/ws3-2_m_s_aulakh.pdf)



published data, the formation of this phenomenon has a number of causes, including changes in rainfall and excessive exploitation of natural resources. In addition, based on the information provided by India's Resourcesat-1 satellite, we can see that one third of the country's area, equivalent to 105.48 million hectares, is facing environmental degradation. Currently the environment has undergone at least eight changes, in which soil erosion is the most obvious phenomenon. The changes of nature have caused 32.07% of India's surface area to be affected by land degradation.<sup>47</sup>

- Desertification affects food security:

Food security is understood in a narrow sense as the availability of a world food supply at all times to meet the increasing demand under variable conditions of rice production and prices. Hunger and poverty are not new issues in India since they occur frequently, desertification makes it harder for the Indian Government to control these issues. Desertification reduces agricultural land, destroys fertile lands, and reduces agricultural output, affecting the food security of the people living in the affected areas.<sup>48</sup> “Soil erosion is thus a menace which adversely affects agricultural production and productivity and creates not only food insecurity but insecurity for the whole economy.”<sup>49</sup>

- Impacts on biodiversity:

Due to the depletion of forest resources and natural land for agricultural land expansion, urban and industrial development projects have put species diversity in the country at risk. Some species, due to their inability to adapt, have decreased both in quantity and quality, leading to a decrease in food chains and an imbalance in the ecosystem. The number of species has decreased, some species are in danger of extinction, destroying forests, losing habitat of animals. Reducing biodiversity directly affects food and the health of local people living on animals and plants with many genetic strains of rare plants and animals being lost.

- Impacts on livestock husbandry and grazing:

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<sup>47</sup> *Desertification status mapping*. ISRO - Government of India. <https://www.isro.gov.in/desertification-status-mapping>

<sup>48</sup> *Land degradation, desertification and food security in India*. Analysis & Policy Observatory | APO. <https://apo.org.au/node/268531>

<sup>49</sup> Dr. Jitender Saroha, Associate Professor, Dr. B.R. Ambedkar College, University of Delhi, Delhi, India. (2017, November 4). *Soil Erosion: Causes, Extent and Management in India*. [www.ijcrt.org](http://www.ijcrt.org). <https://ijcrt.org/papers/IJCRT1704172.pdf>

Desertification has been removing areas of grasslands and grazing land. A significant proportion of grasslands and grazing land have been encroached on agricultural land. This easily leads to loss of vegetation and affects the regeneration of vegetation, leading to degradation of grazing land, eventually becoming barren. Livestock farming in India depends on crop residues and agricultural products. The rate of increase of 2% per year puts a huge pressure on resource-limited land (ICAR 2003). The grazing of livestock much larger than what could be maintained year by year resulted in severe erosion of the fallow land.

#### **4.4.3 National soil and water conservation**

According to Prof. S.P. Chatterjee, “Soil erosion is the greatest single evil to Indian agriculture and animal husbandry.”<sup>50</sup> It is clear for the India Government to see these problems, consequently, the Government has come up with many plans or programmes on soil conservation, stating these objectives below should be achieved<sup>51</sup>:

- “Conservation of soil and water resources on watershed basis with a view to sustain Agricultural Production and to rejuvenate the ecosystem. Promotion and propagation of eco-friendly and cost effective conservation measures adopting watershed principles.
- To develop suitable strategies for rainfed farming by adopting rainwater harvesting through participation of the people and people’s representatives for potential development of watersheds and promotion of farming system approach for augmenting the income of farming communities.
- To prevent Soil erosion and runoff from the watershed with a view to prevent premature siltation of multipurpose reservoirs and also to reduce flood peaks and volumes of runoff.
- Check the silting up of natural water bodies, drainage courses, reservoirs, paddy fields etc.
- Stabilize and develop land slide/slide prone areas.

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<sup>50</sup> Dr. Jitender Saroha, Associate Professor, Dr. B.R. Ambedkar College, University of Delhi, Delhi, India. (2017, November 4). *Soil Erosion: Causes, Extent and Management in India*. [www.ijcrt.org](http://www.ijcrt.org). <https://ijcrt.org/papers/IJCRT1704172.pdf>

<sup>51</sup> Super User. *Soil conservation*. The Official Website Of The Department Of Soil Survey & Soil Conservation. <https://www.keralasoils.gov.in/index.php/programmes/soil-conservation>

- Generate rural employment on a regular basis as a result of the soil and water conservation projects implementing throughout the state thereby enhancing the socio-economic status of the people of that locality.
- Awareness creation among the public on the need for conservation of natural resources for the future generations.
- Rejuvenation of polluted and unproductive ecosystem considering all means for the holistic development of the area.”

Some noticeable programmes<sup>52</sup>:

*Soil and Water Conservation on Watershed Basis – RIDF (NABARD assisted)*

“[...] Development Fund of NABARD with a view to create required infrastructure backup for land development under various projects. [...] The main objective of the scheme is to bring improved and sustainable agricultural productivity in identified watershed areas by adopting scientific soil and water conservation activities. The contribution of the projects for enhancement of ground water recharge, mitigation of floods and moderation of droughts in the watersheds are quite substantial. [...]”

*Application of Information Technology*

“[...] Minimum required no. of computer systems have been installed in all the Soil Conservation Offices and it has proved to be very effective in improving the service quality and efficiency of the department. NIC has developed the required software for facilitating online monitoring of activities for the Department. Monitoring & Evaluation of Soil and Water Conservation Projects is also a component under this scheme.”

*Stabilisation of Landslide Areas*

“[...] The projects help to stabilize/restore natural ecosystems prone to /affected by phenomena like landslide, landslip etc. This scheme provides 100% financial assistance to the concerned beneficiaries. The scheme has been implemented in selected districts on need basis. The major works proposed through these schemes are Graded bunds, Agrostology, vettiver planting, diversion channels for the safe disposal of water, stubble mulching, coir geotextiles etc. [...]”

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<sup>52</sup> Super User. *Soil conservation*. The Official Website Of The Department Of Soil Survey & Soil Conservation. <https://www.keralasoils.gov.in/index.php/programmes/soil-conservation>

*Rashtriya Krishi Vikas Yojana (RKVY)*

“[...] The interventions proposed under the project is construction of water harvesting structures and farm ponds. The works are progressing in the project area.”

Below is the list of some programmes/schemes that have been done, provided by The Department Of Soil Survey & Soil Conservation.<sup>53</sup>

1. National Watershed Development Project For Rainfed Areas (NWDpra)

“[...] project activities were taken up in 31 sub watersheds comprised in 134 micro watersheds. Holistic development of the watershed area with proper natural resource management activities through soil conservation measures, revival of the agrarian sector with improved production and productivity were the major objectives of the programme. [...] income generating activities under Farm Production System and Livelihood Support Initiatives for the landless were also included under the projects.”

2. River Valley Project Kabini (since 1998-99)

“[...] The principle objective of the scheme is to prevent siltation in the reservoirs of hydel dams constructed across Kabini River and to prevent soil erosion from the catchment of Kabini river in Kerala Portion. The assistance for the project under Macro management in Agriculture (MMA) Scheme has been stopped by the Central Government. Hence steps have been taken for finding alternate source of funds through RKVY, NMSA etc for saturating the already selected & executed priority watersheds of the district.”

3. Special Rehabilitation Package for Farmers of Distress Districts - Check Dam Project in Wayanad

“Government has accorded administrative approval for 13 check dam projects under Special Rehabilitation package for Farmers of Distress Districts in Wayanad district at an estimated cost of Rs 11 crores. The major objective of the scheme was to reinforce the drainage lines of selected watersheds for enhancing the ground water recharge and provide water for improving agricultural production. [...]”

4. Soil Conservation activities under Kuttanad Package

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<sup>53</sup> Id.

“[...] The Project gives emphasis for various water conservation activities aimed at ensuring potable water for domestic use and irrigation purposes. The various activities devised under the programme include renovation of wells, ponds, well curbing, planting of vetiver, supply of medicinal and horticultural plants etc. Works under first phase sanctioned for an amount of Rs 15.25 crores and second phase sanctioned for an amount of Rs.25.20 crores in the three districts of Alappuzha, Kottayam and Pathanamthitta have been completed.”

#### 5. Eco restoration Project in the Habitat of Particularly Vulnerable Tribal Group

“The project [...] aims at eco restoration of the vulnerable habitats of the 78 tribal colonies in the districts of Malappuram, Palakkad, Thrissur, Wayanad and Kasargode. [...] The main constraints [...] includes rapid degradation of soil and water resources, unavailability of safe drinking water, threat from wild animals and fragile ecosystem. The treatments undertaken for natural resource management [...] helped to build up the infrastructure base of the project area and in the socio economic development of the backward tribal community.”

There is at least a quarter of India's area — 81 million hectares, in desertification. In order to mitigate and overcome the negative effects of drought and to combat desertification, the Indian government has pursued a strategy and implemented a number of development programs over the past two to three decades. These programs include the region's drought that will be affected. Program started in 1973-1974, Desert development program started 1977-1978<sup>54</sup>, River basin national development program in wet areas, started in 1990, etc.<sup>55</sup> Also country effective countermeasures to drought have been taken in the past 3-4 decades. India has signed the United Nations Convention against Desertification, developing an action plan based on the experience gained through Agenda 21-study on areas prone to drought and desertification.<sup>56</sup>

Application measures are often aimed at minimizing the rate of desertification and regenerating fertile soil, but primitive motives such as overcrowding of livestock and land farming have not yet been overcome. Desalinate seawater in the oceans near the desert and then bring it to the mainland using pipes and pumps to grow plants. The use of a plumbing system to water plants will limit the amount of water lost due to evaporation and seepage in the sand, helping plants thrive in today's arid regions. These planted areas can also bring in greater

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<sup>54</sup> *Agenda 21 - India*. Welcome to the United Nations.  
<https://www.un.org/esa/agenda21/natlinfo/countr/india/natur.htm>

<sup>55</sup> G. Pegram, Y. Li, T. Le. Quesne, R. Speed, J. Li, and F. Shen. 2013. River basin planning: Principles, procedures and approaches for strategic basin planning. Paris, UNESCO.

<sup>56</sup> *Agenda 21 - India*. Welcome to the United Nations.  
<https://www.un.org/esa/agenda21/natlinfo/countr/india/natur.htm>

rainfall, creating more clouds that reflect the sun's rays into the space, causing the temperature of some places to drop significantly. Eucalyptus and some other tropical plants, apart from their fast-growing properties, are also resistant to heat due to abundant water reserves in the roots. But the cost of this plan is enormous, and there may be other side effects that adversely affect your surroundings. Because of the ability to absorb nitrogen gases from the air and then add it to the ground, they are often grown for geological improvement.<sup>57</sup> Other methods include placing rocks around the stump to accumulate dew and moisture, or raking small beds to accumulate plant seeds from wind blowing and delaying rainwater from draining too quickly. Use wind-resistant greenery to minimize the chance of soil being exposed to dust and water evaporation. With the high demand for firewood for fuel in developing countries, the problem of people cutting trees for firewood is a driving force for desertification. One option is to popularize solar cookers for cooking or high efficiency wood stoves. There are localities to install sand fences to prevent wind and plant herbaceous species carpentry to prevent soil from being eroded. Green bushes planted at the base of the dune are capable of stabilizing the dune's position and reducing the amount of sand being moved by the wind.

#### **4.2 Water resource**

As India is an agricultural country, much of the population is dependent on agriculture and Indian farmers are mostly dependent on rainwater or river water. The pressure on our water resources is increasing due to the increase in population and the improvement in standard of living in India. Due to this, the availability of per capita water resources is decreasing day by day. According to a study: “India receives an average of 4,000 billion cubic meters of rainfall every year. Unfortunately, only 48% of rainfall ends up in India’s rivers. Due to lack of storage and crumbling infrastructure, only 18% can be utilized. Rainfall is confined to the monsoon season, June through September, when India gets, on average, 80% of its total annual precipitation. Due to India’s storage crunch, the government is unable to store surplus water for the dry season. Such uneven seasonal distribution of rainfall has not stimulated the development of better capturing and storing infrastructure, making water scarcity a critical problem. India is blessed with good rainfall well distributed over 5-6 months in the year. The average annual rainfall in the country is 1170 mm with a wide range between 100 mm in desert areas of Rajasthan to 10000 mm in Cherapunji. The total available sweet water in the country is 4000

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<sup>57</sup> *Proceedings. Regional expert consultation on eucalyptus. Volume I.* Home | Food and Agriculture Organization of the United Nations. <https://www.fao.org/3/ac777e/ac777e06.htm>

billion m<sup>3</sup> per annum. Out of this, over 1047 billion m<sup>3</sup> water is lost due to evaporation, transpiration and runoff, reducing the available water to 1953 billion m<sup>3</sup> and the usable water to 1123 billion m<sup>3</sup>.<sup>58</sup> Also, it has been clarified in several studies that in the near future the difference between demand and supply may take worrisome form. The source of water resources in India is mainly rain water, yet the water resources can be divided into the following two parts: surface water and groundwater.

#### 4.2.1 Surface water

Surface water is completely dependent on rainfall. Rainwater availability in India is considerable and is also a part of normal life here. India receives an average of 1160 millimeters of rainfall a year.<sup>59</sup> Most of the rainfall occurs in the monsoon season (June – September). The water collected in the ponds, lakes and rivers etc. is used by the Indians throughout the year. It is possible to have both floods and droughts in India within any given year because the rainfall in India is very variable on a spatial and temporal basis. While on one side in the country, Massinram near Cherrapunji receives the highest rainfall in the world, on the other side almost every year in dry seasons, there is a shortage of water at many places.

The glaciers deposited on the mountains of India, melts in the summer and flows into the rivers. The geographical area of the rivers is about 329 million hectares. Some rivers are famous as great rivers in the world, such as Indus, Ganga, Yamuna, Brahmaputra, Meghna etc. Majority of the population of India is rural, which is completely based on agriculture. For which rivers are the only source of irrigation, it is no exaggeration to say that rivers are the heart and soul of Indian life.

#### 4.2.2 Groundwater

Groundwater is water that leaks from rocks and soil and accumulates below the ground. The rocks in which groundwater is stored are called aquifers. Ground water is mostly clean and can be used directly. India is the world's largest geothermal water user. However, even in India, the distribution of groundwater is not uniform everywhere. The plateau parts of India have always been weak in terms of groundwater. Here groundwater is found in geological formations such as fault basins and cracks. The alluvial plains of northern India have always been rich in

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<sup>58</sup> Tariq Ahmad Bhat. (2014). *An Analysis of Demand and Supply of Water in India*.

<sup>59</sup> वर्षावन और पृथ्वी पारिस्थितिक तंत्र *rainforest and earth ecosystem in Hindi*. (2018, November 27). 1Hindi. <https://www.1hindi.com/rainforest-and-earth-ecosystem-in-hindi/>

groundwater, but now an unprecedented reduction has been recorded in the northern western parts due to rapid exploitation of irrigation.

Concerns are being raised about the situation of water bodies and ground water in India. The way groundwater is being exploited in India, conditions can be quite dangerous in the future. It is known that in India 60% of the water for irrigation and about 85% of the source of drinking water is groundwater<sup>60</sup>, in such a situation the fast falling level of ground water is emerging as a big challenge.

#### 4.2.3 Water resources Policy

Water is the basis of life and if we have to save life, then we have to take measures to conserve and save water. The availability of water is decreasing and the fighting is increasing. In such a situation, it becomes the responsibility of every human being to find the right solution to the crisis.

According to the NITI Aayog, India is facing a water crisis for the first time, if remedial steps are not taken, there may be a shortage of potable water in the country by the year 2030. Keeping this in mind, the government is planning to make significant changes in the new National Water Policy (NWP) as well as the governance structure and regulatory framework related to water. But it is very important to build consensus among the states for these changes. It is known that India's first water policy came in the year 1987, which was revised in the years 2002 and 2012.

Why is the new water policy necessary?

The last amendment to the National Water Policy took place seven years ago and during these seven years many changes related to water resources have been observed which need to be identified and re-defined to prioritize the use of water.

NITI Aayog in its Composite Water Management Index 2.0- 2018 has recognized that at present, water is being used excessively and improperly. The efficiency of water used in the irrigation sector is 30–38%. Where about 40-45% of the water supply for potable water and sanitation is wasted in the urban area, on the other hand, the villages get very small amounts of water, so there is a need to balance the water supply. According to NITI Aayog, spring sets are decreasing in the Himalayas due to water management problems. It is known that in September last year, the NITI Aayog formed a group of experts for a dedicated mission to revive the Himalayan Springs. There is a need to use technologies such as sensors, geographic information

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<sup>60</sup> Tariq Ahmad Bhat. (2014). *An Analysis of Demand and Supply of Water in India*.



systems (GIS) and satellite imagery to control and track the flow of water. Also, the budget needs to be constructed in such a way that it covers all the water levels from the basin to the sub-basin. A new water policy is also needed to deal with the adverse effects of climate change, excessive rainfall, shortage of water during summers, drying up of rivers, water quality and river pollution.

#### Linking agriculture with water management from NITI Aayog

- Availability of area-based water: Water availability should be ensured keeping in view the characteristics of the agricultural sector, as well as choosing the appropriate cropping method for the particular climatic zone. For example, sugarcane in Maharashtra and paddy in Punjab are not suitable for the climate because these crops require more water, which gives less water to other crops and affects their growth. Water should be provided according to the needs of the agricultural sector, so that there is no waste of water.
- Redefining Subsidies: Instead of receiving free benefits, Indian agriculture should adopt the process of availing benefits by paying resources and services. Resources available to farmers, such as water or electricity, can be valued in two ways. One is the cost of resources, the other is the cost of ensuring access to resources.
- Better Funding: The distribution of finance and other resources should be done directly by the Central or State Government Distribution Centers, so that they can provide monetary and other support in a better way. This will bring efficiency in agricultural operations.
- Improving technology: India is still following the old practice of dam construction and then passing water through open canals causing problems like water logging and the actual amount of water is not transferred to the source. Whereas today globally available technologies such as micro irrigation, sprinkle irrigation, in which every single drop of water is used, should be implemented.

#### National Bureau on Water Use Efficiency<sup>61</sup>

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<sup>61</sup> *COMPOSITE WATER MANAGEMENT INDEX*. (2019, August). NITI Aayog, National Institution for Transforming India, Government of India. [https://social.niti.gov.in/uploads/sample/water\\_index\\_report2.pdf](https://social.niti.gov.in/uploads/sample/water_index_report2.pdf)

- Establish the scale of efficiency in the field of water resources, especially in the domestic and industrial sectors.
- Treat river basins or sub-basins as hydrological units rather than administrative and political boundaries and to bring about comprehensive changes in water management.
- Propose a River Basin Management Bill. The Bill envisages the establishment of river basin authorities. It will be managed by a two-tier structure - one governing council and the other executive board.
- The Governing Council will primarily implement a river basin management plan. If the river basin would be defined as a hydrological unit, it would have to be constituted within the constitutional framework and there would have to be a consensus among the states involved.
- This will be the first time that the issues and problems related to the river basin at the political level will be ensured to be resolved at the basin level. This will save time and efforts of tribunals.

India started its first water policy in the year 1987 and now the earlier policies should be kept in mind to find strong points and flaws to work according to the new circumstances. The new policy framework should be based on the recommendations of NITI Aayog's Composite Water Management Index 2.0, 2018. Integrated water resources management should be redefined. Aspects of the basin and sub-basin planning should be taken into account for setting realistic goals. There is no scarcity of water in the country but there is a need for water management. Therefore, proper management of water should be on the agenda.

### **4.3 Forests**

Forests have been at the center of human development since the beginning as the most important natural resource and hence human life cannot be imagined without forests. However, in view of the unforeseen deforestation that has been taking place in the past few years, there is no denying the fact that soon we are witnessing its terrible consequences. The issue of deforestation remains an important topic in the world as well as in India, many efforts are being made by the government in this context. The result of these efforts of the government has been seen in the recently released India Forest Status Report, 2019. According to the report, green areas of the country have registered an increase in the last two years. In this report, data received

from more than 2200 locations across the country have been used for estimation of forest and forest resources. A new chapter called 'Forest Types and Biodiversity' was added to the current report, under which the species of trees are divided into 16 main classes and their 'Champion & Seth Classification'. Assessment has been done on the basis.

According to the 16th India Forest Status Report, at present the total area covered by forests and trees in the country is about 8,07,276 sq km, which is 24.56 percent of the total geographical area of the country.<sup>62</sup> If we compare the recent report with the report of the year 2017, then it is known that during this time the total area covered by forests in the country is about 3,976 sq km.<sup>63</sup> That is, an increase of 0.56 percent, while the area covered by trees is about 1,212 sq km. That is, an increase of 1.29 percent. However the above data should be viewed as just one bird of India Forest Status Report-2019, as another side of the report states that 2,145 sq km in the last two years. Dense Forests have been converted into Non-Forests.<sup>64</sup>

According to the report, the forest cover area of the total geographical area in the country is about 7,12, 249 sq km. Is (21.67 percent). It is worth noting that this number has been around 21-25 percent for the past several years, while according to the National Forest Policy, 1988, it is mandatory to be about one-third of the total geographical area of the country. This shows that India has failed to work in accordance with the National Forest Policy framed in the year of 1988.

#### **4.3.1 Problems facing Indian forests**

We have traditionally observed that the forest is naturally reproducing in abundance. This type of approach was true until the early 18th century when the country had abundant or sufficient resources and population pressure was low. However, at the end of the 17th century, there was a rapid increase in population and agricultural activities in India. This fueled the demand for forest produce and led to the destruction of forests. The British Empire followed an exploitative

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<sup>62</sup> Ministry of Environment, Forest and Climate Change. (2019, December 30). *Total forest and tree cover rises to 24.56 percent of the total geographical area of the country*. Press Information Bureau.

<https://pib.gov.in/PressReleaseDetailm.aspx?PRID=1597987#:~:text=ISFR%202019%20is%20the%2016th,forest%20cover%20is%20consistently%20increasing.&text=%E2%80%9COut%20of%20this%2C%20the%20increase,tree%20cover%20is%201%2C212%20sq>

<sup>63</sup> Id.

<sup>64</sup> India Forest Status Report 2019. Forest Survey Of India - Government Of India. <https://fsi.nic.in/forest-report-2019>

and colonial or imperialist economic policy, especially after 1857. The country's economy was severely affected due to which between 1860 and 1945, more than 30 million people died of hunger.<sup>65</sup>

In 1890, only 61 percent of India's population depended on agriculture, which increased to 75 percent by 1931 and about 90 percent at the time of independence. It was called industrialization in India.<sup>66</sup> Being deprived of other means of livelihood, people naturally turned to agriculture, for which they vacated the forest land. In the post-independence period, the country had no other option, but it produced more grain for its people. Forests were destroyed for cultivation of food crops. In this process, two important resources like forest and minerals were left few. Forests were also eliminated for social, developmental and other projects.

#### Unequal distribution of forests

The distribution of forest areas in various states is highly skewed. While the proportion of forest area in northwest India is 11 percent, it is 44 percent in central India. The scarcity of forest areas can be seen in the regions most in need of them. In areas like Punjab, Haryana, Uttar Pradesh and Bihar with high population density and extensive Krishna land, the use of cow dung is widely used as fuel due to non-availability of fuel wood.

Low productivity of forests : The productivity per hectare of forests in India is very low. “The productivity of forests is extremely low as 0.7 cum (Cubic metre) as against the world average 2.1 cum/ha./year (Lal, 1989) and along with this, the average growing stock is 32 cum per ha.

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<sup>65</sup> *British Raj*. Encyclopedia Britannica. <https://www.britannica.com/event/British-raj>

<sup>66</sup> Tripathi, A., & Prasad, A. R. (2010). Agricultural development in India since independence: A study on progress, performance, and determinants. *Journal of Emerging Knowledge on Emerging Markets*, 1(1). <https://doi.org/10.7885/1946-651x.1007>

as compared to the world average of 110cum.”<sup>67</sup> India has been unable to exploit its forest resources in a proper and favorable manner. The following reasons exist behind this:

1. Difficulty in exploitation due to uneven distribution and inaccessibility.
2. Uncontrolled harvesting of forest cover through compensatory plantation.
3. Deprivation of vast areas of unclassified forests from the rehabilitation process.
4. Lack of proper transport and basic facilities.
5. Overuse due to irregular grazing.
6. Destruction of forests due to fire.
7. Harvesting, pruning and modification by abusive and unscientific methods.
8. Unscientific economic activities such as farming through drafts and jhuming methods, which destroy the brittle forest cover.
9. Dependence on notions of stable conservation, such as natural development, which do not lead to substantial uptake in afforestation activities.
10. Lack of adequate information about forest resources and lack of research facilities.
11. Loss of forest cover as a result of expansion of industrial and irrigation projects and illegal harvesting.

#### Destruction due to agricultural and development needs

With the pressure of increasing population, the demand for land increased manifold, resulting in rapid contraction and depletion of the country's forests. Forest land was used for agriculture. Forest land is also being used for commercial activities. Till the enactment of the Forest (Protection) Act, 1980, the annual rate of change of forest land for use for other purposes was 1,50,000 hectares. In addition, encroachment and jhum agriculture also affected several million hectares of land.<sup>68</sup>

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<sup>67</sup> D.P. Malik and Sunil Dhanda. *Status, trends and demand for forest products in India*. Home | Food and Agriculture Organization of the United Nations. <https://www.fao.org/3/xii/0228-b1.htm#:~:text=The%20productivity%20of%20forests%20is,to%20world%20average%20of%20110cum>

<sup>68</sup> Forest (Conservation) Act, 1980 amended. (1989). *Indian Journal of Public Administration*, 35(3), 707-709. <https://doi.org/10.1177/0019556119890344>

The increase in animal population and its economic management also created a crisis for the regenerative capacity of forests. There is a lot of pressure on Indian forests today due to increasing demand for them. Increase in hydroelectric schemes, roads and urbanization have also contributed to deforestation.<sup>69</sup>

### **4.3.2 Forest Development and Conservation**

#### **Forest Survey of India - FSI**

The Forest Survey of India, established in June 1981, collects information and data related to the forest areas and forest resources of the country. It is headquartered in Dehradun and has four regional offices in Bangalore, Kolkata, Nagpur and Shimla. Coordination and control in the administrative functions as well as in the regional offices is carried out by the headquarters. Apart from this, preparation of maps of forest areas, collecting data and training are other major tasks. Its offices carry out the preparation of a list of trees inside the forests and outside the forests and other activities assigned by the headquarters.

The following are the objectives of the Forest Survey of India:

- Preparation of comprehensive forest status report including National Forest Botanical Map once every 2 years and to prepare thematic map using distant sensory data with mandatory facts in maximum 10 years.
- Collecting, storing and retrieving necessary data related to forestry for national and state level planning and creation of computer based National Infrastructure Forest List System.
- Preparation of the forest cover in selected states / UTs till the establishment of their own resource survey units, depending on the agency.
- To impart training in modern forest survey technology to the Forest Guards at various levels of the States / Union Territories / Government of India.

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<sup>69</sup> Kumari, R., Banerjee, A., Kumar, R., Kumar, A., Saikia, P., & Latif Khan, M. (2020). Deforestation in India: Consequences and sustainable solutions. *Forest Degradation Around the World*. <https://doi.org/10.5772/intechopen.85804>

- To assist and supervise the work of making technical information to be done by the States / Union Territory Forest Departments.

## Forestry research

The Indian Council of Forestry Research and Education<sup>70</sup> is the apex body of the forestry research system. The Council deals with the need for planning based research, promotion, conduct of work and all aspects related to forestry, research, education and coordination in the work of its promotion.

The Council has found solutions based on forestry research to address the problems faced in the region including climate change, conservation of biological diversity, preventing desertification and sustainable management and development of resources. Public confidence has been increased by the Council successfully meeting the challenges in the field of forest management and research.

The Council has 8 regional research institutes and 4 research centers in different geographical parts of the country to cater to the need of forest related research in the country. There are 6 research institutes and 4 advanced research institutes under the Council. Research institutes include Forest Research Institute, Dehradun; Institute of Forest Genetics and Tree Breeding, Coimbatore; Kanth Institute of Science and Technology, Bangalore; Tropical Forest Research Institute, Jabalpur; Rain Forest Research Institute, Jorhat, Arid Forest Research Institute, Jodhpur; Himalayan Forest Research Institute, Shimla; The Forest Productivity Institute is Ranchi.

Advanced research institutes under the Council are as follows: Social Forestry and Ecological Rehabilitation Center, Allahabad; Center for Forestry Research and Human Resource Development, Chhindwara, Forest Research Center, Hyderabad; Bamboo and Cane Advanced Research Center, Aizawl.

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<sup>70</sup> <https://icfre.gov.in/>

## National Forest Policy 1988

Prior to independence, forest policies in colonial India were mainly focused on revenue collection. Which was owned by the Imperial Forest Department, which was also the protector and manager of forest wealth. Even after independence, forests were mainly seen as a source of raw materials for industries.<sup>71</sup> This was followed by the creation of the National Forest Policy<sup>72</sup> (1988), in which forests were seen as an important component of environmental sensitivity and conservation, rather than merely looking at forests as a revenue source. At the same time, it was also stated in this policy that the primary rights over forest products should be of the communities whose daily needs depend on these forests. This national policy also emphasized increasing people's participation in the conservation of forests. The main goals of this policy are:

- Sustaining environmental sustainability by preserving and restoring ecological balance,
- Conservation of natural wealth
- Control of land erosion and soil erosion in the area of the route of rivers, lakes and other streams
- Increase in forest and tree cover through extensive tree plantation and social forestry programs
- To take steps to meet the fuel wood, fodder and other small forest produce requirements for the rural and tribal population,
- Increase in forest produce to meet national requirements
- Promoting the proper use of forest produce and finding a suitable alternative to wood,
- Take appropriate steps to increase public participation for forest conservation.

In addition to this, the Forest (Conservation) Act, 1980<sup>73</sup> was also amended in 1988 to prevent the use of forest land for deforestation and non-forestry purposes. Various types of punishments were provided for violation of rules. The 1988 Forest Policy talks about the symbolic relationship between the forest and the forest dwellers. However, tribals and other forest dwellers are not allowed to grow wild fruit trees, fodder or fuel-wood, all of which are

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<sup>71</sup> *COLONIAL FOREST POLICIES AND CRIMINAL TRIBES*. eGyanKosh. Available at: <https://egyankosh.ac.in/bitstream/123456789/67208/1/Block-8.pdf>

<sup>72</sup> Government Of India - Ministry Of Environment And Forests New Delhi. (1988). *NATIONAL FOREST POLICY*.

<sup>73</sup> Forest (Conservation) Act, 1980 amended. (1989). *Indian Journal of Public Administration*, 35(3), 707-709. <https://doi.org/10.1177/0019556119890344>



necessary for their survival. This is because they are under the policy non-forest purpose has been considered (non-forest usage). However, the success of this policy is doubtful due to uncontrolled growing population and increasing encroachment of forest land. Apart from this, large-scale irrigation and mining schemes have also caused major damage to the forest area.

#### National Forestry Action Program (NFAP)<sup>74</sup>

For timely and efficient implementation of the National Forest Policy 1988, the Government formed a National Forest Action Program (NFAP) and for this in June 1993, the United Nations Development Program (UNDP) and FAO made a project with NFAP. It came into existence in the year 1999. Under this, a comprehensive action plan was made for the sustainable development of India's forests in the next twenty years.

The objective of the National Forestry Action Program is to bring 33 per cent of the total area of the country under forest cover and to control deforestation. The main elements of the program are as follows:

1. Conservation of existing forest resources;
2. Improvement of forest productivity;
3. Reduction in total demand for forest produce;
4. Strengthen policy and institutional framework; and
5. Increase forest area

#### Forest fire control

A major cause of forest destruction in India is forest fires. In most cases, the fire is set by humans. On some occasions, it seems accidental. Causes of deliberate fire accidents in the jungles - cattle grazing, mahua, etc. In order to reduce fire accidents in India, the Forest Department has taken the following steps:

1. Development of fire lines, and;

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<sup>74</sup> National Forestry Action Programme--India. (1999). *National forestry action programme--india*.

2. Establishment of surveillance columns in addition to the appointment of fire guards during the particular season of fire.

A modern forest fire with the help of United Nations Development Program (UNDP) at Chandrapur in Maharashtra and Haldwani in Uttarakhand and Nainital to find out the causes, control and prohibition of forest fires in the country. Control project has been initiated. The scheme is currently being run in 11 states. These schemes are also being expanded to other states. The scheme has been named Modern Forests Fire Control Projects .

#### India's Modern Forest Fire Control Project<sup>75</sup>

“The overall development objective of the project is to ensure an adequate quantity and quality of forest products from both natural and human-made forest, as well as the protection of soils and environment on lands where the protective and productive role of forests and forest vegetation is accorded national land-use priority.

The specific objectives are:

- ❖ to devise, test and demonstrate principles and techniques of prevention, detection and suppression of forest fires in the states of Uttar Pradesh and Maharashtra;
- ❖ to determine the technical, socio economic and financial feasibility of the application of modern forest fire-fighting techniques in India to enable the government to take appropriate investment decisions in this respect;
- ❖ to institute an effective, useful and appropriate system of fire statistic reporting, recording and dissemination;
- ❖ to establish through appropriate fire behaviour trials a fire danger rating system applicable to the major fuel types encountered, suitable for use as a basis for extrapolation nationally;
- ❖ to formulate an effective programme to strengthen the fire prevention, detection and suppression capabilities of the forest and rural fire protection authorities in the two States;

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<sup>75</sup> R. Saigal. *Modern forest fire control: The Indian experience*. Home | Food and Agriculture Organization of the United Nations. <https://www.fao.org/3/t9500e/t9500e06.htm>

- ❖ to organize and promote a cooperative fire prevention programme based on the active participation of rural communities;
- ❖ to establish a cooperative programme of fire management with other departments and authorities, including agreements for reciprocal and mutual aid benefits, and to facilitate the integration of forest fire protection into overall development plans.’’

### Social forestry<sup>76</sup>

The National Forest Policy, 1988 emphasizes people's participation in the development and conservation of forests of waste or lesser importance, fuel wood, fodder and small amounts of timber to meet the needs of the local community and its development and conservation. Says to develop it for environmental improvement. Therefore, the social forestry scheme was started which increased the green cover, supplied forest produce and fuel wood and brought some wood and some forest produce to the villagers. At the same time, it met the fuel requirement of the urban population and produced the raw material for the matchstick industry.

The National Agricultural Commission of the Government of India first used the term social forestry in the year 1973. It was felt that the forests were under pressure due to increasing population and the land was getting destroyed due to human activities. Social forestry was adopted to involve people to achieve some main objectives.<sup>77</sup> India's natural forest cover is declining rapidly. Therefore, the importance of social forestry increases greatly in terms of maintaining ecological balance. Social forestry as a mass movement has also been included in the 20 point program. Social forestry has the following objectives:

1. To increase forest area and maintain ecological balance: This is accomplished by conservation measures of moisture and soil and natural habitats.

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<sup>76</sup> Tiwari, K. M. (1983). *Social forestry in India*.

<sup>77</sup> Monika Jaiswal, Ramesh Kumar Singh and Prabhat Tiwari. *Role of Social Forestry in India: A Review*. Bulletin of Environment, Pharmacology and Life Sciences. [https://bepls.com/OCT\\_2017/4.pdf](https://bepls.com/OCT_2017/4.pdf)

2. To meet the basic rural needs: Social forestry fulfills five basic needs of the villagers - fuel, food, fodder, fertilizer and fiber. The availability of fuel wood and fodder in India is one-fourth and half of the total demand respectively, which can be increased only through social forestry. Apart from this, raw materials are also supplied to rural cottage and small scale industries through small forest produce like timber, bamboo, gond, mahua, medicinal grass, lac, etc.
3. Ensuring better soil utilization: Social forestry helps in the achievement of balanced and sustainable land use through soil erosion control, marginal land reclamation, anti-drainage efforts and monolithic integration of agro-animal husbandry.
4. Employment generation: Social forestry programs can bring about a satisfactory reduction in the situation of rural unemployment (especially in non-agricultural seasons). It helps in stabilization of income of weaker sections of the society.
5. Pollution control: Absorption of harmful gases by trees emits oxygen. In this way they are helpful in reducing air pollution (especially in urban areas).

*Social forestry scheme*<sup>78</sup>

The scheme was launched in 1980-81 in 101 districts lacking fuel wood. It was a centrally sponsored program, provided financial and technical assistance by Canada and Sweden. The social forestry program has been extended to Jammu and Kashmir, Himachal Pradesh, Haryana, Uttar Pradesh, Pt. Success has been achieved in Bengal, Odisha, Gujarat and Tamil Nadu. One of the main features of social forestry has been the active participation of local communities, including rural poor, landless, laborers, voluntary organizations, Mahila Mandals, rural youth, school teachers, etc. The Forest Department assists in the selection of plant species. And the product is distributed to the local community. Tree planting is done at community sites, canal fences, ponds, roadsides and railways, panchayati lands,

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<sup>78</sup> Kumar, Vikas. (2015). Social forestry in India: concept and schemes. 10.13140/RG.2.1.1652.4243.

waste marshlands, waterlogged areas, low forests, industrial areas, school and college campuses, hospitals, monuments and historical sites, etc.

There are two main components of the social forestry program - first, afforestation of rural lands, and; second, plantation on private lands, called agro-forestry. Agricultural forestry has been extremely successful in terms of rapid production of trees. Eucalyptus trees have been established in some areas of Gujarat and Karnataka. Village or community forestry, on the other hand, was unsuccessful as it did not have effective participation by the local people. Villages are often heterogeneous, lacking a sense of coherence. Village councils are also bodies made up of many villages and which do not take every member of the village into confidence. Apart from this, no tradition of management of common land also exists. => Success in agronomy, but neglect of village forestry.

Furthermore, this scheme preferred market oriented trees and neglect of fuel wood and fodder trees. This was not only adverse to the objectives of social forestry but was also a cause of increased pressure on forest land. Collecting wood, leaves, grass etc. from forests continued as before by the farmers. However, social forestry projects being run on forest lands due to lack of government funds as compared to foreign contribution had to be faced with lack of capital. These half-baked projects failed to produce the expected results.

The richness of a country is measured by the biodiversity of its inhabitants more than the physical prosperity of its inhabitants. In India, even though in the name of development, forests have been unbalanced in the last few decades, but our forest wealth is unique and unique around the world. Trees are the main source of oxygen, so our life is dependent on trees. If trees do not exist then no animal or animal will exist. Therefore, it is necessary that issues like deforestation and tree plantation be seriously considered and this subject should be kept at the center of policy making.

## 5 Conclusion and Author's Suggestions

To sum up everything that has been studied so far, the Indian Government has found many programs for the conservation of natural resources. However, a big contradiction that has no answer is the man's infinite greed for the finiteness of natural resources. That is the problem that gives rise to all negative impacts on the environment, on a rich resource that is now in danger of exhaustion. Therefore, it is necessary to have a reasonable comparison between the types of resources used to achieve maximum capacity for stable production and food safety, improve livelihoods while also protecting the ecosystem, plants and habitats.

India has the potential for diverse and rich natural resources. However, it is the unreasonable exploitation and use and protection of natural resources that will lead to degradation, depletion, poverty and lack of resources. In order to effectively prevent and restore natural resources, it is necessary to propose solutions for appropriate development and use (or sustainable development) that need to be actively, consistently and synchronously implemented. In the current period, along with the general energy saving, the use of clean energy is being exploited by the world, so we need to promote and exploit and use them to meet the energy demand. current quality of the country and contribute to environmental protection.

In conclusion, it is necessary to increase the education of environmental awareness for the people so that people can raise awareness and change their behavior towards nature, and at the same time need to raise the sense of responsibility and expertise of managers, as well as building a good two-way relationship between the people and the government in order to well implement the national and local environmental policies. For a clearer understanding, I have suggested some ideas which are stated below.

Author's Suggestions	
Land and soils resources	The two most important issues for the country in particular and the world in general today in the protection of the environment and land resources are the protection of cultivated land and the prevention of land degradation. To protect cultivated land, it is necessary to have a

	<p>reasonable land use planning, and limit the conversion of cultivated land.</p> <p><i>The Government</i> has a standard orientation from the beginning of the planning to expand urban areas and industrial zones to minimize the loss of arable land, and in some necessary cases, conduct zoning maps for protection of agricultural land.</p> <p>Continue to supplement, amend and improve more policies and laws on land ownership, use and state management in general and regulations on slope land management. well integrating national policies with international action plans to combat degradation and sustainable land use.</p> <p><i>In socio-economic</i></p> <p>it is necessary to regulate population distribution and migration among regions and regions in order to reduce population pressure on land resources; to take appropriate measures to ensure food security in mountainous areas, to settle and settle down, to protect and develop forests, to prevent soil erosion ...</p> <p><i>In terms of technique:</i> application of integrated technical measures (agronomy, biology, chemistry, mechanics ...) and intensive investment in land use; Growing perennial crops with high economic and commercial value but less soil</p>
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	<p>disturbance and integrated agroforestry systems on sloping land, keeping ecological balance and regulating mutual impacts between plains and mountains;</p> <p>regenerate vegetation cover with forest trees or a combination of agroforestry to protect soil fertility.</p>
<p>Water resources</p>	<p>Water resources are not endless. The protection of water resources is not anyone's own business, but requires coordination between the state and the people.</p> <p><i>Responsibilities of the State:</i></p> <ul style="list-style-type: none"> <li>- The State develops and disseminates legal documents, decrees and regulations on water resource use and protection, and encourages research works to save water.</li> <li>- Guide the forms of exploiting and using water resources with proper technique to protect water resources, at the same time investigating, surveying and evaluating natural resources and planning reasonable exploitation zoning plans.</li> <li>- Propagate, mobilize and organize many contests on the sense of economical use and protection of water resources among the people from district to ward level.</li> </ul> <p><i>Responsibilities of the people:</i></p> <ul style="list-style-type: none"> <li>- Raising awareness of economical use and protection of water resources: People must be aware of the cause of protecting water</li> </ul>



	<p>resources not only for the present but also for the future generations, so they must learn and master. legal regulations on water resources protection through newspapers, radio and television ... and actively promote a daily sense of economical use and protection of water resources.</p> <ul style="list-style-type: none"> <li>- High up the spirit of self-awareness: Self-discipline strictly abiding by the State's regulations on the protection of natural resources and the environment.</li> <li>- Determined to coordinate with the State in the protection of water resources, detect and boldly denounce acts of violation of the State's law in the use and protection of Natural Resources and Environment, and participate in the movement calling for action to protect Natural Resources and Environment.</li> <li>- In agricultural production, there must be appropriate watering and fertilizing regimes. Water the tree when it is cool, keep the base to keep the tree moist. Avoid using excess, unidentified pesticides. It is advisable to apply biological methods to the destruction of pests and insects.</li> <li>- In livestock breeding, poultry should be raised in barns with a waste treatment system. Do not graze to lead to water pollution and the environment.</li> </ul>
Forests resources	Not only in India, but every country has a program to Increase, protect and maintain

forests, especially when indiscriminate deforestation is happening everywhere and becomes a problem. To prevent this, the following solutions should be performed:

*For legal jurisdiction:*

To increase human resources and means to promptly detect and prevent and properly fight against all acts of thugs and protests by loggers and illegal loggers.

- Develop a legal framework to arrest, prosecute and prosecute those who dare to destroy, burn and destroy forests indiscriminately for their immediate self-interest. The prison term can range from 5 years to life in life depending on position, rank in society, living situation, depending on national protected forest or regenerating forest.

- Develop a legal framework that prohibits forest rangers from accepting bribes from loggers to indiscriminately exploit forests.

- Equip forest rangers with modern equipment to prevent forest fires caused by nature (drought, thunder) and humans ...

- Temporarily put regenerating forests on the list of national forest conservation for a long time to have enough time for full development and diversity of vegetation and animal species.

*On the community side:*

- Education for the local community.

- Based on a pedagogical program from high

	<p>school up to the university level. It is possible to increase the number of lessons in places with ethnic minorities.</p> <ul style="list-style-type: none"> <li>- End the situation of free migration - indiscriminate migration that has existed for decades by closely managing the ethnic minorities who have specialized in nomadic cultivation so far in the locality.</li> <li>- Commend and restore jobs and positions to those who have the courage to stand out and denounce those who deforestation indiscriminately.</li> <li>- For nomads and shifting cultivators who are returned to their old places, a daily living allowance, job creation and a cultivated land are provided according to the state and local planning.</li> </ul> <p><i>In terms of micro and macro views:</i></p> <ul style="list-style-type: none"> <li>- Provide priority policies for areas which have economical, educational, and medical difficulties...</li> <li>- Shorten the gap between rich and poor; city and countryside; plain and mountainous regions...</li> <li>- Regularly launch the program of afforestation on national festivals/holidays.</li> </ul>
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