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# Causesand consequences of environment degradation in Uttarakhand

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## Abstract

**Objectives**: To study the causes and consequences of Environmental degradation in Uttarakhand, India.
**Methods/Statistical analysis**: The study is exploratory in nature where secondary data of 2016-17 is used as a data base collected from different sources. The criteria for inclusion and exclusion are according to the standards set by the government where list of red listed companies is given. This study does not involve any statistical analysis however theoretical analysis is presented in the study.
**Findings:** The study highlights the important role of institutions in encouraging sustainable development. Economic activities also produce negative externalities without having to pay for them. Therefore, the solution would be to determine their correct market value so that economic agents can take account the environmental costs. The study found that while there is a growing trend in the economic development of the state, at the same time, there is also an increase in activities resulting environmental degradation. Government agencies play a vital role in minimization of the degradation.
**Application/Improvements:** Study provides a document to analyze and to formulate a policy for the state to control pollution.
***Keywords*:** Environmental degradation, Economic development, Sustainable development, GHG,Carbon Dioxide.

## 1. Introduction

The atmosphere provides all kind of resources which sustain life on earth such as water, air and land as well as the materials for satisfying all developmental needs of human beings. The economic growth of developed countries has played a major role in the historic rise in Green House Gas (GHG) emissions. It is therefore not surprising that there is a scholarly debate about how the economy and development are both part of the problem of climate change as well as part of the solution [1]. Environmental degradation is articulated as unsustainable forest management, desertification, loss of fertile soils, reduction of freshwater availability and an extreme biodiversity loss. There has been a high correlation between economic growth, rural development and environmental sustainability [2]. This concern about rising economic activity and environmental quality has focused attention on the connection between economic growth and environmental degradation. The relationship between environment and economic growth has been the objective of a long debate in the economic literature for many years [3]. Widening income disparity and environmental deterioration in the relation to economic growth has increasingly become a pressing issue of our concern [4]. Although the majority of the scientists agree that global warming and climate change caused due to the environmental degradation is a serious threat for the future generation and human beings are very much responsible for the cause, but still we are not taking that much attention which is needed, the increasing carbon emissions around the world is the example of our carelessness. In recent years there has occurred a major revision in development thinking that is presenting a fundamental challenge to the conventional consensus on economic development [5].The 'total development of society' involves not only changes in economic activity but also political, social, and cultural, transformations. In assessing the 'total development of society', economics tends to focus primarily on economic changes and thus isolates economic development from 'total development' [6].

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Economies are reliant upon fossil fuel energy resources and focused on meeting the increasing economic and lifestyle demands of every citizen, so each economy moves closer to economic crises with ever increasing energy costs, lack of energy security and diminution of natural resources [7]. These resources will not remain as they are presently available, with every unjustified use of resources counts to depletion; in fact, Lobbyists of industry sector reliant upon fossil fuels advise that resources may last another 20 years or possibly 40 years. There is no doubt that fossil fuels at current rates of consumption will run out very quickly, if as suggested: "tipping points" have already been passed [8]. The present study focused on environmental degradation caused by economic development in India particularly in the state of Uttarakhand. The analysis highlights the important role of institutions in encouraging sustainable development.

## 2. Objectives

To study the causes & consequences of Environment degradation in Uttarakhand.

## 3. Methodology

The present is exploratory in nature. Secondary data for two years collected from different sources, papers, articles, websites, etc. of Uttarakhand is considered as the base for the study. The criteria for inclusion and exclusion are according to the standards set by the government. This study does not involve any statistical analysis however theoretical analysis is presented in the study.

## 4. Literature survey

In [9] analysed the relation of environment degradation with various aspects namely rural poverty, rural development, and economic growth. Study is concerned to India only and it was found that depletion of the natural resources is very common and prevalent in India. Deforestation has also resulted in calamitous consequences. Study suggested that essential measures should be taken to minimise environmental degradation. In [10] analysed the present scenario of CO2 concentration and found that concentration level is increasing year after year at a rate which will cause serious conditions for future generations. Study also described techniques to reduce concentration of CO2 in the air. In [11] highlighted adverse effects of environmental degradation on human health, biodiversity, ozone layer, etc. Study concludes that main cause for environmental degradation in India is overpopulation and overexploitation of natural resources. Study also reveals that India has fastest progress in the world in addressing environmental issues since 1995 to 2010. In [12] studied the impact on environment in India caused by population pressure with particular reference to the degradation of natural resources and the consequential environmental pollution in the Eastern and Central regions environmental degradation was low (excluding Kolkata).

The same trend is visible for Southern and Western regions. Environmental degradation is severe in Northern region. North- Eastern experienced a lower degree of environmental degradation. Study suggested that there is immediate need to take immediate steps through policy prescriptions to halt environmental damage and reverse these trends where- ever is possible. In [13] analysed carbon footprint for opting climate change mitigation strategies in India. Study mainly focuses on the state-wise carbon emissions ($CO_2$, CO and $CO_4$). Study found that major sectors of carbon emissions in India are through electricity generation, transportation, domestic energy consumption, industries and agriculture and a majority of carbon storage occurs in forest biomass and soil. Study also found that Maharashtra emits higher CO2, followed by Andhra Pradesh and Uttar Pradesh which shows that carbon storage capacity is more than emission. In [14] studied the relationship between environmental degradation and economic development. The study found that environmental degradation manifest itself severely because of the combined action of various elements like growth in population, urbanisation, increased in the withdrawn of groundwater for agriculture purpose, etc. There is a need of economic planning for higher level of integration in these marginal areas.

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## 1. Profile of the study area

Uttarakhand was carved out of Uttar Pradesh on the 9th of November 2000. It occupies 17.3 % of India's total land area with 53,566km$^2$ of which 92.57 % is under the hill and 7.43 % under plains. Uttarakhand is located between 77°34'24'' to 81°02'22'' E longitude and 28°53'24'' to 31°27'50'' N latitude [15]. Uttarakhand is divided into two administrative divisions, Garhwal and Kumaon. Garhwal extends from 29°26' to 30°28' North latitude and 77°49' to 80°06' East longitude. It is situated between the tributaries of Ganga- Alaknanda and Mandakani and was designated by Aryans as the celestial land or "DevBhoomi". The Kumaon region extends from 28° 44' to 30°49' North latitude and 78°45' to 81°1' East longitude. The word Kumaon can be traced back to the fifth century B.C.

According to 2011 census, the population of state was 10.12 million of which 70.33% is rural inhabited in 15024 villages (census 2011). About 66% is forest cover and only 13% is agriculture land. Situated on the southern slopes of Himalayas, the northern part of the state is in greater Himalayan Ranges and southern part is in the foothills. The state is administratively organized in 13 districts, among which 11 districts accounting for about 93% of the total area of the state are mountainous as shown in Table 1.

*Table 1. Climate zones of Uttarakhand*

| Climatic Regions | Altitude Range (m) |
|---|---|
| Tropical | < 500 |
| Sub- Tropical | 500 – 1000 |
| Sub- Temperature | 1000 – 1800 |
| Temperate | 1800 – 2300 |
| Sub- Artic | 2300 – 3700 |
| Artic | > 3700 |

*Source: Gupta, P., Sundaresan, J., Boojh, R., and Santosh, K.M. (2014). Climate Change and Himalaya: Natural Hazards and Mountain Resources. Scientific Publishers, New Delhi*

## 2. Economic development and environment degradation

Literature reveals that increasing development causes environment degradation; it is clearly represented by Kuznets cure named after its invention by Simon Kuznets. Misuse of resources by the present generation without caring about the future generation is seen in every corner of the society. Harming of resources is the matter of concern in almost every country. This environmental attention gave birth to the new tern sustainable development. This environment and economic development Linkage evoked the much discussion in last few decades. Available literature shows that income growth and pollution relationship is grown in many decades and in the early stage of development environmental pressure was increased more than the GDP growth. The growth rate of output in the early stage of development is positively related to the environment.

Global climate change is considered to be one of the greatest challenges to international development efforts. It poses risks to humans, the environment and the economy [16]. It is well documented that so-called greenhouse gas (CHG) emissions contribute to anthropogenic (or human-induced) climate change [17].Greenhouse gases include ($CO_2$), ($CH_4$), ($N_2O$), (HFCs), (PFCs), and ($SF_6$). Carbon Dioxide ($CO_2$), which is produced by the use of fossil fuels; it can be emitted directly from human-induced activities like deforestation etc. Methane ($CH_4$); agricultural activities, waste management, energy use, and biomass burning all contribute to emission of Methane. Nitrous Oxide ($N_2O$) is produced by the use of fertilizers for agricultural activities. Hydro-fluorocarbons (HFCs), Per-fluorocarbons (PFCs) and Sulphur hexafluoride ($SF_6$) are collectively known as F-Gases which are produced by industrial processes, refrigeration and other variety of consumer products. The most important Green House Gas is Carbon Dioxide ($CO_2$) which is often only referred to as Carbon, due to relation to Carbon emissions and low carbon development. In the atmosphere there is almost 400 ppm level of Carbon Dioxide which is itself a threat to the future generations.

Carbon Dioxide is very important in the atmosphere like oxygen for survival. It is breathing gas for plants just like oxygen is prominent for living beings. It is produced naturally and by humans. Since industrial revolution the atmosphere has witnessed a meteoric rise in $CO_2$ level. The global annual mean concentration of $CO_2$ in the atmosphere since then has increased markedly from 280 ppm to 400 ppm as of 2015 [18]. With this rate, it is expected that the concentration is to rise as much as 500-1000 ppm by the year 2100.

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This increase in the concentration of $CO_2$ in the atmosphere causes an increase in the atmospheric temperature, which is disastrous for future generations. Effects of global warming can be seen in the form of rising in sea level, a mutation in agricultural productivity, depletion of the ozone layer, change in the ecosystem, etc.

*Table 2. Carbon Dioxide ($CO_2$) concentration in PPM for various years (Source [10])*

| Year | $CO_2$ (PPM) |
|---|---|
| 2014 | 398.55 |
| 2013 | 396.48 |
| 2012 | 393.82 |
| 2011 | 391.63 |
| 2010 | 389.85 |
| 2009 | 387.37 |
| 2008 | 385.59 |
| 2007 | 383.76 |
| 2006 | 381.90 |
| 1997 | 363.71 |
| 1992 | 356.38 |
| 1987 | 349.16 |
| 1959 | 315.97 |

Deforestation is also one of the problem of environmental degradation which if occurs on a large scale becomes imperative to discover the factors behind the trend [19]. Deforestation though necessary for economic development but unsustainable deforestation may cause environmental degradation. In India, more than three-fourths of its inhabitants depend directly or indirectly on natural resources for food, industrial output, fuel and amusement [20].

*Table 3. Top five countries that emitted the most carbon dioxide in 2015*

| Total Emission Country Rank | Country | Total Carbon Dioxide from fuel combustion (million metric tons) | Per Capita Carbon Dioxide Emissions from fuel combustion (metric tons) |
|---|---|---|---|
| 1. | China | 9040.74 | 6.59 |
| 2. | United States | 4997.50 | 15.53 |
| 3. | India | 2066.01 | 1.58 |
| 4. | Russia | 1468.99 | 10.19 |
| 5. | Japan | 1141.58 | 8.99 |

*Each country's share of $CO_2$ Emissions (Nov. 20, 2017), Union of Concerned Scientists, Cambridge*
*Source: http://www.ucsusa.org/global-warming/Science -and-impacts*

Table 2 and 3represents the top five carbon dioxide emitting countries, India ranks 3rd in the carbon emission ranking of the countries which is a fact of concern. In India total $CO_2$ Emissions from fuel combustion is 2066.01 million metric tons whereas per capita $CO_2$Emissions from fuel combustion is 1.58 metric tons which are not good for the environment as well as future generations.

## 3. A case of Uttarakhand

Almost one- quarter of the land surface of the globe is covered by high mountain areas which is home to about 10 % of the world's population and provide agriculture, fodder, fuel, energy, timber, minerals, or recreation for another 40 % or more of the world's population, and according to recent estimates, provide water to about 50 % of the world's population for multipurpose uses [21]. Himalaya, being economically underdeveloped and being the most densely populated mountain ecosystem, is highly vulnerable to environmental changes. Owing to limitations of the terrain, biomass-based subsistence agriculture constitutes the main source of rural livelihood. This traditional agro-ecosystem is interlinked with forests, and the flow of biomass energy from forests to agriculture is mediated through livestock [22]. As a result, the traditional land use pattern has changed leading to ecological disruptions, environmental degradation and livelihood insecurities in the entire region [23].Asia often called the "growth centre of the word", has achieved the highest average GDP growth rate of all the world's developing regions over two decades since 1990.

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As a result of speedy economic development in Asia averaging 7.0 % annual economic growth rate of GDP during 1990-2010, the region's per capita GDP increased from US $ 1,633 to $ 5,133, that has worsened income inequality in the region, though the region's proportion of the population living below the poverty line ($ 1.25 – a- day) fell from 54 % (1990) to 22% (2008) [24].Major sectors which contribute to carbon emissions are electricity generation, transportation, energy consumption domestically and industries and agriculture. During 2013 status of ambient air quality was 23 avg. $SO_2$ µg/$m^3$, 26 avg. $NO_2$ µg/$m^3$ and 142 Avg.PM10 in Uttarakhand[25]. Industrial levels of SO2, NO2 and RSPM are under natural ambient air quality monitoring programme (NAMP) during 2008 [26].Status of hazardous waste generation, Landfill able was 5278, Incinerable was 4824 and Recyclable was 45525 where a total waste generation was 55627 [27]. In Uttarakhand municipal solid waste metric tons/day from 2009-12 was 752.0 whereas in India it was 96726.9.Municipal Solid Waste Generation and treatment as on 06-02-2015 was total quantity generated 1013, collected was 1013 and nil was treated.Forest degradation In the Uttarakhand Himalaya, occurs due to human-induced small scale chronic disturbances [28]. A forest fire is very common in Uttarakhand and maximum times it is caused by man-made reasons, one of the common reasons is that people often lit to encourage the growth of better and fresh grass for fodder whereas accidental fires and arson are not common. Based on the interpretation of satellite data pertaining to Oct. - Dec. 2015, the forest cover in the state was 24,295 sq. Km. which is 45.43 per cent of the state's total geographical area. The total Carbon stock of forests in the state is 284.664 million tonnes (1043.768 million tonnes of CO2 equivalent) which is 4.02 % of total forest Carbon of the country [29].

*Table 4. Major pollution causing industries in Uttarakhand*

| S. No. | Industry | Key Environmental Aspects |
|---|---|---|
| 1 | Aluminium | Disposal of red mud, bauxite tailings and other hazardous waste, dust emissions and high-energy consumption. |
| 2 | Caustic | Water pollution due to disposal of brine mud, mercury and chlorine; chlorine emissions |
| 3 | Cement | Fugitive dust emissions from material handling and air emissions from Stack; energy consumption |
| 4 | Copper | Sulphur dioxide and dust emissions; water pollution from electrolytic bath and other processes; disposal of slag from smelter |
| 5 | Distillery | Water pollution due to highly organic effluent from spent wash; soil contamination |
| 6 | Dyes and dyes Intermediates | Water pollution due to toxic azo-dyes, highly organic colored and Phenolicsubstances |
| 7 | Fertilizer | Water pollution due to heavy metal, ammonia- and fluoride-bearing effluent, ammonia emissions, fluoride-bearing dust and hazardous material |
| 8 | Iron and steel | Water pollution from cyanide, fluoride- and heavy metal–bearing effluent, dust emission from sintering, palletisation, pig iron plants; slag and dust disposal |
| 9 | Leather | Water pollution, particularly from hexavalent chromium and salt in discharge |
| 10 | Pesticides | Air pollution due to particulate and volatile organic compounds; effluent containing pesticides residues |
| 11 | Petrochemicals | Water pollution due to phenol- and benzene-containing effluent; fugitive emissions of toxic and carcinogenic and volatile organic compounds(VOC); hazardous material disposal |
| 12 | Pharmaceuticals | Water pollution due to organic residue-bearing effluent; VOC and particulate emissions; hazardous waste containing process sludge and spent catalyst |
| 13 | Pulp and paper | Water pollution from high organic and inorganic substance and chlorinated compounds in black liquor; highly malodorous emissions of reduced sulphur compounds and VOC |
| 14 | Refinery | Water pollution from effluent containing organic and inorganic material, oil, and solvent; air emission of particulate matter, sulphur dioxide, "benzene, toluene, and xylene," VOC |
| 15 | Sugar | Water pollution due to high biological oxygen demand (BOD) and chemical oxygen demand (COD) effluent and spillage of molasses; air pollution due to combustions of biogases, coal, etc. |
| 16 | Thermal power plants | Air emissions from combustion, coal handling, water pollution due to discharge of boiler blow down, overflow from ash pond; land contamination due fly ash disposal practices. |
| 17 | Zinc | Air pollution due to fugitive zinc dust, water pollution containing residues, disposal of solid and hazardous waste. |

*Source: CPCB – List of "Red Category" Polluting Industries*

Table 4 represents list of the industries which are listed red by central pollution control board. These industries are included in the list by CPCB according to the quantum of release of pollution substance in the environment of Uttarakhand.

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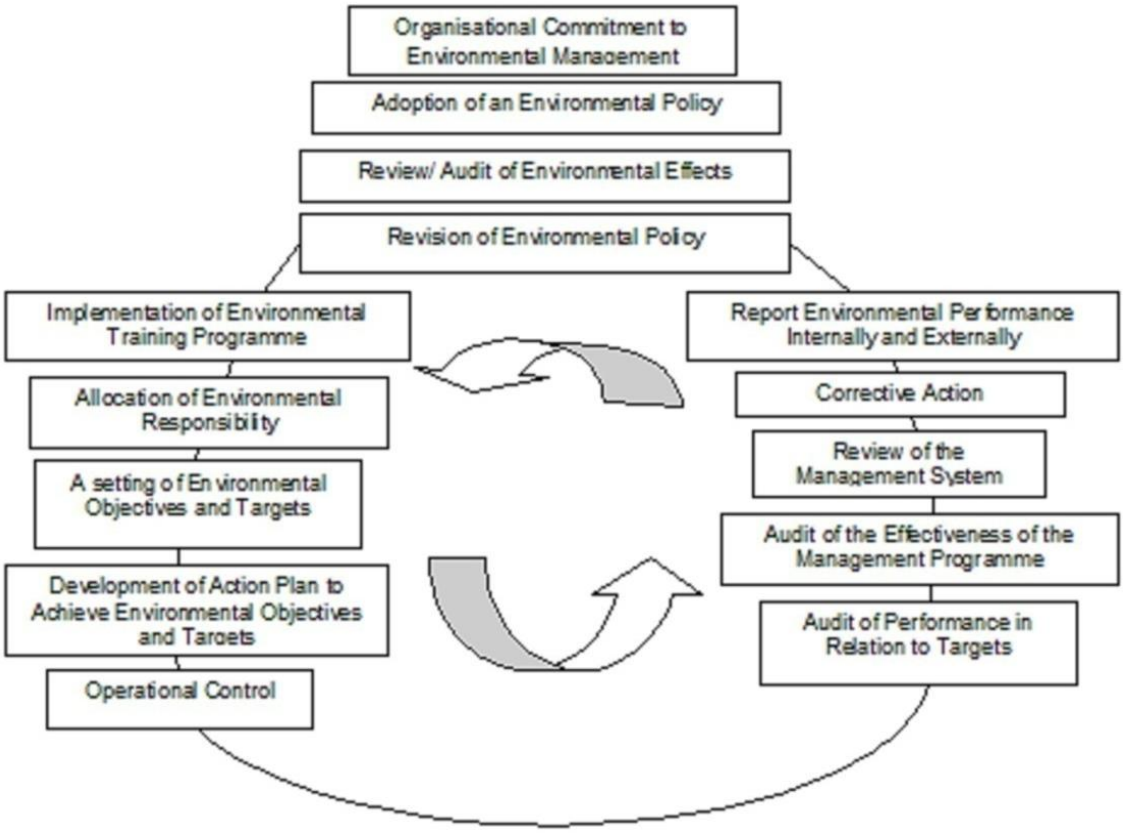
## 4. Role of environment management committee

The concept of environmental management emerged in the 1970s when organizations began to manage the risks associated with industrial pollution and the growing number of legislative and regulatory controls begin introduced by governments [30]. These committees play a very important role in the formulation as well as the execution of environmental plans as shown in Figure 1.

*Figure 1. Environmental management system*




## 5. Roadmap to sustainable development

Climate change is inherently a political issue; nevertheless, the causes of climate change involve an economic dimension. Climate change and GHG emissions are linked to economic development. Development implies industrialization, urbanization and the intensification of resource use, the costs of which have often been externalized at the expense of the environment [31]. According to Article 51A to protect and improve the natural environment including rivers, forests and wildlife is the fundamental duty of every citizen [32]. There is always a scope within an organisation to continually reduce its environmental impact regardless of its business activities. The following list presents some examples of areas where abundant opportunities exist for continual environmental improvement:

1. Minimise energy use through effective energy management
2. Introduce programmes to minimise waste
3. Reduce emissions
4. Ensure new process are fully assessed prior to introduction
5. Reduce the new likelihood of environmental incidents [33].

In 1960s the environmental problems caused by the sturdy growth of economies of the post-war period and the explosive expansion of the chemical industry started to become evident. As a result, the governments of OECD countries, under pressure from public opinion, stated to define regulations to limit environmental impacts [34].

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Establishing a low carbon society would, arguably, appear to be more urgent in Asia where GHG emissions are increasing rapidly due to high economic growth and increasing demand on energy and natural resources. The Asian continent is a most emerging continent in the world especially India and China are first two fastest growing countries in the world. Economic activity will produce effects (externalities), normally negative, without having to play for them. Therefore the solution would be to determine their correct market value so that economic agents can take account the environmental costs [35]. Many studies on mountains show that mountains are experiencing inconsistent warming [36]. For example, in the Tibetan Plateau, the average increase in temperature per decade ranged between 0.2 to 0.6 degrees centigrade over the last 50 years. Similar figures exist for the Andes and other high mountain environments [37]. Almost 17 % of the world's population resides in mountains which are mainly poor and marginalised, 80 % live below poverty line and an estimated 270 million are food insecure and almost half of them facing chronic hunger. These vulnerabilities are getting serious gradually by the impacts of climate change [38]. In India, steady economic growth over the last decade has improved the country's average income and has brought out millions above the poverty threshold. This remarkable economic growth has, however, been clouded by a sharp degradation of environment causing scarcity of natural resources [39]. The possible measures for mitigating problems of environmental degradation could be classified broadly into four categories namely, direct controls, technological measures, institutional changes and economic/ market-based instruments. Direct controls include quantity quotas, seasonal restrictions, safe minimum standards, price controls; Prohibition of certain socially undesirable practices by government and courts, and so on. They are powerful tools of environment management, can take effect quickly, and can be selective. For sustainability in environment and green development specific suggestions should be taken into consideration.

*Figure 2. DPSIR model*

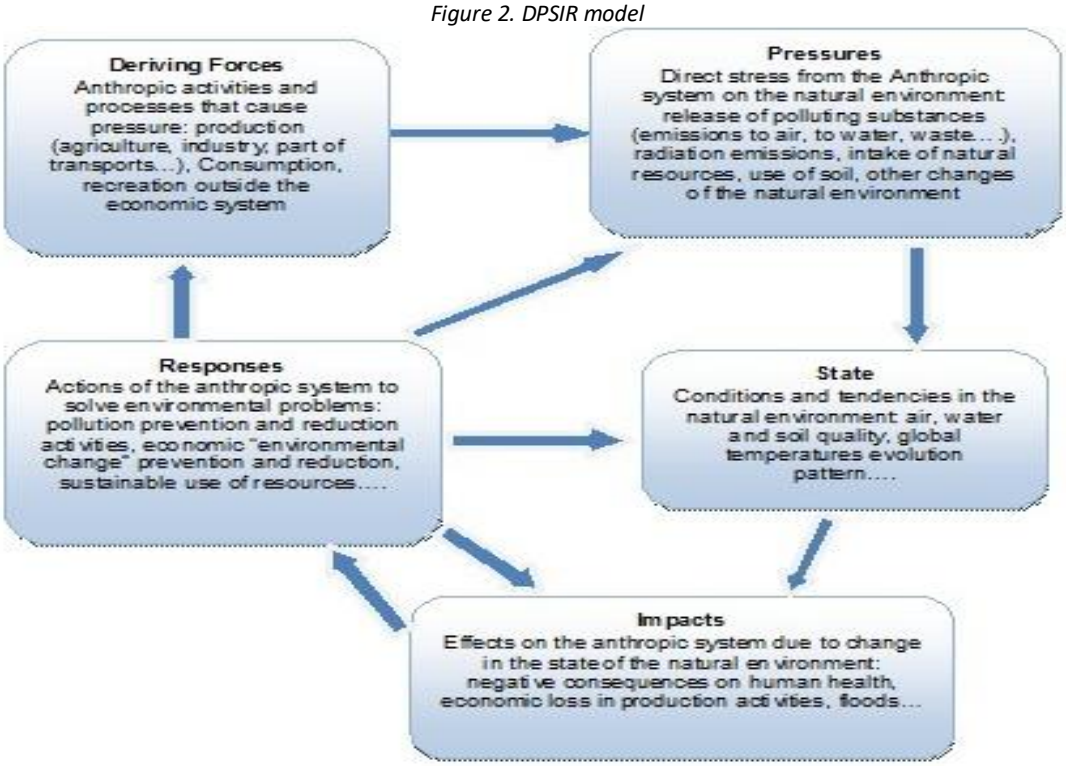


Figure 2 model given by MSPI, government of India, is very helpful in finding out the causes of environmental degradation, effects on the anthropic system due to change in the state of the natural environment, negative consequences on human health, economic loss in production activities, floods and actions of the anthropic system to solve environmental problems.

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## 5. Conclusion and Suggestions

The Himalayan ecosystem of Uttarakhand is economically underdeveloped and being the most densely populated mountain ecosystem, it is highly exposed for environmental problems. Environmental disasters are very common in these regions. A natural disaster of 2013 is the recent disaster in the list. Uttarakhand faces severe challenges from the environmental degradation and suitable environmental policy should be adopted in time to save it. The environmental effects of economic growth have been receiving increasing attention of economists in the study area. The increasing rate of environment degradation in mountains should be of global concern; government intervention is very much needed. Uttarakhand, one of the mountain states of India, is at the stage of development and is facing a problem of environmental degradation. The study highlights the important role of institutions in encouraging sustainable development. Economic activities also produce negative externalities without having to pay for them. Therefore the solution would be to determine their correct market value so that economic agents can take account the environmental costs. The study found that while there is a growing trend in the economic development of the state, at the same time there is also an increase in activities resulting in environmental degradation. Government agencies play a vital role in the minimisation of the degradation.

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