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A Review on the Impact of Climate Change on Sustainable Economic Growth of India

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Abstract

The disparity in average emissions per person has dominated India's position on global climate talks for two decades. Since the 1992 Rio Earth Summit, India has been the strongest voice for "common but differentiated" responsibility. Those were enshrined in the famous 1997 Kyoto Protocol where developing countries avoided binding agreements to reduce their emissions until developed economies first dramatically slashed their own. Frequent droughts, sudden bursts of heavy downpour,s and unseasonal snowfall cannot be dismissed merely as vagaries of weather. These are a result of climate change – which in simple terms, is warming of the atmosphere due to excessive industrial and auto emissions. Climate change is a global issue. As part of our efforts to achieve environmentally sustainable economic growth, we must be committed to reducing the effects of climate change. Without significant measures to reduce greenhouse gas pollution, the planet is expected to warm much more rapidly than previously predicted. The paper suggested some effective mitigation strategies for climate change.

Keywords: Snowfall, Mitigation, Climate, Differentiated, Emissions, Sustainable, Economic

Methodology: The humble approach of this paper is a descriptive study based on secondary sources of data which is doctrinal in nature.

Objectives: The objective of this paper is intended to make conscious efforts to mitigate the impact of climate change to take India towards greater goals of sustainable development.

Introduction:

It is said that *"Earth does not belong to man but man belongs to the earth".* However, mankind has always tried to control and exploit Earth for its own benefits without even blinking once. Climate change is one of the major challenges on the development aspect, which negatively impacts every process of growth. Climate change is not only a significant and emerging universal environmental challenge dangerous to public health, but also a threat for mankind now. This issue had its origin in the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.[1]The United Nations Framework Convention on Climate Change defines "Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Climate change is a

[1] Article by Sanjoy Roy, *"Climate change and its effect on human health*", South Asia Politics, December 2010, p.49

change in the space and time distribution of weather patterns or conditions or properties of a region or some regions or the entire earth. It is caused by natural processes like biotic processes, variation in Earth's orbit, variation in *albedo* or reflexivity of the oceans and continents, continental drift and mountain-building, variation in solar mediation on earth, glacier melting, floods, volcanic eruptions and plate tectonics or anthropogenic activities like deforestation, burning of crop residues, use of fossil fuel and high energy consumption through electronic gadgets (use of air conditioners, aeroplanes, refrigerators, vacuum cleaners, industrial machines etc). While the term "global warming" means specific increase in surface temperature due to human activities, the term "climate change" is very comprehensive and includes global warming as well as other changes in weather patterns/conditions resulting into more emissions of greenhouse gases due to both human activities and natural processes. Many natural scientists have found in their researches that there are internal and external forcing mechanisms for climate change – internal forcing mechanisms are natural processes within the climate system (e.g. thermohaline circulation) while external forcing mechanisms may be either natural (e.g., changes in solar output) or anthropogenic (human activities leading to more emission of greenhouse gases).[2] The warmest eight years have all been since 2015, with 2016, 2019 and 2020 constituting the top three. An exceptionally strong EI Nino event occurred in 2016, which contributed to record global temperatures.[3] July 2022 was one of the hottest months ever recorded on earth according to the world's major climate monitoring agencies.[4]

At present, we have two major global ecological crises: first, the climate change; and second, the extinction of species of flora and fauna. Since the industrial revolution in western Europe, there has been a substantial increase in earth's surface temperature and if no proactive mitigation steps are taken in time, we may experience up to 4^{o}C increase in temperature by the end of the twenty first century. There have been many extreme weather events like global level glacier melting, shrinkage of lakes, rise in sea level, floods, droughts, cyclones, global warming, acid rains, longer and colder winters and so on. A glimpse of such

Sl. No.	**Major Extreme Climate Events**	**Country/Continent**	**Time**	**Climate Effects**
1.	Shrinkage of Lake Chad	Chad, Africa	1960-2002	Persistent drought has shrunk Lake Chad (once world's sixth largest lake) to 1/20th of its size in 1960- now wetland in place of open water
2.	Shrinkage of Lake Toshka	Egypt	1984-2001	From Lake Nasser reservoir (on Nile river) water passed to Toshka depression in Western Desert, but flow to Toshka ceased in 2001- so many lakes almost lost

major extreme weather events at global level may be perused in Table 1 below[5]:

[2] Article by Subhash Sharma, "*Climate Change Mitigation: Proactive Approach*", Yojana, December, 2015, p.61.
[3] Past eight years confirmed to be the eight warmest on record, published 12th Jan 2023, https://Public.wmo.int> press-release
[4] https://www.theweathernetwork.com (17th Aug 2020)
[5] Article by Subhash Sharma, "*Climate Change Mitigation: Proactive Approach*", Yojana, December, 2015, p.62.

3.	Flood in Mississippi river	U.S.	28th Jan 2011-3rd May 2011	Due to snowiest winters and violent early spring rainstorms, Mississippi and its tributaries overflowed their banks inundating lakhs of home, crops, woodland with muddy water.
4.	Flood in Indus river	Pakistan	Aug 2010	More than a million acres of land were flooded destroying crops, devastating towns (Sukkar, Dadu and Mehar) 1800 persons were killed and one crore persons lost their shelters.
5.	Yellow river's course change	China	2001-2009	Yellow river was the cradle of Chinese civilization but frequent devastating floods have changed its course now it is known as "China's sorrow".
6.	Shrinkage of Lake Mead, Nevada/ Arizona	U.S.	2000-2010	Lake Mead supplies water to California, Arizona, Nevada, Las Vegas & Mexico; since 2000 water level is dropping due to lower snowfall-by July, 2010 it is at 38 percent of its capacity; between 2001-2004 it dropped 18mtrs.
7.	Global warming	World over	1880-2009	Earth's surface temperature has increased by 0.7°C since 1880; 2/3rd of warming since 1975 @0.15 degree Celsius to 0.20° C per decade.
8.	Helheim Glacier melt	Greenland	2001-2005	Helheim glacier is crumbling into icebergs, and the glacier's flow to the sea has sped up.
9.	Imja Glacier melt	Himalayas	2000-2007	Major retreat and collapse of the lower tongue of the glacier and formation of new melt ponds.
10.	Ice melt, Mount Kilimanjaro	Tanzania (Africa)	1993-2000	Kilimanjaro is the tallest free-standing mountain, made up of three volcanic cones; there was a major decline in its cap during 1993-2000.
11.	Flood in KedarNath	Uttarakhand, India	June 2013	Cloudburst led to the death of 10,000 persons and huge property loss.
12.	Typhoon Haiyan	Philippines	8th Nov 2013	More than 8,000 people lost their lives and over 14 million inhabitants, including 5.9 million workers, were affected in some way by the storm.

13.	Flood in South India	Tamil Nadu & Andhra Pradesh	Nov-Dec 2015	They affected the Coromandel coast region of the south Indian states of Tamil Nadu and Andhra Pradesh. More than 500 people were killed and over 1.8 million (18lakh) people were displaced.
14.	Drought parts of Central Asia	Central Asia & Russia	April 2021	This led to mass livestock death, most notably in horses, and water shortages for irrigation.
15.	Flood in Pakistan	Pakistan	June-Aug 2022	Over 1.5 million people have been impacted by the recent natural disaster, hundreds have been relocated, and nearly 700 have lost their lives thus far.

Table 1 : Major Global Events of Climate ChangeSource: Based on NASA data

These and other extreme weather events have caused massive losses to humans, animals, plants and properties. In 1995, the United Nations Leipzig Conference on Plant Genetic Resources pointed out that 75 percent of the world's biodiversity disappeared in agriculture due to the Green Revolution and industrial farming. On the other hand, another UN Agency, Food and Agriculture Organization (FAO), has estimated that 70 to 90% of global deforestation is caused by industrial agriculture which has promoted monoculture into forests to grow commodities for export, not for food. Further, according to grain. org report, transnational food industry contributes to 44 to 57% of all anthropogenic greenhouse gas emissions. Furthermore, fossil fuel consumption is also largely responsible for increase in emissions. It is a bitter truth that 68 % of India's energy comes from thermal plants – mostly coal and to some extent gas and oil. Thermal plants are largely responsible for carbon emission besides transport vehicles, use of fuelwood etc.[6] But India, even though not part of the problem, wants to be part of the solution.[7]

In this regard, inter-governmental panel on climate change (IPCC) has published many comprehensive reports (in 1990, 1995,2001,2007 and 2014). Its synthesis report of AR5found the following major trends[8]:

a. Anthropogenic emissions of GHGs are highest in history; climate changes have widespread impacts on both human and natural systems.
b. Oceanic uptake of carbon dioxide (CO_2) resulted in acidification of oceans; warming of 0.85^oC increased during 1882-2012 and sea level rose by 0.19m during 1901-2010.
c. Due to continued emission of GHGs, there is likelihood of severe, pervasive and irreversible impacts for humans and ecosystems.
d. Limiting total human-induced warming to less than 2^oC relative to the period 1861-1800 with a probability of more than 66 percent would require cumulative CO_2 emissions from all anthropogenic sources since 1870 to remain below 2900 $GtCO_2$ had already been emitted by 2011.
e. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in all countries at all levels of development.

[6] Ibid.
[7] Article by Purnamita Dasgupta, "*Economic development and the costs of climate change*", Yojana, December, 2015, p.26
[8] Ibid.

f. Adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change.
g. Without additional mitigation efforts beyond those in place today, warming by the end of the 21st century will lead to a high to very high risk of severe, widespread and irreversible impacts globally.
h. Multiple mitigation pathways would require substantial emission reductions over next few decades and near zero emissions of CO_2 and other GHGs by the end of the 21st century; to implement these would pose technological, economic, social and institutional challenges.
i. Emission scenarios leading to GHG concentrations in 2010 of about 450 PPM CO_2 or lower are likely to maintain warming below 2^{o}C over the 21st century relative to pre-industrial levels. These scenarios are characterized by 40 percent to 70 percent global anthropogenic GHG emissions reductions by 2050 compared to 2100, and emission levels near zero or below in 2100.

The AR6 SYR is based on the content of the three working groups assessment reports: WGI- The Physical Science Basis, WGII- Impacts, Adaptation and Vulnerability, WGIII- Mitigation of climate change.[9] The first section, 'current status and trends', covers the historical and present period. The second section, 'Long-term Climate and Development Futures', addresses projected futures up to 2100 and beyond. The final section is 'Near-term responses in a changing climate', considers current international policy timeframes, and the time interval between now and 2030-2040.[10]

Climate Change Mitigation-Background[11]	
1.	United Nations Conference on Environment and Development (UNCED), Rio De Janeiro, 1992(Rio Earth Summit)-172 countries participated, 108 at level of heads of state or government-agenda 21, the Rio Declaration on Environment and Development, the statement of forest principles, the united nations framework convention on climate change and the united nations convention on biological diversity.
2.	1997 KYOTO PROTOCAL- Annex I Parties commit to take binding reduction targets
3.	2007 Bali COP : Introduction of Nationally Appropriate Mitigation Actions (NAMA), to engage developing countries in voluntary mitigation effort
4.	2009-2010(Copenhagen & Cancun COP): Comprehensive international system for collective action and major developing countries (including India) announced voluntary mitigation pledges
5.	2011Durban COP: ADP launched for evolving a new agreement for post-2020 period
6.	Warsaw & Lima COP: INDC concept for all countries
7.	19th COP in Warsaw (2013): All countries required to prepare INDCs and present them before COP 21 in Paris

[9] https://www.ipcc.ch>report>sixth
[10] AR6 Synthesis Report :Climate Change 2023-IPCC
[11] Supra note 7.

8.	20th COP in Lima (2014): Further clarity on form of INDC: Not mitigation centric and can include other components as per country priorities

According to a new assessment from the Intergovernmental Panel on Climate Change (IPCC), which was prepared by the world's foremost climate scientists, rising temperatures will lead to catastrophic weather extremes also resulting in rising sea levels in the coming years.[12] The report states that human activity is "unambiguously" to blame for more severe climate events such as heat waves, floods and droughts, and attaining net-zero greenhouse gas emissions by 2050 is a must.[13] Climate threats such as sea level rise, rising temperatures, and extreme weather events will aggravate South Asian Cities susceptibility. Coastal and major river delta areas that are 10 metres or less above sea level[14] are home to around 14/ of the region's metropolitan population, totaling about 400 million people. The megacities of Delhi, Dhaka, Kolkata and Mumbai will be the most affected.[15] As outlined in the Paris Agreement, it was required to keep the global temperature change to 1.5 degree C. Despite the fact that Southeast Asian countries are expected to be among the most hit by climate change, the majority of the region's governments lack carbon reduction policies that will effectively decrease the severity of climate hazards.[16]

In the public mind, it is the carbon-dioxide (CO_2) that comes primarily from fossil fuel burning that is the main warming agent and that is rightly so. CO_2 is a long-lived gas and stays on in the atmosphere for hundreds of years and its rising concentration is trapping heat. This demands urgent action across the world to reduce consumption of fossil fuels and modify lifestyle. However, science has also changed our understanding about the role that some of the short-lived gases and particles like black carbon, methane and ozone play in the warning, snow melt and rains.[17]

Effect of Climate Change:

1. Changes in precipitation patterns-

Climate change has led to significant alterations in the precipitation patterns. Increased average global surface temperature may lead to hotter and drier summers and shorter winters and can increase duration and frequency of extreme weather events like drought, hurricanes and cyclones. These events cause severe damage to property, infrastructure and human lives, affecting water availability and, hence, complicating the solid waste management procedure even more.[18]

2. Changes in temperature patterns-

In the last 40 years, huge fluctuations in daily minimum, average and maximum temperatures have been recorded. Frequent occurrences of very high atmospheric temperatures and heat waves are taking place. This is fastening the rate of degradation and decomposition of the waste for which the contemporary infrastructure of waste management is not competent enough.[19]

[12] AR6-Climate Change, 2021, IPCC Report
[13] Article by Avinash Mishra, et.al., "*Sustainable economic growth*", Yojana, May, 2022, P.17
[14] World Bank, 2009, Why is South Asia Vulnerable to Climate Change?
[15] Supra note 13, p.18
[16] Ibid.
[17] Article by Anumita Roychowdhury, "*Air pollution, climate change and public health: dangerous link*", Yojana, December, 2015, p.57.
[18] Article by Kopal Verma, et.al., "*Waste and climate change*", Yojana, July, 2021, p.64
[19] Ibid, p.65

3. Increase in sea level and storm surges-

With the increase in global mean temperature, the snow covers are melting and, thereby, increasing the mean sea-levels. This is leading to high risks of inundation, flooding, bund erosion and seawater intrusion of the dumpsites and waste management sites in coastal areas leading to coastal water pollution. Increased sea level may also aggravate the impacts of storm surges, hurricanes, cyclones, etc., which are known to damage infrastructure and destroy human lives extensively. [20]

4. Impact on Ecosystem Health-

In association with air, water and soil pollution, climate change is also emerging as a significant threat to ecosystem and human health. Natural disasters like heat waves, floods and droughts are all consequences of climate perturbations. These natural disasters subsequently culminate in various kinds of diseases that could be common vector-borne diseases such as malaria, dengue and diarrhoea. However, the magnitude of impact would be significantly different at local, regional and global levels. In view of this, the immediate research challenges before us are-

- To identify cause-effect relationships between EF,CF, ecosystem and human health impacts;
- To carry out exposure risk assessment and integrate them with dose-response characteristics;
- To evaluate population vulnerability and adaptive capacity, and;
- To assess, evaluate and adopt appropriate mitigation and intervention strategies.[21]

Distribution and transport of pollutants through air, water and soil, human exposure to pollutants and toxicology and pharmaco- kinetics of different pollutants are some of the essential elements involved in ecosystem and health risk assessment modeling (Pandey et al., 2001a, 2005).

According to climate vulnerability index[22] (CVI), Assam, Andhra Pradesh, Maharashtra, Karnataka, and Bihar are highly vulnerable to extreme climate events such as floods, droughts and cyclones. It also says that more than 80 percent of India's population lives in districts highly vulnerable to extreme hydro-met-disasters. Only 63 percent of Indian districts have a District Disaster Management Plan, according to the council on Energy, Environment and Water (CEEW) report.[23]

5. Climate change negatively impacting Human sleep-

Increasing ambient temperatures negatively impact human sleep around the globe, according to a study. The research, published recently in the journal *One Earth*, suggests that by the year 2099, suboptimal temperatures may erode 50 to 58 hours of sleep per person per year. The researchers also found that the effect of temperature on sleep loss is substantially larger for residents from lower income countries as well as in older adults and females. According to the study's first author Kelton Minor of the University of Copenhagen in Denmark, "Our results indicate that sleep- an essential restorative process integral for human health and productivity – may be degraded by warmer temperatures." It's long been known that hot days increase deaths and hospitalizations and worsen human performance, yet the biological and behavioral mechanisms underlying these impacts have not been well understood, the researchers said. The study suggested that on very warm nights- greater than 30 degrees Celsius- sleep declines an average of

[20] Id.

[21] Article by J. S. Pandey, "*Climate change: Synergistic impacts on human and ecosystem health*", Yojana, December, 2015, p.50

[22] Mapping India's Climate Vulnerability-CEEW- 26 October, 2021

[23] Supra note 13.

just over 14 minutes. The likelihood of getting less than seven hours of sleep also increases as temperatures rise. [24]

Upcoming threats from Climate Change:

a. Changing rainfall patterns combined with rising temperatures may cause soil moisture and water retention capacity to deteriorate, affecting home and industrial water supply, hydropower generation and agricultural production. By 2050, changes in rainfall and glacial melt are expected to increase discharge in the region's major rivers. River flows are expected to fall significantly later this century, resulting in severe water shortages.[25]
b. We are in dire need of policy advocacy and technical guidance to address climate change and vulnerability issues in agriculture, water and other sensitive sectors. Our water sector projects should be developed and planned to help communities and economies cope with the effects of climate change by minimizing water losses and implementing integrated water resource management to promote community and economic resilience.[26]
c. Our focus should significantly be on managing land use and forests for carbon sequestration. Approximately, one-third of the region's greenhouse gas emissions are caused by the conservation of forests to agricultural land, which has a significant impact on the region's biodiversity. Increased salinity of low-lying lands, changes in sediment balance, and further degradation of arid and semiarid areas would limit agricultural production and eventually, land availability for agriculture. Natural disasters and extreme events will also have an impact on agriculture. Monsoon rains will continue to have a substantial impact on agricultural production. Crop yields will decline dramatically as a result of climate change-induced water stress, rising prices for vital agricultural crops like rice, maize, wheat, and soybeans, and contributing to increased malnutrition in the region by 2050 if current trends continue.[27] One of the most cost-effective strategies to minimize greenhouse gas emissions is to improve forest and agricultural land management and integrate water development along with storage creation.[28]

INDIA IS TACKLING CLIMATE CHANGE:

GOVERNMENTS KEY INITIATIVES
1. JAWAHARLAL NEHRU NATIONAL SOLAR MISSION ➢ Achieve 100GW solar power generation by 2020
2. NATIONAL MISSION FOR ENHANCED ENERGY EFFICIENCY ➢ 98.55MT annual reduction in CO2 emissions
3. NATIONAL MISSION ON SUSTAINABLE HABITAT ➢ Promote recycling and urban waste management
4. NATIONAL WATER MISSION ➢ 20/ increase in water use efficiency

[24] The Assam Tribune, May 26,2022
[25] Supra note 13, p.19.
[26] Id.
[27] ADB. 2009. Building climate resilience in the agriculture sector in Asia and the pacific. Manila: ADB/international food policy research institute.
[28] Yojana, May 2022, p.20.

5. NATIONAL MISSION FOR SUSTAINABLE AGRICULTURE ➢ Enhance soil health and efficiency of water use in farms
6. NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM ➢ Develop state-of-the-art national centre for Himalayan glaciology
7. NATIONAL MISSION FOR A GREEN INDIA ➢ Increase forest/tree cover on 5 million ha of forest/non-forest lands
8. NATIONAL MISSION ON STRATEGIC KNOWLEDGE FOR CLIMATE CHANGE ➢ Enhance research capability in climate science
9. NATIONAL CLEAN ENERGY FUND ➢ Finance and promote clean environment initiatives and research
10. NATIONAL ADAPTATION FUND ➢ Address adaptation needs in agriculture, water & forestry, among others

*GOVT OF INDIA MINISTRY OF NEW AND RENEWABLE ENERGY

Discussion

It is very encouraging to note that many responsible citizens are increasingly getting concerned about saving the only livable planet of our solar system for our posterity. But, this concern must percolate down to every stratum of society at large so as to make it a mass movement. Because the disastrous consequences of the effects of climate change on the planet and the people are no longer topics of scientific research or leisurely discussions only. These are real and happening around us, here and now. An unprecedented rise in global temperature, unseasonal and unpredictable rains causing devastating floods, killer cyclones and tornados, dreaded never-heard-before pandemics and so on and so forth are many cruel truths that mankind has started encountering haplessly. Scientific evidence has established that ever increasing use of fossil fuels like coal and petroleum products along with ruthless deforestation is the single most notable cause of massive carbonization of the planet leading to an increasing global temperature. This in turn is causing an increase in the mean sea level on account of melting of ice in the high mountain glaciers and the icy continents of the poles. If this is allowed to continue unabated, the law-lying seashore areas and some low-lying isolated islands would get totally submerged and lost forever, sooner than later. This situation is very alarming indeed. Incidentally, since such changes are very slow and incremental, humans get used to those and develop complacency. But such concerns need to be sustained till some pragmatic solutions are found to the vexed problems. [29]

Carbonization is fundamentally an increase in the carbon dioxide level around the globe. Carbon is the most dominant and abundantly available fuel mankind uses for combustion to produce heat energy, right from firewood, coal, petroleum products, etc. When carbon gets burnt efficiently it produces carbon dioxide gas in combination with oxygen. As we know, the plants 'inhale' carbon dioxide and 'exhale' oxygen, which is vital for our living. Carbon dioxide is about two times heavier than air. So, it tends to get settled forming a thin blanket around the earth's crust. This blanket of a certain thickness is necessary to keep the radiated heat from the sun entrapped to keep the planet warm enough at a comfortable and livable level. But, as we keep burning carbon in insurmountable degrees for generation of electricity at thermal power stations, in running of internal combustion energies of motor vehicles, flying aeroplanes,

[29] Article by Parag Phukan, "*Green energy : The hidden cost*", The Assam Tribune, Date-04-06-22.

farm equipment, other engines, domestic cooking etc., we produce huge quantities of carbon dioxide gas, thereby increasing the gas's thickness cover. This in turn absorbs more and more heat from sun rays and retains it, increasing the global temperature. Moreover as a double whammy, massive deforestation is causing a huge reduction in carbon dioxide intake by plants.[30]

The UNO has come up with seventeen well thought out Sustainable development Goals which look rosy on paper, but their implementation calls for enormous efforts by all. The United Nations Sustainable Goals Report 2022 provides a global overview of progress on sustainable development using the latest available data and estimates. It tracks the global and regional progress towards the 17 Goals, including climate action, with in-depth analyses of selected indicators for each goal.[31] The Paris climate change target inter alia includes keeping global warming below 2 degree Centigrade above pre-industrial level, and even down to 1.5 degree Centigrade by the end of this century. This in practical terms means a commitment to reduce emissions by a massive 7.6 per cent, year on year, in the next decade. Strong and dominant narratives seem to believe that decarbonisation by using renewable technologies like solar and wind energies and switching to electrical vehicles (EVs) and other forms of green engines shunning the use of fossil fuels is the best plausible way out of this quagmire. But whether such green sounding pronouncements really qualify as the "green revolution" of our dream need to be examined in the larger canvas of perspectives. Usage of green technologies to mitigate the climate change problems probably makes perfect sense at present, but like all things there is an inherent expensive trade off. Going green can be a lot more costly than we imagine.[32]

Great technological break-thoughts tend to throw up unforeseeable problems. For example, development of electric storage batteries for EVs and also for solar and wind energy technologies may even lead to a 1000 per cent increase in the demand for aluminum, cobalt, iron, lead, lithium, manganese and nickel. This would definitely add to the problems of fast depleting resources of the world manifold. To provide refined materials for fabrication of a single EV battery of less than 500 kilograms, a total of about 227,000 kg of materials will be necessary, which is 20 times more than the petroleum used by an I/C car engine in its life span. Majority of EV battery materials and components are made in China with a 60 per cent coal-fired power grid. So, more demand for batteries would only increase carbon emissions in China, meaning just shifting of emissions from developed countries to developing countries. But, climate does not abide by political boundaries![33]

Unchecked climate change and rising global temperatures will mean that monsoon rainfall, the crucial input for food production here, will fail more often over the next 150 years. This could mean a rain shortfall of anywhere between 40 per cent to 70 per cent. It could also mean untimely excess rainfall, which would disrupt life, wreck havoc with food production and push up food prices. A study by Jacob Schewe and Anders Levermann of the Potsdam Institute for Climate Impact Research predicts that the monsoons could fail every fifth year between the year 2150 and 2200 unless governments act decisively to counter climate change.[34]

[30] Id.
[31] 17 Goals to Transform Our World, https://www.un.org>desa>envisio
[32] Supra note 29.
[33] Id.
[34] Yojana, December, 2015, p.75.

Significance of Climate Fintech:

Fintechs are the digital financial technology catalyzing decarbonisation throughout the world, which provides their consumers with innovative ideas, green financial solutions, and services to help them minimize their carbon footprints. The merging of three areas-climate, finance and technology, is known as sustainable Fintech. Climate Fintech solutions are digital innovations, applications and platforms that assist organisations and individuals in saving, spending and investing in environmental-friendly ways. Climate Fintech is an important intermediary in the financial services industry, mobilizing resources, and influencing behavior. Customers may now make more mindful shopping decisions, investors can develop more climate-focused portfolios for their clients, and insurance companies can understand weather dangers better, thanks to Climate Fintechs. They provide firms with greater tools for monitoring, measuring, and mitigating their environmental impact.[35]

Environmental laws:

Humanity has no choice but to move towards a secure future to keep a sustainable environment. Countries like India now have access to scientific knowledge and technological knowledge for development in recent years. We need to blend the knowledge of the past with the scientific knowledge of the present to create a new wisdom. The task is difficult but Indian culture has great resilience and India has a great capacity to overcome hurdles. We have to start somewhere to come to the right path, the ecological path. Still it is not too late to have a beginning. Therefore, the legal experts of the World Commission on Environment and Development (WCED) drafted the following Articles as strategy to combat the environmental problems: "States shall ensure that the environment and natural resources are conserved and used for the benefit of present and future generations (Article2)

States shall observe in the exploitation of living natural resources and ecosystems the principle of optimum sustainable field."(Article 3)[36]

Hence, development of a sound legal mechanism is a sine qua-non to protect our environment. In fact, India and other countries of the world enacted many direct as well as indirect legislations as a means of control of environmental pollution. That are as follows:

1. **Common Law principles**

a. Liability for escape of Noxious Object
b. Careless use of Noxious articles or pollutant

2. **Legal provisions prior to Independence**

a. The Shore Nuisance (Bombay and Colaba) Act,1853
b. The Orient Gas Company Act, 1857
c. Indian Penal Code, 1860
d. The Northern India Canal and Drainage Act,1873
e. The Obstruction is Fair Ways Act, 1881
f. The Indian Fisheries Act, 1897
g. The India Ports Act, 1908
h. The Inland Steam Vessels Act, 1917

[35]Article by Avinash Mishra, et.al., "*Sustainable economic growth*", Yojana, May 2022, p.20

[36] Experts Group on Environmental Law of the World Commission on Environment and Development, Munro (1987), Environmental Protection and Sustainable Development-Legal Principles and Recommendations, London, Graham and Trofman, p. 28.

i. The Indian Forest Act, 1927

3. Substantial laws after Independence

a. The Factories Act, 1948
b. The Mines Act, 1952
c. The Atomic Energy Act, 1962
d. The Insecticides Act, 1968
e. The Wild Life (Protection) Act, 1972
f. The Water (Prevention and Control of Pollution) Act, 1974
g. The Forest (Conservation) Act, 1980
h. Air (Prevention and Control of Pollution) Act, 1981
i. The Environment (Protection) Act,1986
j. The Public Liability Insurance Act,1991
k. The National Environment Tribunal Act, 1995
l. The National Environment Appellate Authority Act, 1997
m. Constitutional Provisions relating to Environment Protection (Art 21,48-A, 52-A(g))

4. Procedural laws

a. Rules framed under Criminal Procedure Code, 1973
b. Rules framed under Civil Procedure Code, 1908
c. Rules framed under the Water (prevention and control of pollution) Act,1974
d. Rules framed under the Air (prevention and control of pollution) Act,1981
e. Rules framed under the Environment (protection) Act,1986
f. Rules framed under National Environment Appellate Authority Act,1997
g. Rules framed under Public Liability Insurance Act,1991
h. Rules framed under Wild Life (protection) act,1972

The environmental laws are not at all developed in a comprehensive manner but rather in a piecemeal way. However from the Stockholm Conference on words through Rio Conference a sound environmental legal framework has been developed. Naturally to implement the environmental laws there is always a need for well designed agencies and sound policy.[37]

Conclusion & Recommendations:

Hence the Courts in India suggested various remedial measures and legal principles to strengthen the implementation process of environmental laws focusing the following areas-

1. The court has rightly adopted the principle of balancing between development and ecology and emerging environmental jurisprudence.
2. With the introduction of PIL a new people- oriented justice concept has been fully utilized by the SC and HC's in implementing environmental laws. Thus PIL is providing access to the justifying system being galvanized into supplying justice to the socio-economic disadvantages.
3. In developing principles of law in implementing environmental laws in substantive aspects, Courts in India are developing various principles in many cases.

The National Policy also recognized the important role of NGO's to implement environmental policy and

[37] Article by Yadvendra Pratap Singh, "*Environmental Laws: Problems and Perspectives",* pp.29-31Jour, AIR 2010.

legislation. The Constitution of India also imposed fundamental duties on the citizens to protect and improve the natural environment and also recognized the freedom of information and right to know.[38] In conclusion, we may observe that India should always emphasis on 'common but differentiated responsibility' for mitigation and adaptation of climate change at global level because of 'historical wrongs' committed by many developed countries as colonial powers in the last 300 years, yet we should also make all voluntary genuine efforts at national and state levels to reduce carbon emissions and practice adaptation through technological innovations in view of substantial absolute emissions in India.[39] India should opt for following options for both mitigation and adaptation:

a) Actual renewable sources of energy like wind, solar, hydro, geothermal, bio-energy and natural gas etc. should be given topmost priority- solar energy is cheaper than wind energy- to fossil fuels like coal, oil, fuel wood etc.
b) Nuclear power is not environmentally safe (rather very hazardous) in the long run, though it may appear cheaper for the time being; hence it may be avoided.
c) There should be promotion for public and private investments to raise energy efficiency levels (e.g. LED bulbs/tubs in place of conventional bulbs), and Bureau of energy efficiency at national level and state renewable energy development authority should be more proactive.
d) There should also be public and private investments to expand capacity in clean renewable energy; public-private partnership (PPP) mode should be encouraged in letter and spirit. New investments in renewable sources of energy will bring huge employment.
e) All states should prepare fool-proof and comprehensive state action plans on climate change (2009); so far 31 States/ Union Territories have prepared these. But out of 31, only 20 State Action Plans on Climate Change were found in order and endorsed by the National Steering Committee on Climate Change. The proposed budget (2022) for implementing State Action Plans on Climate Change by all States is Rs. 30 Crores. Again there should be transparent mechanisms for their implementation at every stage.
f) As per Article 12 of Kyoto Protocol, there is a carbon market for global reduction of carbon/GHG emissions through sale and purchase of carbon credits- this is called 'Clean Development Mechanism' (CDM). During 2003-14 out of total 7589 CDM projects, 1541 were from India (second highest in the world). Certified emission reductions issued to Indian projects is 19.10 crore (13.27 per cent) - mostly in sectors of energy efficiency, fuel switching, industrial processes, municipal solid waste, renewable energy and forestry. But in the second commitment period, the number of CDM projects from India were submitted out of total 3227 projects. Hence, Indian public and private sectors should be proactive, and new and effective market mechanisms should be created to cover all countries of the world.
g) A National Adaptation Fund with a corpus of Rs.100 Crores has been set up by Govt. of India (Ministry of Environment and Forests and Climate Change) to support adaptation actions to combat the major challenges of climate change in agriculture, water, forestry etc. but it has not materialized so far on the ground. Further, this corpus fund is quite meager in view of the huge problems of climate change to be adapted in letter and spirit in India in different sectors.[40]

India's emissions trajectory is compatible with a 2degree C future. Although India's sectoral policies are still not in line with the Paris Agreement, the country's ambitious renewable energy strategy is a positive

[38] Ibid, p.32
[39] Article by Subhash Sharma, "*Climate change mitigation: proactive approach*", Yojana, December, 2015, p.65.
[40] Ibid, p.65.

indicator. India's 500GW renewable capacity target by 2030, as well as the overall Indian economy's high degree of energy efficiency, are among the highlights in the National Statement by the Prime Minister at COP26 Summit in Glasgow.[41]

The orientalist concept of development and environmental effect is a spurious dichotomy. To grow, India requires its own fair amount of carbon space. Either the west can provide the necessary scale of money or clean technology to allow India to swiftly deploy renewable energy to fuel its development or the west must substantially reduce its emissions to allow for rising Indian emissions in the future years.[42]

Huge investments are necessary to install wind and solar farms. Massive quantities of cement, steel, glass, non-recyclable plastics, other rare metals and rare earth, etc., are necessary for the purpose. All these are derived from the earth only through unsafe mining, mostly in the underdeveloped countries, creating high levels of pollution locally. Moreover, large spaces are covered by such farms in an already space-constrained world. The world today is seized with the annoying problem of plastic disposal. The waste generated by renewable technologies would only add to our existing owes. This paper is not to suggest that technological solutions should not be pursued. But too much reliance on technologies may not be the panacea and principal means to address the problem in the long run. Surprisingly, hardly anybody talks about the enormous embedded hidden environmental, economic and geo-political costs of going green per se. Awareness is the urgent need of the hour. The Court is playing a vital role in the implementation of environmental laws and involving legal principles to prevent environmental pollution. Today, mankind is indeed in a vicious circle. We must find doable solutions to reverse the perils of climate change, fast. Otherwise posterity would curse us! [43]

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[42] Supra note 28, p.19.
[43] Supra note 24.

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