INDIAN CONSTITUTION AND ENVIRONMENT: CASE STUDY OF UTTARAKHAND'S ENVIRONMENTAL CHALLENGES

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Abstract

The right to a clean and healthy environment is a fundamental aspect of Article 21 of the Indian Constitution. Environmental protection and improvement are key principles that have been consistently upheld in various judicial rulings. Citizens also bear a constitutional duty to protect and improve the environment, which includes forests, rivers, wildlife, and showing compassion for all living creatures. Established legal principles, such as the Polluter Pays Principle and the Precautionary Principle, need to be integrated into the concept of Sustainable Development. It is indeed undeniable that law plays a pivotal role in protecting our Environment. In a state like Uttarakhand, which is highly susceptible to numerous calamities, it makes it all the more crucial to institute robust legal frameworks. Uttarakhand has a history of judgements addressing wide range of Environmental challenges. Measures by the state government such as approval of District Fire Management Plan, Awareness Generation programmes, Rotational burning/controlled burning of forest floor litter, Clearing of fire-lines in the forests, Master control room watch towers, Crew stations, wireless communication network are just some examples of initiatives our government is undertaking to protect and preserve our environment. Uttarakhand is also the first state to introduce Gross Environment Product index which assigns monetary value to natural resources like air, water, forest, and soil. The index will monitor the health of four key environmental constituents directly affected by development:

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air and water quality, the number of trees planted annually, and the area of organic soil. An improvement in these factors will reflect positively on the GEP index, signifying environmental harmony. Conversely, deterioration due to industrial activities will cause a decline in the index. Essentially this will help evaluate the environmental carrying capacity to accommodate the imposed load. All of this represents merely the tip of iceberg. However, the primary objective of our paper is to comprehensively evaluate the various measures and judicial precedents that the state of Uttarakhand has implemented.

Keywords: *Uttarakhand, Environment, Sustainable Development, Constitution*

INTRODUCTION

Sheltered in the Himalayas, Uttarakhand is known for its scenic views, abundance of natural resources and a wide range of flora and fauna. Uttarakhand's unique topography, its susceptibility towards natural calamities and its unique way of handling the climatic challenges is what makes it a perfect State to do environmental research on.

It is no surprise that the rapid growth in industrialization, emissions from industries, improper disposal of waste, and release of chemical effluents are certain factors causing severe and irreversible environmental harm to the environment. However, the Indian Constitution provides specific provisions for Environmental Protection. Article 51-A (g), says "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers, and wildlife and to have compassion for living creatures." The Constitution of India under part III guarantees fundamental rights which are essential for the development of every individual and to which a person is inherently entitled by virtue of being human alone. The right to the environment is also a right without which development of individual and realisation of his or her full potential shall not be possible. Articles 21, 14 and 19 of this part have been used for environmental protection. Public Interest Litigation under Article 32 and 226 of the constitution of India resulted in a wave of environmental litigation. The leading environmental cases decided by the Supreme Court includes case of closure of limestone quarries in the Dehradun region (Dehradun Quarrying case, AIR 1985 SC 652), the installation of safeguard at a chlorine plant in Delhi (M.C. Mehta V. Union of India, AIR 1988 SC 1037) etc. In Vellore Citizens Welfare Forum vs. Union of India (1996) 5

SCC 647, the Court observed that "the Precautionary Principle" and "the Polluter Pays Principle" are essential features of "Sustainable Development." Considering the above-mentioned provisions, certain proactive measures taken by the Uttarakhand Judiciary and their implementation by the State's Executive have led to improved ecological conditions an towards a sustainable future. future.

The researcher in the present research has made efforts to use a descriptive and analytical research design, aiming to describe the environmental hazards and climatic conditions in the State of Uttarakhand and analyzing the proactive role played by the Uttarakhand Judiciary in taking measures for mitigating the disastrous environmental impact and bringing in adaptive rulings. The objective of this paper is also to understand the Gross Environment Product Index. State of Uttarakhand, being the first State to adopt the GEP Index, have taken an implied responsibility to bringing forth the progressive measure.

The primary data is secondary research, involving an extensive literature review, books, online news websites, judgments of the Hon'ble High Court of Uttarakhand, journal articles, and other literary works. Existing databases and published research papers on the present topic were crucial sources for gathering a comprehensive overview of the research. The content Analysis method helped the authors extract meaningful insights from qualitative information sources. The Bluebook Citation format adhering to its 19th Edition has been used uniformly throughout the research.

1.1. State Profile

To understand the brief geography of the State of Uttarakhand, it lies in the Northern part of the Indian Sub-continent between 28o 44' & 31o 28' N Latitude and 77o 35' & 81o 01' East longitude. The State, mostly lying in the hilly terrain was carved out of the State of Uttar Pradesh on 9th November 2000. The geographical area of the State is about 53483 square km, with large areas under snow cover and having steep slopes. The State comprises of 2 major regions-Garhwal and Kumaon, having 13 districts, 78 tehsils and 95 community blocks.

On the parameters of altitude, the State has separate climatic zones which are divided as per their temperature records. Following are the climatic zones of the State:

Table 1: Different climatic zones of Uttarakhand.

Elevation (in meters)	Climate Zone based on temperature
"900m – 1800m	*Warm Temperate*
1800m-2400m	*Cool Temperate*
2400m-3000m	*Cold Zones*
3000m-4000m	*Alpine Zones*
4000m-4800m	*Glacier Zone*
>4800m	*Frozen Zone"*

Data adapted from Uttarakhand Biodiversity Board (An autonomous statutory Body constituted under Biological Diversity Act 2002), Last Updated on 13-07-2023

On the parameters of land elevation, the classification of different regions of the State of Uttarakhand is as follows:

Table 2: Different regions of the State of Uttarakhand on the parameters of land elevation

Elevation Level (above mean sea level)	Region
"<300m	*Terrain Region*
300m-600m	*Lower hilly region*
600m-2400m	*Upper Hilly Region*
2400m-4500m	*Altitude Region*
>4500m	*High-Altitude Region"*

Data adapted from Uttarakhand Biodiversity Board (An autonomous statutory Body constituted under Biological Diversity Act 2002), Last Updated on 13-07-2023

The State is blessed with the large variety of Flora and Fauna. The State shelters around 4000 species of plants which fall under 192 families. According to the International Union for Conservation of Nature, 161 out of these 192 falls under threatened or rare species. Out of the 223 orchids found in the Northern part of the country, 150 are found in Uttarakhand. There are about 102 species of mammals, 124 varieties of fish, approximately 20 categories of Amphibians and 69 categories of reptiles. Top of FormSome endangered species like Asian Elephant, snow Leopard, tigers, musk, deer, Himalayan Monal, King cobras are found in Uttarakhand.

With all the unique forms of diversity that the State is blessed with, the biodiversity of the State is bound to be rich. It is astounding to know that

post the creation of State of Uttarakhand, as many as 3748 faunal species were inventoried and documented.[1]

1.2 Environmental susceptibility

After having a brief knowledge about the State of Uttarakhand and its rich heritage which is supported by floral diversity, vegetation, forest cover, healthy and pristine ecosystem, it is important to understand the environmental susceptibility. Due to the unique biodiversity that the State enjoys, the State is also abode to many rare and endangered species of herbal and aromatic plants. Realizing the immense potential of the resource in the State, the State Government has declared Uttarakhand as an Herbal State.

Furthermore, this enriched variety of flora, fauna, terrain, climate, the geographical location of the State also makes it highly prone to the natural disasters. This develops a vulnerability factor and deserves to be study. Over the period of over a decade, the State has been witnessing what can only be termed as some of the worst calamities ever known and seen by humans in ages.

In 2013, the State faced catastrophic flash floods and landslides. Official number of people who were dead and missing came out to be over 6,000. The actual figures going up to over 10,000 in number. The deceased included all kinds of lives including pilgrims, tourists, cattle, horses, ponies, birds and the Environment.

The 2013 calamity was nothing less than a warning bell. At this juncture, it is crucial to delve into the key problems in Uttarakhand.

2. Key Problems in Uttarakhand

Due to the varied terrain of Uttarakhand, there are several problems that the State faces when it comes to their environment degradation. To list a few of these:

2.1 Forest Fires

Uttarakhand is on the sixth place amongst all the States in India in terms of percentage of recorded forest area. "*The total forest area under various classes of the State is 37,999.53 km*^{2}*, which is 71% of the geographic*

[1]Jaspal Singh Chauhan, "Natural and Anthropogenic Impacts on Forest Structure: A Case Study of Uttarakhand State ", 11 The Open Ecology Journal 38-46 (2018).

[2]Abhishek Sharma & Shri Ram, "Deforestation and its effect on landslides", 2 International Journal for Scientific Research & Development, (2014).

area. The forest area under forest department is 24418.67 km^2*. In state according to FSI-2011 the very dense forests is 4,002 km2, moderately dense forest, 14,396 km2, and open forest, 6,044 km2. Scrub is 320 km2. About 19% area of the state is under permanent snow cover, glaciers and steep slopes where it is not possible to grow trees due to physical limitations."*[2] The figure below shows the forest cover as depicted from the Satellite Images of Forest Survey of India in the year 2012-2013:

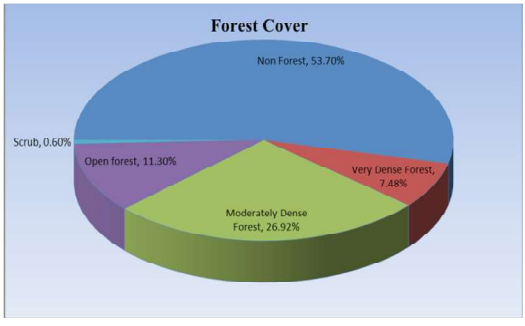

Fig.1. Forest cover as depicted from the Satellite Images of Forest Survey of India in the year 2012-2013. (Source: Uttarakhand Forest Statistics, 2012-2013)

Because of the agrarian-economy, there is a very high density of population which depends on the forests and consequently, this leads to having significant impact on the forest and the overall ecology of the State.

Forest fires have been a matter of concern for almost all districts of the State. In the Garhwal Region, forest fires were witnessed and reported in Uttarkashi, Pauri, Radraprayag, Chamoli and Dehradun. And in the Kumaon Division, forest fires were recorded in the districts of Almora, Bageshwar, Pithoragarh and Udham Singh Nagar. According to the reports of Uttarakhand Forest Department, nearly 11,256 fire incidences were reported in the time frame of November 23, 2023, to June 19, 2024.[3]

2.2 Landslides

In accordance with the reports of the Landslide Atlas of India, 8 out of 13 districts of the State of Uttarakhand are categories as highly vulnerable to landslides.[4] Because of the high-risk factor and as a precautionary measure,

[3]https://india.mongabay.com/2024/08/uttarakhand-forests-burn-while-fire-guards-face-outstanding-salaries-and-lack-of-resources.

[4]Varsha Singh, Uttarakhand: Here's how forest fires and encroachments paved way for landslide at Varunavat mountain, (Sept. 23, 2024), available at: https://www.downtoearth.org.in/natural-disasters/uttarakhand-heres-how-forest-fires-and-encroachments-paved-way-for-landslide-at-varunavat-mountain.

Uttarakhand Chief minister Shri Pushkar Singh Dhami, directed the State to develop landslide warning system, after the incidence of Varunavat landslide. The alarming systems may warn for the heavy rainfalls and the Geographical survey of India issues timely warnings however, the fact remains that it is very difficult to time as to exactly when and at exactly what place the landslide will occur. This makes the State even more vulnerable.[55]*Ibid.*

2.3 Extreme Rainfall and Cloudbursts

In recent times, cloudbursts and severe rainfall are being very commonly reported in the Upper Ganga Basin. The Upper Ganga Basin part of the of State of Uttarakhand as depicted in the figure below:

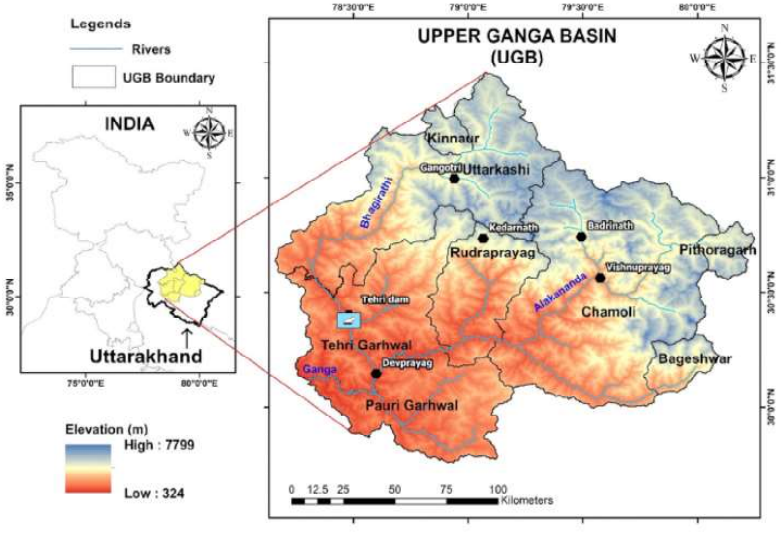

Fig. 2. The Upper Ganga Basin part of the of State of Uttarakhand (Source: Science Direct)

The interaction of the monsoons with the features of the Himalayan ranges creates conditions in the area that attracts these are climatic conditions and risks like cloudbursts and extreme rainfalls. High altitude locations complimented with extreme weather conditions and low visibility are some reasons that sufficient monitoring of the area cannot take place which makes it even more hazard prone. The most vulnerable districts of the State as identified by the study conducted on "*Assessment of cloud bursts, extreme rainfall and vulnerable regions in Upper Ganga River Basin, Uttarakhand, India*" and published in International Journal of Disaster Rish Reduction, are

[5]*Ibid.*

"*Joshimath, Bhilanganga, Bhatwari, Ukhimath, Chamoli, Rudraprayag and Tehri Garhwal."*[6] Adding to this, man-made interventions and poorly planned development in this region are also responsible for such evidence.[7]

2.4 Non-biodegradable waste

When waste is thrown in the areas which are eco-sensitive, it usually reaches the forests or the water bodies situated nearby and have severe impacts on the wildlife species. Research was published in the Journal for nature conservation which reported that dumped materials like metal pieces, plastic bottles, rubber and glass were reported to have been found in the elephant dung collected from the forests of in Uttarakhand.[8] The author of the research quoted, "*It is an uncomfortable truth to face that elephants ingest plastic along with food waste (discarded food often wrapped in plastic) and carry it deep into the forest. Once the plastic exits the elephant's system, it can continue to be a danger to other animals in the forest as it gets passed up the food chain*."[9] It is important to note that the State lacks the availability of processing, treatment and disposal plants. Urban local bodies face issues like difficulty in finding appropriate area for the set-up of landfills, less and improper collection of user charges and taxes and lack of skilled taskforce and technical experts.[10] And therefore, the State faces problems of waste management and disposal which have severe impacts on the biodiversity, natural resources and ecosystem.

3. Around the world

After a through view of key problems, there is an understanding that there exists an urgent demand to address the crises faced by the environment and

[6]Prabhash K Mishra et al., "Assessment of cloudbursts, extreme rainfall and vulnerable regions in the Upper Ganga Basin, Uttarakhand, India", 69 International Journal of Disaster Risk Reduction (2022).

[7]S.Nandgiri, et al., Hydrological Analysis of Extreme Rainfall Events and Severe Rainstorms Over Uttarakhand, India., 61 Hydrological Sciences Journal 2145-2163 (2015).

[8]Anusha Krishnan, Plastic, glass and other waste materials found in elephant dung in Uttarakhand, available at: https://india.mongabay.com/2022/06/plastic-glass-and-other-waste-materials-found-in-elephant-dun g-in-uttarakhand/.

[9]Vishal Kumar, *Waste Management in Dev Bhoomi*, revolve, available at : https://revolve.media/features/waste-management-dev-bhoomi.

[10]Dhananjay Singh Shyamal et al., A review on the urban municipal solid waste management system of an Indian Himalayan State, 24 Journal of Material Cycles and Waste Management System of an Indian Himalayan State

to re-build the capacity of environment to sustain well-being of life on Earth. It's time that humans re-think about their consumption patterns and make required changes in their lifestyles. The UNEP, 2021 Report states "*system-wide transformation is the key to sustainable future."* This revolution will encompass multiple changes in the very fundamentals. Changes are required in the way society progresses, the organisation pattern of the society, the norms and principles from which the society is shaped, the judicial principles that have evolved over time and the overall governance structure of the State.[11]

For a sustainable transformation, the process involves re-structuring and re-orientation of governance process. Governance popularly refers to *"covers the whole range of institutions and relationships involved in the process of governing*."[12] It is how *"collective goals are chosen, decisions are made, and actions are taken to achieve those goals."*[13]

It signifies a complete institution whose decision making and the implementation of the same leads the way for successful redressal of the problems and challenges. A successful governance structure includes law-making, judicial oversight, and active involvement of both government and non-government agencies implementing the law made.

The effective governance for the sustenance of environment is needed in different directions however, for the purpose of this research, the paper will specifically examine the role that the Hon'ble High Court of Uttarakhand has played in shaping and advancing the environmental jurisprudence. Hon'ble High Court of Uttarakhand has over time assessed various issues pertaining to hazards related to the environment and have highlighted various ecological concerns. The judiciary has, in the form of various adaptive measures and directions has worked towards promoting sustainability and achieving SDGs. This paper, therefore, focuses on how judicial activism in Uttarakhand has contributed to establishing environmental jurisprudence that is responsive to the region's specific needs.

4. Judiciary: India and State of Uttarakhand

After understanding the major environmental hazards that are faced by the State of Uttarakhand, we see that the number of litigations concerning the

[11]United Nation Environment Program, *Making Peace With Nature a Scientific Blueprint to Tackle the Climate, Biodiversity and Pollution Emergencies*, (2021).

[12]Andrew Jordan, The Governance of Sustainable Development: Taking Stock and Looking Forwards, 26 Environment and Planning C: Government and Policy 17-33 (2008).

[13]Cosens Barbana, The Role of Law in Adaptive Governance, 22 Ecology and Society 1-12 (2017).

same has also gone significantly high. Across all jurisdictions, there have been environment specific litigation in order to mitigate the climate changes and restore the environment or adapt to the crises brought by the environmental depletion. These mitigation techniques and adaptation measures are directed in the due course by the adjudicating authorities.[14] The environment disputes are majorly brought in relation to the execution of compliances from different stakeholders, violation of Human rights and Constitutional rights, corporate liabilities etc.[15] In developing countries like India and geographically vulnerable mountainous States like Uttarakhand, Himachal Pradesh and Jammu and Kashmir, environment claims brought before the Court are mainly relating to implementation of government policies to mitigate or adapt to climate crises.

The Indian judiciary has always stood strong as the protector of the rights of its people.[16] The Hon'ble Supreme Court of India is famously called as the "*guardian of the social revolution.*"[17] Additionally, International principles, Public Interest Litigation and the law enforcing tortious and contractual liabilities have played an important role in deciding environmental concerns.

In Uttarakhand, environmental jurisprudence is shaped by the State's distinct challenges: environmental conservation, infrastructure development, climate resilience, and disaster mitigation etc. The Uttarakhand judiciary has responded to these challenges with unique, State-centric rulings, ensuring compliance from various stakeholders. By enforcing accountability and adapting to the State's specific needs, the judiciary of Uttarakhand actively contributes to global efforts toward sustainable development and helps the State fulfill its role in the broader Sustainable Development Goals framework.

This section of the paper analyses key judgments from the Uttarakhand High Court that tackle issues including forest fires, mining impacts, solid waste disposal, and agricultural vulnerability to climate change.

Uttarakhand Forest Fires pose one of the most persistent environmental challenges, which particularly effect its dense pine and oak forests. According

[14]Meredith Wilensky, Climate Change in the Courts: An Assessment of Non-U.S. Climate Litigation, 26 Duke Environmental Law & Policy Forum 131-179 (2015).

[15]Joana Setzer & Catherine Higham, *Global Trends in Climate Change Litigation: 2021 Snapshot. London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science.*, (2021).

[16] Ravi Bhatia, Evolution of Judicial Activism in India, 45 Journal of the Indian Law Institute (2003).

[17]Austin Granville, *The Indian Constitution: Cornerstone of a nation* (Oxford University Press,2nd ed. 2000).

to the latest data collected by Global Forest Watch, there were 324 VIIRS[18] fire alerts reported between 20th November, 2023 and 18th November, 2024 considering high confidence alerts only (*The table No. 01 below shows the empirical figures*).[19] Additionally, forest fires were responsible for 5.7% of tree cover loss in Uttarakhand between 2001 and 2023 (*The pie chart (table No. 02) represents the figures graphically*).[20]

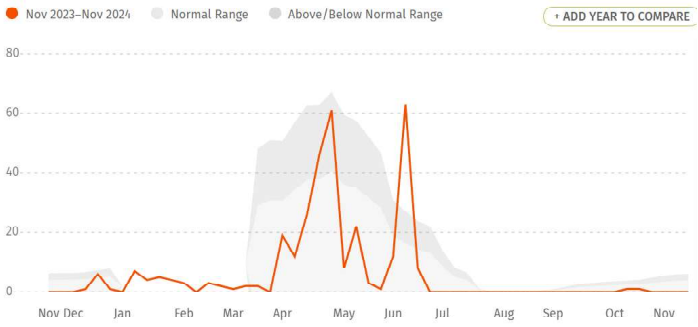

Fig.3. The empirical figures of forest fires (Source: Global Forest Watch)

Fig.4. Graphically represented figures of Forest Fires ((Source: Global Forest Watch)

In the matter of the Protection of Forest Environment, Ecology, Wild Life etc. from the Forest Fire v. Union of India & Ors (2016)[21], the Court

[18]Stands for, Visible Infrared Imaging Radiometer Suite.

[19]GFW, "Uttarakhand, India Deforestation Rates & Statistics", available at: https://www.globalforestwatch.org/dashboards/country/IND/35/?category=fires.

[20]*Ibid*.

[21]In the matter of the Protection of Forest Environment, Ecology, Wild Life etc. from the Forest Fire v. Union of India, SCC Online (Uttarakhand High Ct. 2016).

pointed out what impact has been put on forest wealth of the State through uncontrolled and frequent forest fires and how this has impacted the overall ecology of the State. The Court also acknowledged the excessive harm caused to the State's biodiversity when in one season, 1798 forest fires were recorded which affected 3,238 trees of various species.

The Court through this judgment issued a series of directives which aimed at forest management and fire prevention. It directed the law makers to draft the National Forest Policy which will focus on forest management and which aligns with International environmental standards like the Rio de Janeiro Declaration, Kyoto Protocol etc. Apart from this, certain specific directions were also given by the Court in relation to the demarcation of the 10-kilometer eco-sensitive zone around Jim Corbett National Park and other wildlife sanctuaries to limit construction activities and safeguard wildlife. The Court also recognised the role of Fire Protection Groups, and ordered for the formation of the same which will involve the local community in forest conservation efforts. Additionally, it emphasized the importance of fire-prevention infra-structure, such as fire towers, water bodies for moisture retention, and fire-resistant clothing for officials, alongside stringent monitoring and disciplinary actions for forest officers in cases of persistent fires.

Moving forward, illegal and disorderly mining activities in Uttarakhand have led to widespread environmental degradation, particularly in mountainous regions. In the matter of Naveen Chandra v. State of Uttarakhand (2017)[22], the Court addressed the adverse environmental impact of mining such as deforestation, soil erosion, and unregulated water cycles. Mining activities were found to increase soil erosion, altering the river flows, and disrupting the geohydrological balance which subsequently results in drying of local streams and contamination of water resources. Dust and emissions from mining have also been reported to cause respiratory health issues and harmed plant life. Along with this, the blasting activities that are carried have threatened the stability of water bodies near the area and have made the locations prone to floods and other water calamities.

The Court through this decision ordered restrictions on mining near human settlements, and made it mandatory to create a buffer zone of at least 8 kilometres from towns and villages, with a minimum separation of 4 kilometres between two or more mining sites. It directed authorities to implement measures that will prevent soil erosion which includes construction of check dams below

[22]*Naveen Chandra v. Uttarakhand through its Secretary*, SCC Online (Uttarakhand High Ct. 2022).

the mining areas. Recognizing the loss of forest cover, the Court directed to launch afforestation programs and also ordered to make use of drought-resistant trees in mining-affected areas, with an aim to rehabilitate degraded land and prevent further soil erosion. Additionally, the case highlighted the necessity of conducting thorough socio-economic assessments to evaluate the impacts of mining on local communities before approving future projects.

Moving further, in Dinesh Kumar Chandola v. Union of India and Others (2023)[23], the Court emphasized on the risks associated with dredging and mining near ecologically sensitive areas. It raises problems when private companies are allowed to carry dredging processes. The Court feared that while conducting dredging activities, the private companies rather than taking environmental concerns into consideration, would look for their own personal benefits and would prioritize their commercial interests far more than environment protection which will result in irreversible damages to the environment.

The Court therefore restricted private entities from undertaking dredging activities, and asserted that public welfare and environmental preservation must be kept above the concerns of all. It stipulated that dredging projects be closely monitored by the State to prevent excessive exploitation and ensure that environmental considerations remain central in decision-making processes. This restriction illustrates the Court's commitment to sustainable resource management, especially in activities that could significantly alter natural landscapes.

Furthermore, in Himadri Jal Kalyan Samiti v. State of Uttarakhand (2018)[24], the Court addressed the ecological damages that are caused by improper muck disposal in rivers. The unscientific and unregulated dumping of materials that are excavated and the construction leftovers directly into the rivers have led to the increased river bed levels, have changed the water courses and have increased the flood risks. This has not only threatened the aquatic life but have also posed serious damages to human settlements and agriculture in riverine areas.

The Court mandated that the Ministry of Environment, Forest and Climate Change (MoEFCC) and the Uttarakhand Environment Protection and Pollution Control Board identify suitable muck disposal sites at least 500 meters from

[23]Dinesh Kumar Chandola v. Union of India & Ors, SCC Online (Uttarakhand High Ct. 2023).

[24]Himadri Jal Kalyan Samiti v. Uttarakhand, SCC Online (Uttarakhand High Ct. 2018).

riverbanks to prevent direct river contamination. Construction activities near riverbanks were ordered to be at a halt until these disposal sites were made operational. The Court also ordered to maintain a minimum flow of 15% downstream of weirs, barrages, and dams to sustain ecological balance. Furthermore, environmental and forest clearances for any new project were made conditional on the inclusion of proper strategies for the muck disposal in order to safeguard the aquatic ecosystem.

Another important issue of solid waste management in Uttarakhand was brought to the forefront in the case of Indira Nagar Jan Vikas Samiti v. State of Uttarakhand (2018)[25], where the Court examined the improper disposal of solid and biomedical waste near the Gola River. This river serves as an important water source for nearby settlements, including Haldwani, and the careless disposal of waste which compromises public health and contributes to greenhouse gas emissions.

The Court ordered Nagar Nigam Haldwani to establish a Solid Waste Management Plant within six months to prevent further environmental degradation and improve waste disposal practices. In addition, the Court ordered strict adherence to the Bio-Medical Waste Management Rules, 2016, and directed that biomedical waste be segregated and treated before the disposal. By enforcing these standards, the Court aimed to reduce pollution, protect public health, and curb greenhouse gas emissions. The Court had also made its efforts to align waste management practices with environmental conservation principles.

With the State's effectiveness in dealing with Solid waste going better day by day, the Solid Waste Annual Report of Uttarakhand State for the Financial Year 2022-23 reveals that out of 1152 wards, Door to door waste collection is initiated in all 1152 wards (100% achievement). Source segregation in all the 1152 wards have been started. However, 40.4% households, shops, institutions, schools etc are doing this at source. Nagar Nigam Dehradun and Haridwar have storage area while other ULB's have temporary storage area. 10 sites have been notified to be used for storage of C&D waste.[26]

Last but not the least, increasing environmental hazards are also posing challenges on the State's agricultural sector which affects crop yield and food security. The Court dealt with this issue in the case of Raghuvar Dutt v.

[25]Indira Nagar Jan Vikas Samiti v. Uttarakhand, SCC Online (Uttarakhand High Ct. 2018).

[26]Uttarakhand Pollution Control Board, Government Of Uttarakhand, India, "MSW Reports", available at: https://ueppcb.uk.gov.in/pages/display/177-msw-reports.

State of Uttarakhand (2018) wherein it cited reports from Inter Governmental Panel on Climate Change (IPCC). It addressed the adverse effects of the rising temperature and increased proneness of the State to floods and droughts which have severely impacted the overall agricultural productivity of the State. The decline in the crop yields have impacted the lives of small-scale farmers who are more vulnerable to the climatic fluctuations.

In response, the Court promoted the development of Climate Smart Villages (CSVs) as a model for climate-resilient agriculture. The CSV initiative have made an effort to integrate traditional knowledge with scientific methods to enhance crop productivity and adapt to changing climate conditions. The Court encouraged collaboration among local communities, researchers, and policymakers to introduce climate-smart agricultural practices, including water management techniques, diversified cropping, and infrastructure to protect against extreme weather.

5. Gross Environment Product (GEP) Index: A Path breaking model adopted by the State of Uttarakhand

The primary meter for measuring economic development and advancement continues to be outdated economic measures like GDP. GDP emphasises the economic aspects and measures the market worth of both goods and services.[27] However, it does not go into the details of environmental costs, long term sustainability, impacts on the environment, which are important dimensions for achieving Sustainable Development Goals of the United Nation.

State of Uttarakhand, recognizing these limitations, adopted an alternative and a more comprehensive framework called Gross Environment Product Index in the year 2021. GEP provides a more comprehensive approach to sustainable development and aims to measure and coordinate human activities to enhance the environment in tandem with economic progress.[28]

It incorporates air, water, soil and forest as key columns who's individual GEP Index provide us with the Gross Environment Product Index and acknowledges that assessment of the qualities of air, water, soil and forest ecosystem are essential for sustainable development.

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[27]Mayis Gulaliyev et al., Study of Human Capital Development, Economic Indicators and Environmental Quality, 28 Ekoloji (2019).

[28]Anil Prakash Joshi et al., Unveiling the Green Paradigm: Introducing Gross Environment Product (GEP)-The Frontier in Ecological Growth, 146 Ecological Indicators (2023).

The AIR-GEP Index

Air quality is a determinant of ecological and human health, and is defined by the concentration of pollutants in the atmosphere. Factors like industrial emissions, urbanization and vehicular pollution have led to deteriorating Air Quality Index (AQI) levels over the decades. Conversely, mitigation efforts, such as adopting alternate sustainable energy sources, enforcing stricter pollution rules, management of pollutant emissions from the industries represent strides towards improving air quality.[29]

The Air GEP index assesses these dynamics by tracking changes in the Air Quality and gauging the effectiveness of pollution mitigation strategies. Monitoring the levels of air pollutants including ozone, sulphur dioxide, nitrogen dioxide, nitrogen trioxide, and others contributes to the current Air Quality Index which is a composite numerical number that measures the overall quality of the air.[30] It serves as a lens to evaluate human led interventions aimed at ecological improvement. Air quality not only impacts human respiratory health but also poses significant impacts on ecological processes like photosynthesis, water cycle etc. Therefore, engaging with Air Quality Index is essential for shaping adaptable and proactive policies that foster a stable and tough ecological landscape.

5.1 The Water-GEP Index

Water is indispensable for sustenance of life, biodiversity and economic activities likes agriculture, running industries and energy production. Challenges such as population growth, industrialisation and climate change have exacerbated issues related to water availability and quality.[31] Instruments like water quality index measures water health, providing insights into its suitability to different uses and identifying areas for policy or judicial interventions.[32]

[29]Yogendra Kambalagere, A Study on Air Quality Index (AQI) of Bengaluru, Karnataka During Lockdown Period to Combat Coronavirus Disease (Covid-19) Air Quality Turns 'Better' From 'Hazardous', 40 Studies in Indian Place Names (2020).

[30]Pak Lun Fungac et al., Improving the Current Air Quality Index With New Particulate Indicators Using a Robust Statistical Approach., Science of the Total Environment (2022).

[31]Mngereza Miraji et al., The Impacts of Water Demand and Its Implications for Future Surface Water Resource Management: The Case of Tanzania's Wami Ruvu Basin (WRB), Water (2019).

[32]Ashok Lumb, A Review of Genesis and Evolution of Water Quality Index (WQI) and Some Future Directions, Water Quality Exposure and Health (Mar. 11, 2023), available at : https://link.springer.com/article/10.1007/s12403-011-0040-0.

The Water-GEP index builds on this by recognising the value of the universal solvent. Th index also focuses on sustainable practices such as rainwater harvesting, pollution reduction and efficient irrigation techniques. Policy makers, judiciary and other important stakeholders use this index to identify priority areas, allocate recourses effectively and promote practices that ensure long-term ecological and economic benefits from water recourses.

5.2 Soil-GEP Index

Soil health is fundamental to ecosystem as it supports plant growth, water filtration, nutrient cycling etc. However, activities like deforestation, overuse of chemical fertilizers, soil erosion, excessive rainfall, intensive agriculture, urban expansion etc. threatens soil stability. Conversely, restoration efforts like reforestation, agroecological farming etc. increases soil stability. The soil-GEP index evaluates soil productivity and ecosystem viability as it assesses factors like organic matter content in the soil, erosion rates, increased capacity of soil's water retention, land management practices etc.

The index will help policy makers, judiciary, law implementers to monitor soil heath by quantifying the impact of sustainable and unsustainable practices. These practices ensure that agricultural and ecological systems thrive in the long run.

5.3 Forest-GEP Index

Forest is essential for climate regulation, biodiversity, providing clean air and water, regulating nature cycles etc. However, deforestation, urbanisation, human interventions, unsustainable practices, climate changes etc. pose risks and threats to forest ecosystems. The index evaluates essential criteria's such as tree plantations, deforestation rates and species diversity in promoting forest growth sustainably.

Additionally, the index offers useful information on how well conservation and forest management programs are working. By measuring net forest growth and benefits of biodiversity, the forest-GEP index will help in policymaking which will subsequently enhance carbon sequestration, protect ecosystem, and foster socio- economic benefits derived from healthy forests.

Thus, Gross Environment Product index offers a thorough review mechanism for assessing ecological health and human efforts to improve environmental quality. By utilising Air, Water, Soil and Forest GEP Indexes, the integrated GEP index provides a holistic multidimensional perspective on sustainable development. Unlike GDP, the GEP captures the interconnectedness

of environmental wellbeing and progress. It also aligns with SDG goals and helps various stakeholders to development, interpret and implement policies for environmental sustainability.

6. Recommendations and Concluding remarks

It will be correct to say that climate changes and environmental challenges have emerged as critical concerning areas for India, particularly for ecologically sensitive States like Uttarakhand. By means of judicial interventions and policy interventions, the State has taken meaningful steps towards achieving sustainable development. However, there are still critical issues like agricultural vulnerability, mining impacts, waste management etc. that require a more integrated approach.

The adoption of the GEP Index by Uttarakhand is an innovative shift towards measuring environmental well-being along with economic growth. This framework will provide the stakeholders' actionable insights into health of air, water, soil and forest and will help in overall development of life in a sustainable ecosystem. By addressing the issues systematically, Uttarakhand has set a precedent for other States to follow and contribute to global efforts to achieve sustainable development goals.

Recommendations

After understanding the environmental issues in the State of Uttarakhand and the efforts that has been put in by Uttarakhand judiciary to resolve the issues by sustainable means following are the recommendations that the authors recommend:

1. Strengthening the existing implementation mechanism: While the research acknowledges that Uttarakhand judiciary has laid down series of decisions in favor of sustainable environment however, there is a need of implementing and monitoring bodies who can look at the overall implementation of the directions given by the judiciary. There is also a need for a State level task force consisting of experts in the environmental field who can monitor the progress of the GEP index and reasons for any difficulties in its implementation in the State.
2. Use of Artificial intelligence and technology: Use of Technologies like Satellite imaging, weather forecast, fire predictors, artificial intelligence tools to simplify complex data, should be utilized for monitoring of different indicators of environment. These tools may help the agencies to track illegal activities that deplete the environment

and change geographics, factors responsible for the same and would in turn help in timely decision making before any risk turns into reality.

3. Involvement of local community: It is important to understand the role that local communities play in resource management. Therefore, environmental protection programs that involve local communities should be promoted. For example, participation of public in forest management, waste segregation, adopting environment friendly agricultural practices should be encouraged. These practices will be further conducted efficiently if there is an incentive-based system attached to the practices. Awareness programs, tree plantation drives, educational campaigns are further initiatives that can increase the involvement of community in environment management.
4. Enhancing coordination between various departments like pollution control boards, urban planning, mining, water resource, forests etc. will foster an integrated approach to resource conservation. Additionally, the law must also be amended to incorporate such synergies so that long term benefits and sustainability can be achieved.
5. There is also a need to enforce stricter environmental standards. The penalties should be such that to compensate the environment and not to a particular department or an individual. Penalties should be strong enough to deter non-compliance.
6. There must be maximum investment in research and development. Universities and research institutions should be sponsored to conduct studies in relation to recognizing and bringing out solutions to environmental concerns. Engagements must be made with global counter parts to develop unique yet state-centric solutions to combat environmental issues.
7. Development of GEP model to set as a pioneering bench mark for other States and countries to follow: Uttarakhand being the first State in India to have adopted this model, the plan of action of developing this model should be such scale so as to act as an example from which different States can learn and take assistance for the overall unified development of the Nation.
8. International funding mechanisms should be approached by the State of Uttarakhand to get better assistance which supplements the national assistance programs. Green financing mechanisms, such as the Green Climate Fund, may also be looked on to gain additional financial assistance.

9. With all the development and implementation taking place, it is very important to make citizens aware of the GEP Index and its significance. The Government should also publish annual reports about progress achieved using the GEP model and make it available to the public so that the benefits can be understood by one and all.

Thus, lastly it is correct to say that the innovative frameworks like GEP index, judicial mechanisms, involvement of community, international collaboration etc. can be utilized to make the State of Uttarakhand a proactive protector of the environment and resolving environment issues. A holistic, multifaceted approach will help the State in addressing the challenges effectively. These all-round recommendations not only align with SDG goals but also help in overall wellbeing of the community and economic development.

At the concluding remark, it is important to acknowledge Uttarakhand Judiciary's commending and applauding role in enforcing accountability, safeguarding natural resources and promoting resilience against climate changes.