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(13th - 15th April, 2024)

Prospects of Manufacturing and Service Sector Growth in India

***

Role and Impact of Social Protection Programmes

***

Emerging Features of Trade and Trade Policy

***

Growth and its Drivers in Uttar Pradesh and Uttrakhand

***

Environment, Climate Change and Sustainable Development

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UTTAR PRADESH - UTTARAKHAND ECONOMIC ASSOCIATION

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FROM SECRETARY'S DESK

The Uttar Pradesh-Uttarakhand Economic Association (UPUEA), founded in 2005, has seen impressive growth in its short tenure. Membership has exploded tenfold in less than fifteen years to about 1800 life members, showcasing the association's increasing significance. The UPUEA, Society for Promotion of Economics in both states, is a premier society of economists. It actively contributes to the field of economics by publishing its research findings. It further promotes economic exploration through annual conferences, providing a platform for economists to share research and collaborate. These conferences are experiencing a rise in participation, with growing numbers of delegates, paper presenters, and esteemed resource persons. Overall, UPUEA's dedication to organizing high-quality events and fostering research collaboration makes it a key player in advancing economic understanding within Uttar Pradesh and Uttarakhand.

The Uttar Pradesh-Uttarakhand Economic Association (UPUEA) is gearing up for its 19th Annual National Conference, a three-day event scheduled for April 13th-15th, 2024. We have received more than Three Hundred Sixty (360) Research papers under the broad theme of the conference: **Sustaining Growth with Equity: Sectoral Growth, Trade and Social Protection in the 21st Century.** A pre-Conference research workshop for the young researchers has been organized on 13th April 2024 to acquaint the researchers with various nuances of the research. This year's conference delves into the dynamic forces shaping the Indian economy, with a particular focus on the state of Uttar Pradesh and Uttarakhand. Researchers and economists have a great opportunity to contribute their expertise by submitting papers on five key sub-themes.

- ***Growth Prospects of Manufacturing and Service Sectors in India,***
- ***The Impact of Social Protection Programs,***

- ***Emerging Trends in Trade and Trade Policy,***
- ***The Drivers of Economic Growth in Uttar Pradesh and Uttarkhand***
- ***Environment, Climate and Sustainable Development.***

All accepted papers will be published within the conference proceedings, creating a valuable record of scholarly contributions. However, the organizers have encountered a recurring challenge: ***delayed paper submissions.*** This has resulted in last-minute scrambling and potential disruptions to the conference schedule. Despite persistent and frequent reminder to the members to contribute their papers as per schedule, we continue to receive the late response under the pretext of late information, leading to accomplishment of further steps in haste. While we've disseminated information about the conference and deadlines, we understand that occasionally, important details might require reiteration. To ensure a well-organized event and allow ample time for the publication of full papers in the conference proceedings, we kindly request all interested members to reach out to the General Secretary or Organizing Secretary in March for any clarifications or updates. By adhering to the specified page limits, members can contribute to a well-organized and informative conference. We appreciate your understanding and look forward to receiving your valuable research contributions. The Uttar Pradesh-Uttarakhand Economic Association (UPUEA), a well-established organization for over a decade, recognizes the need to adapt with the time. With the national economy rapidly evolving, the association acknowledges new challenges facing the economies of Uttar Pradesh and Uttarakhand, particularly in agriculture and rural development. To address these challenges, the UPUEA sees the current times, as an opportune moment for critical reflection. The association proposes an objective discussion to analyze both the successes and failures of past development efforts. This analysis aims to identify crucial strategies with the potential to unlock growth across all sectors.

The UPUEA expresses gratitude to various funding agencies and institutions for their financial support towards conferences, journal publications, and conference proceedings printing. Additionally, we acknowledge the valuable contribution of NABARD for publication financial support. Upuea is also grateful to publisher, Kunal Books, New Delhi, for their efficient printing of the conference proceedings.

(Vinod Kumar Srivastava)
General Secretary, Upuea.

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Contents

THEME 5

Environment, Climate Change and Sustainable Development

Sustainable Development Goals and Indian Leather Industry

Haya Khalid Hashmi and Dr. Vandana Dwivedi

Abstract

United Nations Member States in 2015 adopted 2030 agenda for Sustainable development goals where the aim was to encourage sustained growth and development worldwide with peace and prosperity for people and planet by having a long term vision. There are 17 Sustainable Development goals which are to be managed by global partnership of developed and developing countries. Sustainable manufacturing ensures that the manufactured product are economically produced and the manufacturing process is environment friendly by conserving energy and valuable limited natural resources. The ninth goal of the sustainable development goal is related to industry, innovation and infrastructure. Here, the goal is to 'build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation'. In this paper, an attempt is made to investigate as to how Indian leather industry is abiding by these goals and how sustainable leather manufacturing can aid in increasing export earnings for India. This paper is an outcome of a pilot survey done on one of the clusters of leather industry, that is, organized region of Kanpur cluster.

Keywords: *Leather industry, sustainable development goals, export earnings, sustainable manufacturing, long term growth, environment friendly*

INTRODUCTION

There are 17 goals formulated by United nations to achieve 2030 agenda for sustainable development. Participation is by all developed and developing nations as a global partnership for a common goal of world sustainable development. These goals cover basic human needs in present, while keeping in mind the needs of the future generation.

Over the years, working environment has been moving towards economic growth at all costs and at a very rapid pace. In order to achieve this target, the developing nations are

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risking major natural resources by rapidly increasing industrialisation and modernisation which if not implemented properly shall lay a huge impact on long term sustenance of livelihood. Therefore, this is where the relevance of these important sustainable development goals come to play; as these have been a very profound step towards encouraging conservation and preservation of natural resources which shall continue to be a means of human sustenance.

It is important to note here that, each of these goals are explicitly important and that is the reason why they have been formulated in such a way that they shall be interconnected to each other. The precise agenda of these 17 goals laid by United nations 2030 agenda for sustainable development is to work towards developing cities, businesses and communities to meet their current needs for economic growth and development, without sacrificing the future generations ability to meet their needs in the future. This is the reason why each sustainable development goal has environment conservation as its primary motive.

One of the most important factors for ensuring implementation and success of these sustainable development goals is to create environment consciousness among individuals and to create awareness of importance of these goals as with deliberate conscious awareness these goals shall be implemented worldwide. A means of federal mandate implementation can also facilitate success of these sustainable development goals. Rapid urbanisation and industrialisation can have an inclusive growth results by implementing sustainable development goals alongside. Economic benefits through implementing these goals shall be increasing employment opportunities, reducing poverty, promoting economic growth and improving standard of living of individuals. Apart from economical aspects, looking on sociological aspects it can be highlighted that these goals promote social justice and peace in societies by ensuring fair importance to all ecological entities.

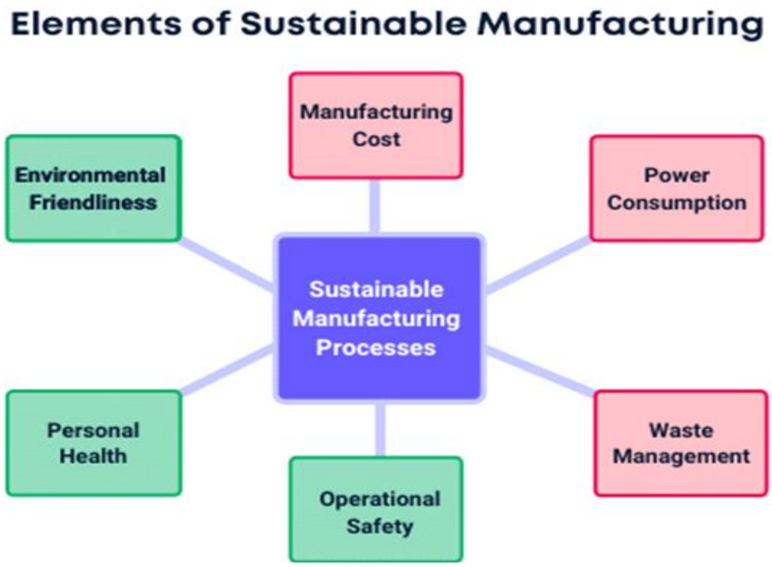
SUSTAINABLE DEVELOPMENT GOALS AND MANUFACTURING

The meaning of sustainable manufacturing is to undertake manufacturing activity in such a way that, it ensures to minimize environmental damage while conserving energy and natural resources. This concept has a socio-economic benefit that shall be prosperous of the whole ecological well-being. At present, many manufacturing businesses are laying importance on creating a sustainable manufacturing environment so that businesses may enhance but not at the cost of environment well-being. Earlier, only niche and top rated businesses laid importance on sustainable manufacturing but now, with growing customer consciousness around the globe, all leading businesses are incorporating sustainable manufacturing.

There are a few important aspects that are promoting sustainability, some of these are highlighted below:

Operational efficiency of businesses shall be increased by monitoring wastage and that shall eventually have cost benefit in the long run Enhancing competitive advantage by reaching out to new and a more socially aware customer base.

- ❖ Increasing the prestige of brand and reputation of business as it is manufacturing a product that is not harming/damaging anything
- ❖ A long term business viability and success in the form of increased revenues may be ensured with sustainable manufacturing practices
- ❖ Regulatory operations are well regulated and the ease of doing business may be enhanced
- ❖ Increasing collaborative association with external stakeholders



- ❖ Manufacturing cost: This is the amount that is used to produce/manufacture the product. This has to be regulated and minimised in order to attain sustainable manufacturing output.
- ❖ Power consumption: This is the amount of energy that is used to produce the product. This has to be efficiently consumed in order to attain mechanise sustained manufacturing process
- ❖ Waste management: This is the process where it is decided as to how the waste has to be disposed, re-used and recycled in order to minimise environmental damage and make the most of the waste generated
- ❖ Operational safety: This is the step where, it is ensured that no entity is harmed in the production process
- ❖ Personnel health: This is the step where, it is monitored as to how the safety of workers shall be ensured in the production process so that no worker is harmed in any way and are safeguarded against any risk

- Environmental friendliness: This step is extremely crucial for the sustained manufacturing process as in this step is ensured that the process of manufacturing the product is not harming environment in any form.

The above mentioned sustained manufacturing process is a generalised process which can be adopted by most industrial units that are manufacturing any product. Although each step is a simplified and essential route towards sustained manufacturing but still many manufacturing units find in difficult to implement them to achieve sustained manufacturing. Some of the commonly observed challenges faced by most manufacturing units are mentioned below:

- Lack of performance benchmark and standardization of input units is a major factor affecting sustained manufacturing process
- The cost of environmental manufacturing is too high for small to medium units to afford in daily manufacturing process
- Lack of awareness of the importance of sustained manufacturing is another factor responsible for many manufacturing units not engaging in sustained manufacturing

Therefore, there is a need to formulate a streamlined centralised model for sustained manufacturing which should be adaptable by all manufacturing units.

OBJECTIVES

As discussed above, all the problems faced for attaining sustainable manufacturing leads towards the objectives of present study. As this is a small scale pilot survey outcome, so the objectives are structured with the intend to as an outline of one of the clusters of leather industry. The objectives of this study are:

- To access the viability of sustainable development goals in performing manufacturing practices in Kanpur cluster of leather manufacturing process
- To access the role of adoption to sustainable development goals in increasing export earnings of the firms in Kanpur cluster of leather industry
- To access the constrains faced by manufacturers in adapting to sustainable development goals in Kanpur cluster of leather manufacturing process

HYPOTHESIS

H_0^1 : Indian leather industry is not abiding by sustainable development goals objectives

H_1^1 : Indian leather industry is abiding by sustainable development goals objectives

H_0^2 : Sustainable development goals have not aided in increasing export earnings for Indian leather industry

H_1^2 : Sustainable development goals have aided in increasing export earnings for Indian leather industry

RESEARCH METHODOLOGY

The research methodology for this paper is based on primary data collection. The mode used for primary data collection was a questionnaire including 5 questions related to the objectives of the study. Data is collected from 15 organised leather industry units in Kanpur region. Interviews were taken from the managerial segment of the manufacturing industry. A specimen of the questionnaire schedule is mentioned beneath.

SPECIMEN OF QUESTIONNAIRE SCHEDULE

1. Do you think that adoption of SDG's are effective and important practice of manufacturing
   - YES
   - NO
   - DON'T KNOW

2. Do you think adoption of SDG's is an economical practice of manufacturing
   - YES
   - NO
   - DON'T KNOW

3. Are you able to adopt SDG's in your manufactring unit
   - YES
   - NO
   - DON'T KNOW

4. Has adoption of SDG's helped in increasing your units export earning
   - YES
   - NO
   - DON'T KNOW

5. Do you face problems in adoption of SDG's in manufacturing process
   - YES
   - NO
   - DON'T KNOW

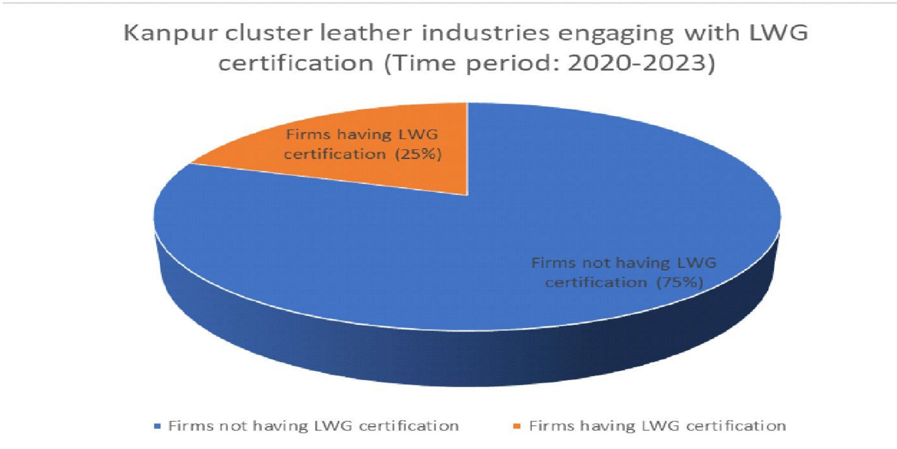
PILOT SURVEY

In order to investigate the adoption and implementation of sustainable development goals on the industrial sector of India, there has been a pilot survey done on one of the clusters of Indian leather industry; Kanpur cluster of leather industry. This is a very important cluster of the Indian leather industry as this cluster cater towards the need of saddlery manufacturing that is primarily export oriented. Saddlery manufactured in this region has got a GI (Geographical Indication) . Apart from saddlery manufacturing, this cluster is famous for manufacturing varied leather products; ranging from leather accessories to tanned leather that can be used for further manufacturing. The Kanpur cluster of leather industry is further divided into two broad clusters based on their nature of manufacturing:

- Organised cluster: This includes the area of Unnao, Kanpur Dehat and Banthar. The industries in these areas have majorly adopted an advanced form of manufacturing where they are showcasing the willingness to adapt environmental norms and compliances. Mainly the size of industries are medium to large scale in terms of operational occupancy
- Unorganised cluster: This includes the area of Jajmau in Kanpur that is mostly using traditional methods of manufacturing and are hesitant to adopt a modernised and environmental friendly technique of manufacturing. Mainly the size of industries are small to medium scale in terms of operational occupancy

The present pilot survey in order to access the viability of sustainable development goals is conducted on the organised cluster of leather industry. The survey has been done on 15 industrial units belonging to organised cluster. Personal interviews with the managing executive and official representatives revealed that they are showing willingness to adopt sustainable development goals as their purchasers/importers of their produce are keeping a mandate on abiding to environmental norms in the manufacturing process as a compulsion to sale of their products. Certain certifications which primarily aim at environment conservation and sustenance in the manufacturing process have become mandatory by big companies giving order for manufacturing their products in India. One of the commonly used association that is famous in this particular industry has been 'Leather Working Group' (LWG) . It is a multi-stakeholder group that aims to develop and maintain environmental compliance and performance capabilities of leather manufacturers. Their goals are the same as the ninth goal of sustainable development goal laid by United nations, that is; promoting sustained industrialisation and foster innovation. This working group involves brands, suppliers, retailers and leading technical experts within the leather industry.

Lately, there have been various seminars and programme organized in all clusters of leather industry in India. While interviewing the pilot survey samples of 15 leather firms in Kanpur cluster, it was computed that out of these 15 firms; only 3 firms of the organised cluster have attained LWG certification. A graphical representation of the same as been illustrated beneath:



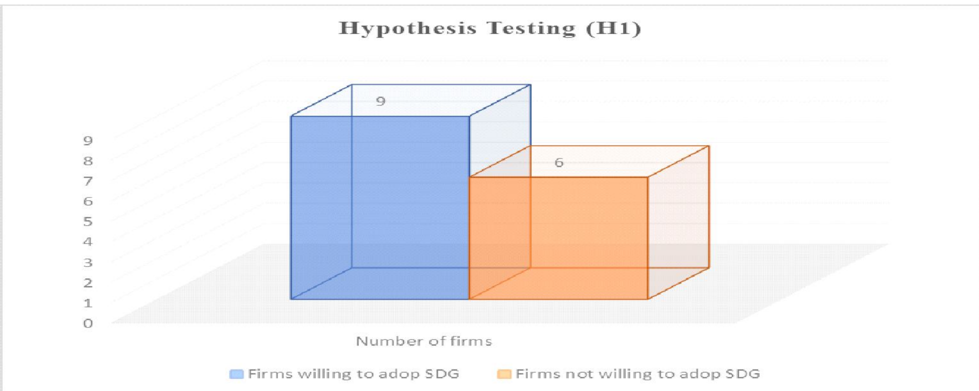
LWG engages major brands like ZARA, H & M, ADDIDAS and these brands through this group specify that they will only work with manufacturers having LWG certification. LWG certification has certain ratings that lead to categories of meritorious like Gold, Silver and Bronze.

Therefore, it can be concluded from the pilot survey that associations like LWG can be a great motivating aspect for manufacturers in this cluster to abide by the protocols and norms set by these groups to achieve dual benefit of; adherence to environmental norms and manufacturing a good standard product to qualify as a member of this group and attract popular international brands and buyers. This shall eventually facilitate Kanpur to become a manufacturing hub which shall benefit national export earnings in the long run.

TESTING OF HYPOTHESIS

$H0^1$: Indian leather industry is not abiding by sustainable development goals objectives

$H1^1$: Indian leather industry is abiding by sustainable development goals objectives



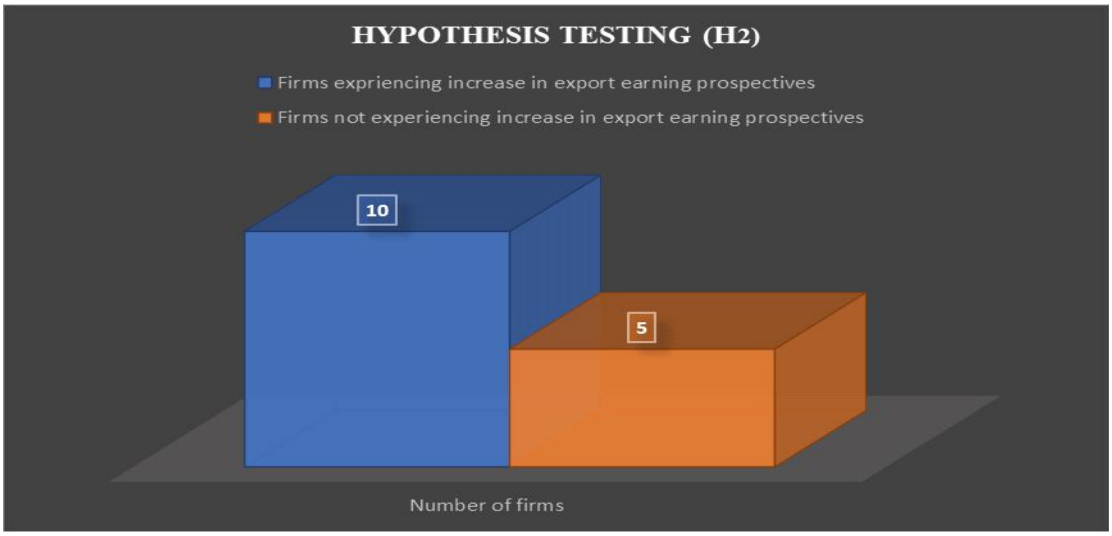
Since the size of the study is confined to 15 industrial units only. Therefore, a basic statistical estimation on average is taken to test the hypothesis.

The average of firms making efforts to abide by sustainable development goals are 9 out of 15. Making the true difference being 6 firms which are not willing to abide by SDG’s into their manufacturing practice. Therefore, in this way the null hypothesis is rejected and alternate hypothesis is accepted ; based of clear majority of firms showcasing willingness to abide by SDG’s.

$H0^1$: Indian leather industry is not abiding by sustainable development goals objectives

$H1^1$: Indian leather industry is abiding by sustainable development goals objectives

Since the size of the study is confined to 15 industrial units only. Therefore, a basic statistical estimation on average is taken to test the hypothesis.



While interviewing firms in the sample size, the outcome for SDG adherence having an impact on export earnings for Indian leather industry was very clearly positive as out of 15 firms; 10 firms left that they attracted more export earnings by following SDGs. Making the true difference being of 5 firms. Therefore, the alternate hypothesis is accepted and the null hypothesis is rejected.

RESEARCH OUTCOME

·While testing the hypothesis it was interpreted that most manufacturing units working on large scale are showing the willingness to abide by sustainable development goals.

❖ But industry fail in eminence of sustainable development goals as they fail in terms of arranging for additional manufacturing cost to allocate towards waste management for sustained manufacturing process.

Please note: This inference is conceived by the above mentioned pilot survey result on Kanpur cluster of leather industry

·The second hypothesis represents the case of a fast developing nation like India, abiding by sustainable development goals can directly aid in increasing export earnings as their adherence shall exhibit a more reliable and viable manufactured product that most developed nations are giving due importance to sustained manufacturing process acknowledge.

Please note: This inference is also conceived by the above mentioned pilot survey which highlighted as to how big brands and companies lay down adherence to sustained manufacturing process as a compulsion for purchasing products that have not harmed environment in any form.

CONCLUSION

Sustainable development goals link environmental, economic and social issues in order to ensure sustainable development for people and the planet. Adopting these goals can lead towards a more productive and prosperous environment. India is a fast developing nation that has an increasing young population that if utilised efficiently, can contribute towards the nation's aim of reaching the status of developed nation. But, an increasing population of the country is a major constrain in the pathway of reaching its development rate. Imparting education to the population is also an important element of Sustainable Development Goal (SDG) as the quality of young population is very important. In order to ensure that this increasing population doesn't become a burden or liability for the nation's growth; a systematic and organised arrangement for skill training to young working population as per their capabilities is essential.

There is a need for federal intervention in all aspects of sustainable development goals and along with the federal support, adequate awareness and education of manpower is essential to reap the benefits of these goals in the long term.

It can be concluded that after evaluating various reports through secondary data and a hands on pilot survey on one of the industrial sector of the nation; it can be stated that if the nation realises the importance of these sustainable development goals, it can work towards the aim of becoming a developed nation. The massive young population needs training and education to become an asset for the nation's growth and create an environment friendly surrounding, which can lead towards nations growth by attracting export earnings, increasing nation's participation on global agendas and operations, creating a manufacturing hub, attracting FDI's.

Therefore, each and every goal of sustainable development goals is extremely important for a nation's inclusive and prosperous growth.

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Role of Organic Farming in Environmental Sustainability

Vikas Verma and Dr. Pradeep Kumar Tripathi

Abstract

Earth is the centre of life, and everything that exists here is a synthetic form made of both organic and inorganic components of creation that exist in harmony with one another. Climate change is a real illustration of how the modern world is being disrupted by human consumerist policies and changing environmental conditions. Currently the growing population is placing more strain on the environment, which is why we are overusing natural resources and the environment in an irregular way to satisfy the demands of the growing population. Currently, the agriculture sector is utilising excessive amounts of fertilisers and pesticides to feed the growing population, which is seriously affecting the stability of the environment and the human life system. A primary contributor to climate change is the increased carbon emissions in agriculture and allied industries brought on by the overuse of fertilisers and pesticides. The UNFCC (United Nation Framework Convention on Climate Change) report states that while the global average is between 30 and 40%, in India the agriculture sector accounts for only 14 to 15% of greenhouse gas emissions. which pesticides, fertilisers, and chemicals have the most contributions to. In this research paper, secondary data has been taken by the researcher from a variety of Generals, Global organizations and websites. Which has been systematically evaluated through bar diagrams annually and shows how the excessive use of chemicals, pesticides and fertilizers in the agricultural sector is leading to greenhouse gases, which are increasing with increasing climate change. Mainly responsible for the degradation of environmental sustainability. The world would be better off solving this issue through organic farming since it involves growing in a totally natural manner. It has the power to stabilise and safeguard the environment as well as provide a healthy and better future for everyone because it does not utilise chemicals, fertilisers or pesticides. We have attempted to make clear in this study article the significance of organic farming's current role in environmental conservation.

Keywords: *Organic Farming, Environmental Sustainability, Climate Change, Green House Gas*

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Introduction:

One of the most pressing issues of our day is climate change and its effects, which seriously jeopardize our agricultural systems and food production in general. The IPCC (Intergovernmental Panel on Climate Change) reports that, in comparison to 1850–1900, the global surface temperature has already increased by more than 1°C in the last ten years, with warming over land often being greater than that over the ocean. Furthermore, there has been a noticeable increase in the frequency and severity of climate-related extreme weather events, such as heatwaves, droughts, and heavy precipitation, all of which have a significant effect on agricultural output. As there isn't much time left to turn things around, altering the way food is produced can have a significant impact on reducing climate change and assisting farmers in adapting to new conditions and building resilience. However, they cannot make up for delayed emissions reductions in other sectors. According to the 2022 IPCC (Intergovernmental Panel on Climate Change) report on mitigation, land use and agriculture can assist in removing and storing carbon. By maintaining healthy soils, preserving biodiversity, and preserving ecosystem processes, organic farming has a significant potential to lower greenhouse gas emissions and increase soil carbon sequestration.

To reduce greenhouse gas emissions, aid in the agricultural sector's adaptation to climate change, and maintain healthy ecosystems, organic farming gives a method of addressing these issues that takes into consideration their complexity and encourages a systemic approach. The organic movement's overall purpose was to build food systems that are environmentally friendly for healthy farms, healthy people, and a healthy world. This movement is fundamentally based on a holistic view point. Growing the conversion to organic farming has significant advantages, like enhancing system resilience to climate change, and can help lower greenhouse gas emissions, conservation of soil fertility, mitigation of eutrophication and water pollution, preservation of farmland biodiversity, enhancement of food security, and preservation of farmers' sovereignty. Taking a food systems approach is essential, concentrating not only on agriculture production mitigation but also taking consumption trends and optimal resource usage into account. A more sustainable and climate-friendly food system and agricultural output are made possible by organic farming, less use of concentrated nourishment and animal-derived goods, and decreased food waste.

According to the 2022 IPCC (Intergovernmental Panel on Climate Change) report, agroecological techniques promote biodiversity, ecosystem services, food security, and human health and well-being.1

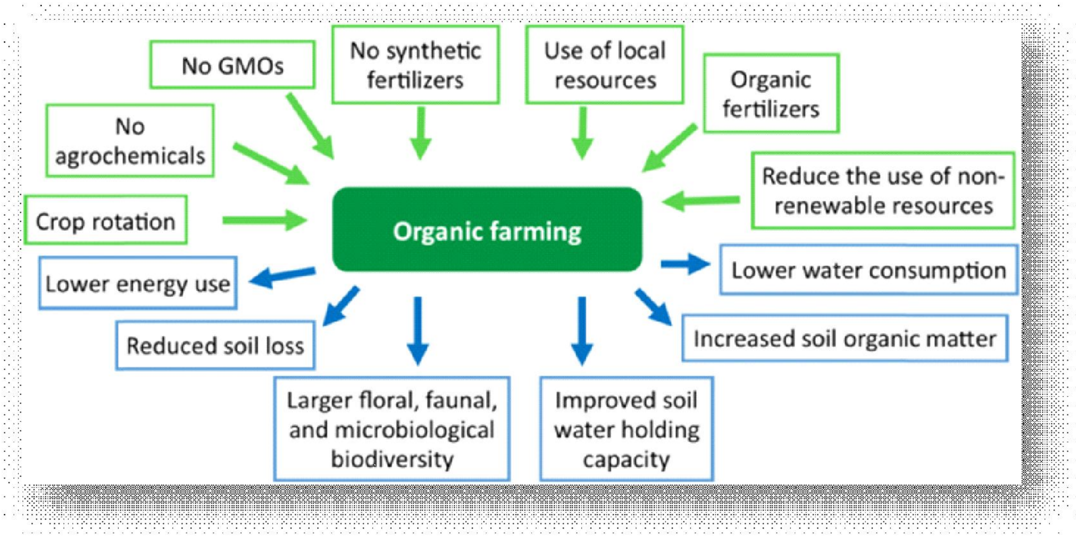


Fig. 1 The main practices and effects of organic farming

Litrature Review:

Emil Debuschewitz & Juern Sanders (2022) have revealed in their research paper **"Environment of Organic agriculture impact and the controversial scientificdebates"** For a long time, the scientific community has engaged in contentious debates on the environmental effects of organic agriculture. Regarding the extent to which organic agriculture may assist in addressing resource and environmental issues, as well as whether promoting it is a suitable course of action for policymakers looking to address current socioecological issues, opinions remain divided. There is currently no fixed viewpoint on these issues.For a long time, the scientific community has engaged in contentious debates on the environmental effects of organic agriculture. Regarding the extent to which organic agriculture may assist in addressing resource and environmental issues, as well as whether promoting it is a suitable course of action for policymakers looking to address current socioecological issues, opinions remain divided. There is currently no fixed viewpoint on these issues. What explanation is there for this? And does the scientific discourse have a "lock-in"? This research seeks to recreate the scientific discourse on the subject and identify potential explanations for the continued disparities in assessments of organic agriculture's environmental effects. In order to achieve this, n = 93 scientific papers were used as the sample for a qualitative content analysis. Expert interviews were also done in order to confirm the findings of the literature review. What explanation is there for this? And does the scientific discourse have a "lock-in"? This paper's goal is to reconstruct the scientific discourse on the subject and identify potential explanations for why studies on the environmental effects of organic agriculture are still ongoing.

It is conclude that The often-binary opening question—is organic agriculture better than conventional agriculture? is mostly to blame for the divisive discussion. Moreover, the discourse should pay more attention to issues that haven't received enough attention up to this point, such the selection of reference units or ethical fundamental assumptions in empirical sustainability assessments.

Varun dhiman (2020) has revealed in his research article **"Organic Farming for Sustainable Environment: Review of Existed Policies and Suggestions for Improvement"** that Globally formulated environmental regulations take into account the significance of organic farming in attaining sustainable development of

setting. Organic farming now has a net annual sales value of 40 billion US dollars, reflecting the significant increase in environmental concerns associated with current agricultural practices. However, the organic industry hasn't yet reached its maximum potential. Because organic farming contributes to the improvement of the environment's natural health, there is a clear correlation between it and environmental sustainability. This essay aims to examine the historical changes in the organic farming industry, the application of the sector to the attainment of a sustainable environment, and a review of international legislation pertaining to the same, along with some specific recommendations for the advancement of organic farming.

Udeshna Buragohain (2020) has revealed in his research paper **"Importance of Organic Farming in Economy with Special Reference to Sikkim"** that, Chemical fertilizers, pesticides, and genetically engineered crops are the three threats that jeopardize our food security. These chemical fertilizers are subsidized by the government through the use of tax revenue. The government purchased chemical fertilizers at a cost of 98000 crore rupees in 2009. Despite giving the plants nourishment, chemical fertilizers are hazardous for the plants. Moreover, it percolates into the groundwater and mixes with it. Farmers utilize chemical insecticides in addition to chemical fertilizers. This insecticide kills a variety of beneficial organisms in addition to the targeted bug. Nowadays, people are becoming more aware of their health. They are willing to spend more for high-quality, chemical-free products. Products made from organic materials have the ability to meet modern needs.

In this paper, they attempted to examine the value of sustainable farming in light of the world's expanding population as well as how it may be a vehicle for economic growth.

Anshika (2020) has revealed in her research paper **"The Role of Organic Farming in Rural Development"** that Organic farming is being acknowledged as one of several viable models for the environmental, social, and financial sustainability of agriculture by policy makers, consumers, farmers, and environmentalists. Organic farming has lately been suggested to provide benefits for rural development through increased employment and stronger ties to the local economy, which can help to reestablish the link between producers and customers and create positive economic multipliers. Customers, farmers, environmentalists, and administrators are beginning to see organic agriculture as one of several potential models for the environmental, social, and financial sustainability of agriculture. With Organic farming becoming more and more important. In more recent times, there has been an argument made that organic farming can help with rural development by creating more jobs and strengthening ties with the community's economy, which can help to reunite producers and consumers and create positive economic multipliers

Eva-Marie Meemken & Matin Qaim (2018) given a interesting point in their research work **"Organic Agriculture, Food Security, and the Environment"** that, Expanding organic farming would result in more habitat loss and higher output costs, which would lower the cost of food for low-income people in developing nations. While combining conventional and organic farming practices could lead to sustained productivity increases in global agriculture, organic farming is not the only approach to sustainable agriculture and food security. Expanding organic farming would result in more habitat loss and higher output costs, which would lower the cost of food for low-income people in developing nations. While combining conventional and organic farming practices could lead to sustained productivity increases in global agriculture, organic farming is not the only approach to sustainable agriculture and food security.

Nadia El-Hage Scialabba & Maria Muller-Lindenlauf (2010) have revealed in their article **"Organic agriculture and climate change"** There is an inherent potential for organic farming systems to improve soil carbon absorption and lower greenhouse gas emissions. The careful control of nutrients, and consequently the decrease in N2O emissions from soils—the most significant single source of direct greenhouse gas emissions from agriculture—represents a significant potential contribution of organically managed systems. In addition to developing techniques to lower methane emissions from intestinal fermentation, further study is required to better understand and quantify the consequences of producing organic paddy rice. By avoiding mineral fertilizers, organic systems can lower its indirect greenhouse gas emissions.

Ultimately, higher income possibilities for producers are provided by certified organic products, creating a based on markets incentive for responsible environmental behavior. Growing the organic farming sector would help and encourage environmentally friendly farming methods all throughout the world. Nonetheless, in order to fully realize the potential and apply organic agriculture on a wide scale, research and development investments are required.

Objective of the Study:

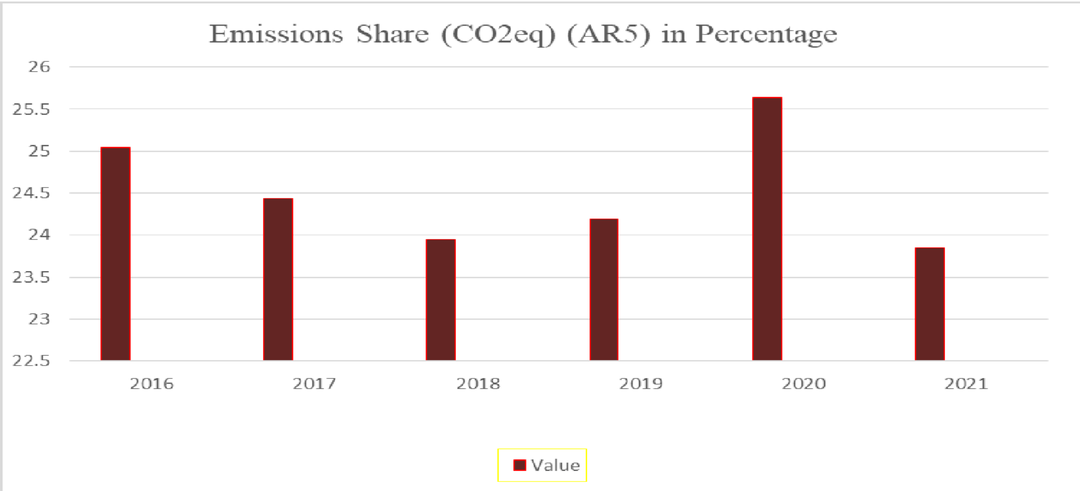
- ❖ To study of Impact of Organic farming on Environmental Sustainability.

Research Methodology:

This study report makes use of secondary data. Data has been gathered from a variety of sources, including books, government publications, theses, and research papers.

Data Analysis:

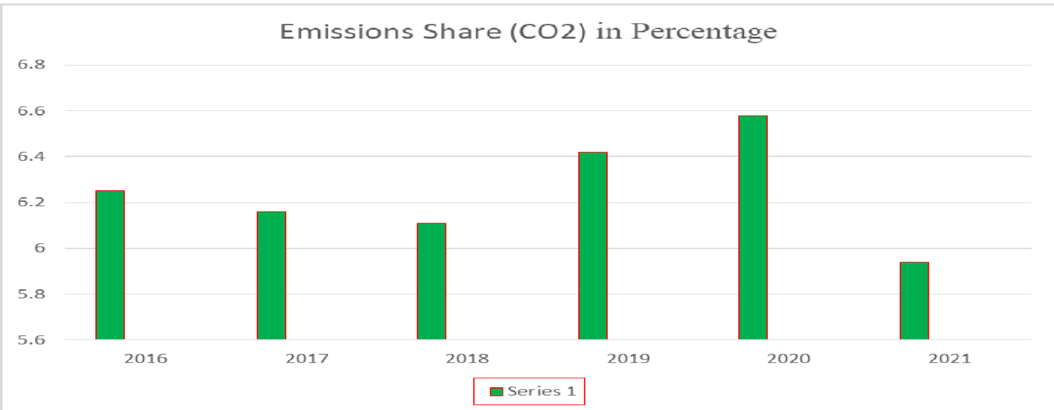
Graph – 1



Source: FAOSTAT (Food and Agriculture Organization Corporate Statistical Database)

The graph above illustrates the percentage of greenhouse gas emissions, specifically CO2eq (Carbon dioxide equivalent) that have occurred in the agriculture sector for the period of 2016 to 2021.

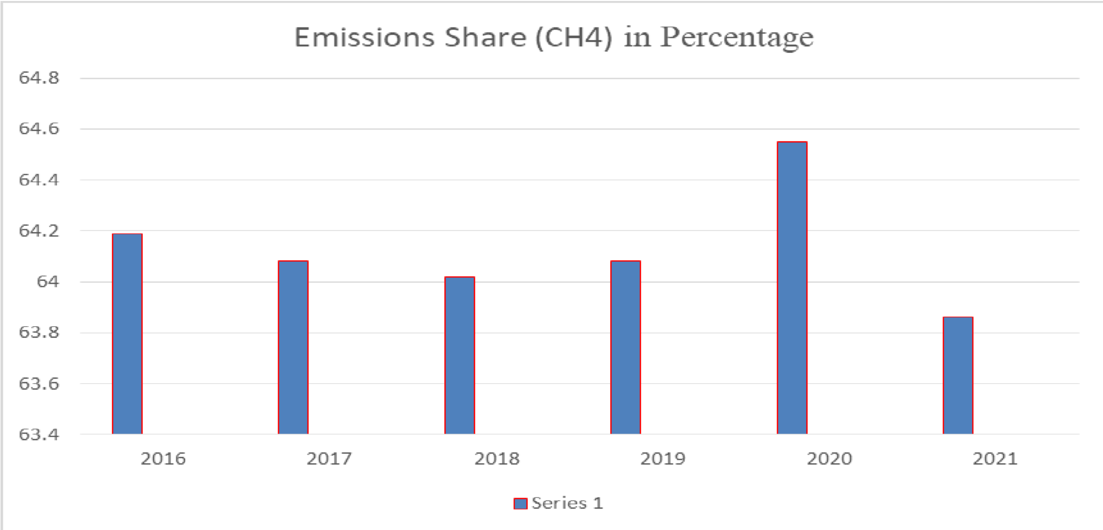
Graph - 2



Source: FAOSTAT (Food and Agriculture Organization Corporate Statistical Database)

The graph above illustrates the percentage of greenhouse gas emissions, specifically CO2, that have occurred in the agriculture sector for the period of 2016 to 2021.

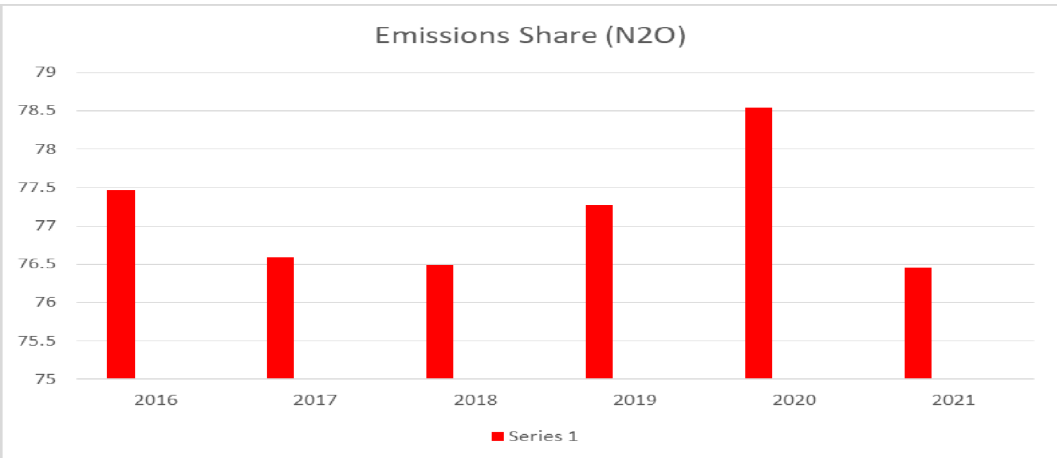
Graph - 3



Source: FAOSTAT (Food and Agriculture Organization Corporate Statistical Database)

The graph above illustrates the percentage of greenhouse gas emissions, specifically CH4, that have occurred in the agriculture sector for the period of 2016 to 2021.

Graph - 4



Source: FAOSTAT (Food and Agriculture Organization Corporate Statistical Database)

The graph above illustrates the percentage of greenhouse gas emissions, specifically N2O, that have occurred in the agriculture sector for the period of 2016 to 2021.

Table 1

Green House Gases Average growth rate (Last 6 Yrs) in Percentage

Green House Gases	Average growth rate (Last 6 Yrs) in Percentage
CO2eq	24.51
CO2	6.24
CH4	64.13
N2O	77.13

In the above graph, data of the last 6 years was taken from the Food and Agriculture Organization of United Nations, in which it is shown that the emissions of greenhouse gases due to chemicals, pesticides and fertilizers used in the agricultural sector, including CO2eq, have increased in the last 6 years. The average increases are 24.51%, CO2 is 6.24%, CH4 is 64.13% and N2O is 77.13%. In which the amount of CH4 and N2O is highest, whose emissions in the agricultural sector are mainly due to the chemicals, pesticides and fertilizers used, which are responsible for climate change as well as degradation of environmental stability.

The evidence provided makes it abundantly evident that the excessive use of herbicides, pesticides, and fertilizers in the agriculture sector is releasing greenhouse gases into the atmosphere, severely damaging the sustainability of the environment and contributing to both global warming and climate change. The world would be better off solving this issue through organic farming since it involves growing in a totally natural manner. It has the power to stabilise and safeguard the environment as well as provide a healthy and better future for everyone because it does not utilise chemicals, fertilisers or pesticides. We have attempted to make clear in this study article the significance of organic farming's current role in environmental conservation.

Conclusion:

We have attempted to draw the conclusion that the indiscriminate use of pesticides, herbicides, and fertilizers in the agricultural sector is contributing to an increase in greenhouse gas emissions, which is concerning for the stability of the environment, based on the data that has been presented and the relevant literature review. Consequently, organic farming is a superior solution to this issue since it will maintain both the soil's and the human body's health. India's goal of having zero carbon emissions by 2070 and our own sustainable development goals (SDG 2030) will both be greatly aided by organic farming.

Organic farming promotes soil health and reduces soil erosion by 20 to 25 %. It protects water bodies by reducing nitrate leaching by 30 to 40 %. Organic farming has a positive impact on crop pollination and natural pest control and its also reduce climate change and promote environmental sustainability.

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(Footnotes)

1 IPCC (Intergovernmental Panel on Climate Change) report, 2022

Effect of PMUY on Consumption and Production of Liquefied Petroleum Gas and Domestic Air Pollution:

Amalesh Yadav & Dr. Surendra Kumar Gupta

Abstract:

Pradhan Mantri Ujjwala Yojana is a famous scheme provide free LPG gas connection to poorer household of the country. In this study we are studying the change in effect of cooking fuel on livelihood of poorer household of the country and this scheme is also improve environment because this scheme is provide clean cooking fuel to poor household which are used large amount of traditional hazardous fuel for cooking purposes. In this study we are studying about effect of PMUY scheme on domestic air pollution which are affect the quality of life of cooking person female, child and their other family member also. Indian poorer household are suffering from cough, eye, cardio logical and skin related problem also which are important to good health and well-being. In this study we are also analyze the change in production and consumption scenario. In this paper we are study about targets of clean energy access in Sustainable Development Goal and Millennium Development Goal. This scheme is very important to achieve environmental sustainability because this distribution of free LPG connection to poorer household from 2016 and continue till now. In this study we are also discuss the adaptation, accessibility and affordability challenges of clean cooking fuel about poor household of the country. In this paper we are focus on environmental challenges and how to help in improvement in environmental challenges of the world. This study is divided in four section. First section is related to introduction, second section is related to literature review, third section is related to data analysis and last and fourth section of this study is related to conclusion, findings and suggestion.

Keyword- *LPG, affordability, adoptability, accessibility, environment, PMUY,*

1.Introduction:

A large number of Indian household are suffering from low level and uncertain income and LPG consumption for a poor family is challenging task and use of traditional fuel are harmful for women, child and old age person also because these are living in home and affected from its and indoor air pollution are very harmful and it can be up to 10 time worse than outdoor air pollution in India it can be up to 13 time worse because due to lake of space in home. In South Asia India, Pakistan and Bangladesh all making the list of top 10 countries with the highest concentration of the air pollution. In 2019 1.7 million death in India due to air pollution like smog emission from motor vehicle, industries and construction but indoor air pollution is significant source of disease. By 2030 united nation committed to achieve clean and modern energy access to entire household of the world in SDG 7. In 2018 83% of total world household are covered from electricity which are raised to 90% in year 2019. So Indian government launch the free electricity connection scheme on 25 September 2017 to provide APL and BPL family of rural areas and poor family of urban areas which are known as SAUBHAGYA "Sahaj Bijli Har Ghar Yojana" for achieve the target of sustainable development goal number 7 which are ensuring the access of clean and modern energy and technology on affordable price to all. And provide free LPG connection scheme PMUY. Pradhan Mantri Ujjwala Yojana is a booster scheme for LPG penetration in India. Before launching the PMUY scheme LPG coverage status of India about 62% in year 2016 but after implementation of PMUY scheme in year 2016 LPG coverage status of India goes up to about 99.8% in year 2021 this reflect the consciousness of the government about adaptation of clean cooking fuel for poorer family of India. This scheme is very important to adaptation of clean cooking fuel to the poor family of India because of subsidy of 1600 rupee provided by government and 1600 rupee loan provided by oil marketing company this amount recovered by cutting the LPG costumer are increases time to time from 1486 lakh in 2015 to 3140 lakh in 2023. Bottling capacity of India is also increases from 2014-15 because of LPG penetration taken as mission mode by government from 2016 with launching the most popular Pradhan Mantri Ujjwala Yojana Scheme. Production and consumption of LPG are increases with time but after implementation Pradhan Mantri Ujjwala Yojana scheme consumption and production of LPG are increases sharply. In year 2009 Indian government instruct to oil marketing company for expand the number of LPG distributor in rural areas because LPG coverage in rural areas was very low. So oil marketing company distribute the LPG agency in rural areas this is reduce the access problem of LPG. In year 2015 government launch the "Give it up" scheme for voluntary left the subsidy on LPG riffle. January 2015 to May 2016, 4% registered LPG consumer give the voluntary resignation from LPG riffle subsidy.

1.1 Production pattern of LPG

Production capacity has also increased slowly but continuously from 2008 but after implementation of Pradhan Mantri Ujjwala Yojana in year 2016 production capacity increased rapidly. LPG production in India during 2015 was 9.84 MMT and after PMUY production capacity boom to 12.82 MMT in 2020 because PMUY is a best performing scheme to penetrate LPG uses as primary cooking fuel for poorer household of the country. PMUY influence the consumption of LPG for poor household and enhance the production of LPG and improve the production capacity of LPG. So production of LPG are increased from 2015 to 2020 but because of COVID19 pandemic LPG production reduced from 2020 and at this time LPG production are 12.24MMT in 2022. In India production capacity are continuously increased from 2008 because of guideline of government in year 2009 to oil marketing company for providing LPG connection in rural areas sincerely. So LPG production of India are increased after 2008 to 2020.

1.2 Domestic consumption pattern of LPG India:

India's domestic LPG consumption was very low in previous decades in year 2015 total number of LPG consumer in India was 148.6 million but after implementation of PMUY number of LPG consumer are sharply increases and this time number of active LPG consumer is 314 million in 2023. So LPG consumption of India are continuously increases from 2015-16 due to PMUY because Pradhan Mantri Ujjwala Yojana provide free LPG connection to the poorer family of India and this scheme are very success to adaptation of LPG as primary cooking fuel. Before this 85% Indian household was used traditional fossil fuel like cow dang, wood, coal and bio mass because of lack of affordability due to low level of income, accessibility of LPG at door step and low awareness about LPG uses. In this scheme government provide 50% subsidy on total cost 3200 of LPG connection and rest of this 1600 loan provided by oil marketing companies majorly Indian Oil Corporation, Bharat Petroleum Corporation limited and Hindustan Petroleum Corporation limited to the consumer. In this scheme consumer get free LPG connection on only 1600 rupees loan by OMC which are recover by cutting the subsidy amount which are provided by Indian Government on refile. This scheme is related to poorer household and large number of poor are live in rural area's so Indian government instruct oil marketing company to expand the LPG distributorship in rural area because 85% rural household was used traditional fuel as a primary cooking fuel in 2008 and after this LPG distributorship are increases in rural area and as well as LPG consumer are also increases in rural area but due to low level of income LPG consumption are very difficult to poor household so government launch the PMUY scheme to providing free of cost LPG connection to the poor household and after this domestic LPG sale are rapidly increases which are 16041 thousand metric ton in 2015 and 25381 thousand metric ton in 2023 because of LPG penetration to the poor household and accessibility of LPG. In year 2014 total number of LPG distributor in India was 13896 after PMUY this number has been increased to 25385 in 2023 because PMUY is one of the Dream project of Indian government.

2.Literature Review:

In This study we are studied various authentic site which are publishing report and news on clean cooking fuel as well LPG coverage and its impact on environment. After analyzing the previous reports and news we are says that LPG penetration in India are increasing and LPG production and consumption of LPG are increases also but rate of LPG consumption and production are rather then LPG penetration. Sale of domestic LPG in India are increasing from 16041 TMT in 2014-15 to 25381 TMT in 2022-23 and number of bottling plants increased from 184 in 2014 to 208 in 2023 (MOPNG). This is shows the change in fuel consumption pattern of rural household because PMUY scheme majorly based on rural sector due to higher unavailability rate of clean cooking fuel. And extension of distributorship from 9365 in 2008 to 25385 in 2023(LPG Profile Report April 2023). LPG distributorship increasing from 2008 in rural area due to instruction of central government to oil marketing companies to expand their distributorship in rural areas. In year 2019 1.7 million people died in India from air pollution like smog emission from motor vehicle, construction and industry but indoor air pollution are dominant cause of death. (Mahima Jain et. all 2023). And many other various research reports are studied which are relevant to satisfy our objectives.

2.1 Objective –

1- To analyze the change in production and consumption pattern of LPG from 2016.

2- To analyze the coverage of LPG before and after PMUY.

3- To analyze the effect of 'Give it up' scheme in succession of PMUY Scheme.

2.2 Methodology:

This study is descriptive and analytical in the nature and based on the secondary data which are published by government of India and other organization like PPAC, MOPNG and another reliable internet site such as Statista, and more sites. Data published on official websites which are related to LPG are collected mainly from 2014 to 2023.In this study various tools and technique, chart graph, diagram, growth rate have been used to reach the valid conclusion.

3.Data Analysis:

3.1 Production of LPG:

Production pattern of liquefied petroleum gas was very slow in previous century after independence to before preparation of Indian government to expanding LPG connection to rural area in 2008. And instruct to all oil marketing companies to expand their distributorship in rural areas. After this production pattern of LPG has been changed and bottling capacity has been increased also. LPG production in 2015 was 9.84 million metric tons (MMT) which are raised to 10.56 MMT in 2016 and continuously increases from implementation of PMUY scheme in May 2016 by Honorable Prime Minister Namenda Damodar Das Modi and contemporaneous petroleum minister Mr. Dharmendra Pradhan at Balia district of Uttar Pradesh. Higher LPG production level in India was 12.82 million metric tons (MMT) in 2020 but after COVID 19 pandemic lockdown production level goes down to 12.07 million metric tons (MMT) in year 2021 and 12.24 MMT in 2022 and 9.84 million metric tons MMT) in 2023.

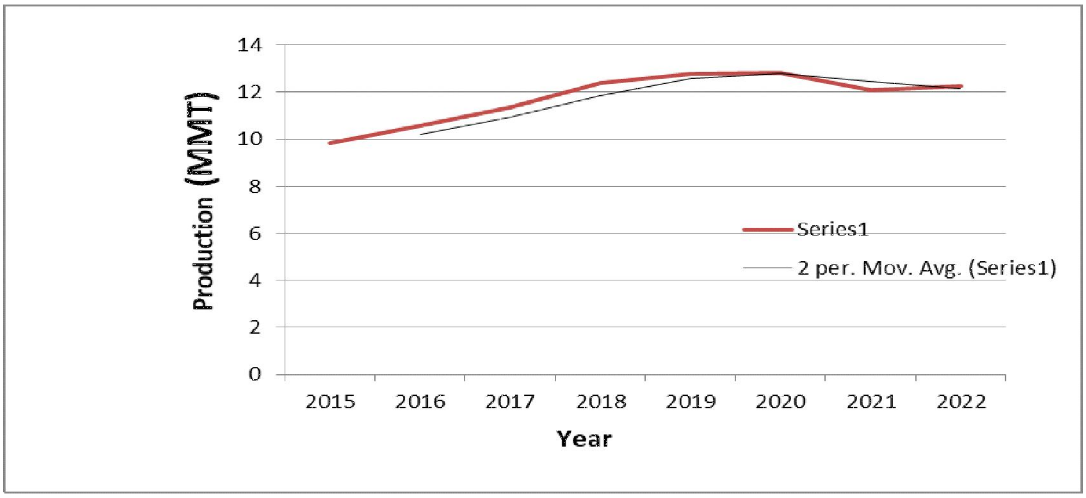
So after PMUY production level of LPG has been increases exempt to COVID 19 lockdown recession.

Production of LPG during 2015 to 2023

Year	Production of LPG (MMT)
2015	9.84
2016	10.56
2017	11.33
2018	12.38
2019	12.79
2020	12.82
2021	12.07
2022	12.24
2023	9.84

Source- statist, India: LPG production volume in 2022 | Statista

Graph Number -01



-This graph is based on table number 01

This graph is shows the production behavior of LPG in India. In this figure we are shows the continuous increase in production of LPG from 2015 to 2020 and after this production level reduces because of lockdown in the world due to COVID-19. But after this pandemic all sectors including LPG are recovering the previous level.

3.2 Domestic LPG sale in India:

Pradhan Mantri Ujjwala Yojana in the context of LPG penetration and LPG uses because domestic sale of LPG in India was 16041 thousand metric tons (TMT) in financial year 2014-15 but after implementation of PMUY domestic sale of LPG increased at 25381 thousand metric ton (TMT) due to providing free LPG connection to the family head of poorer household of the country. This scheme is demanding higher establishment of LPG bottling plants for fulfillment of LPG demand due to PMUY scheme and awareness about LPG uses playing very important role for LPG penetration in India. This awareness campaigns was recognized by the oil marketing companies in chunk of 2100 campaigns in all over India for aware to people for using clean cooking fuel.

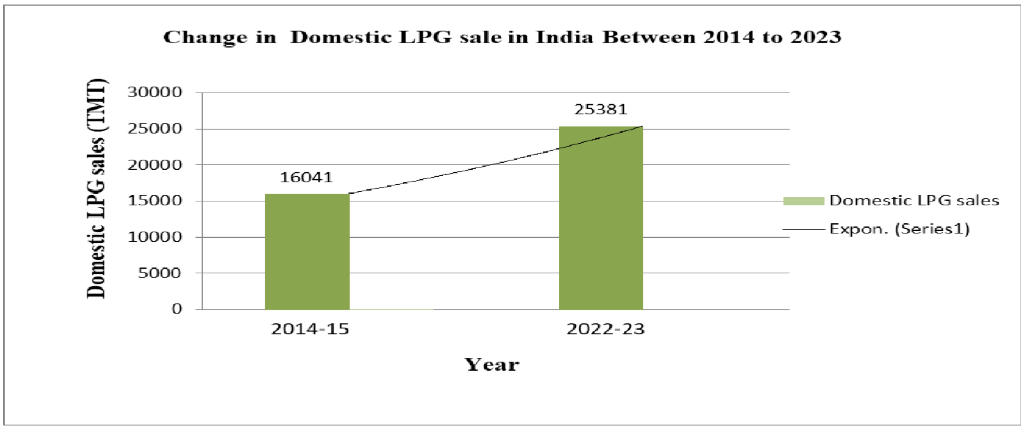
Change in Domestic Sale of LPG Between 2014 to 2023

Table No-02

Year	Domestic LPG sale (TMT)
2014-15	16041
2022-23	25381

Source- Ministry of Petroleum and Natural Gas.PMUY, https://www.pmuy.gov.in/index.aspx

Graph no - 02



This graph is based on table no. 02

3.3 Active Customer of LPG:

Active domestic LPG customer are increasing from independence but rate of increasing was very low before implementation of PMUY but after this active domestic customer of LPG are increases due financial support of 1600 rupees by Indian government as subsidy and 1600 rupees loan provided by the oil marketing companies which are recover by deducting subsidy amount which are granting by the government on LPG riffle. So poorer household of the country are covering in this scheme to achieve clean cooking fuel. Creamy layer of the country always using LPG before PMUY and subsidized LPG connection because this class have no issue with affordability, accessibility and adoptability because these can be beer to upfront cost of LPG and aware about your health and long run effect of traditional fuel uses and these are already have motor vehicle so doesn't matter that how to achieve LPG at door step.

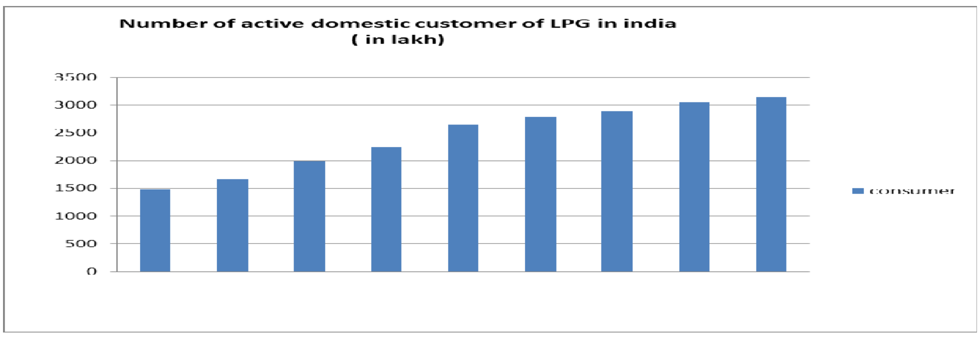
Number of Active Domestic LPG costumer from 2015 to 2023 (In lakh)

Table Number-03

Year	Number of Active Domestic LPG customer (in lakh)
2015	1486
2016	1663
2017	1988
2018	2243
2019	2654
2020	2787
2021	2895
2022	3053
2023	3140

Source- LPG Profile Report 1 April 2023, LPGProfile01042023- 12122023.pdf

Graph No- 03



This graph is based on table number 03

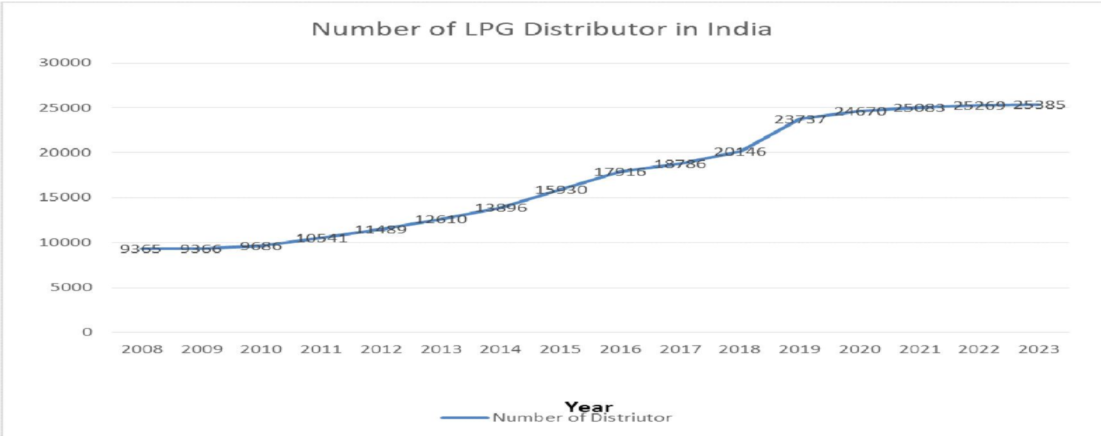
Growth of LPG distributor during 2008 to 2023

Table No- 04

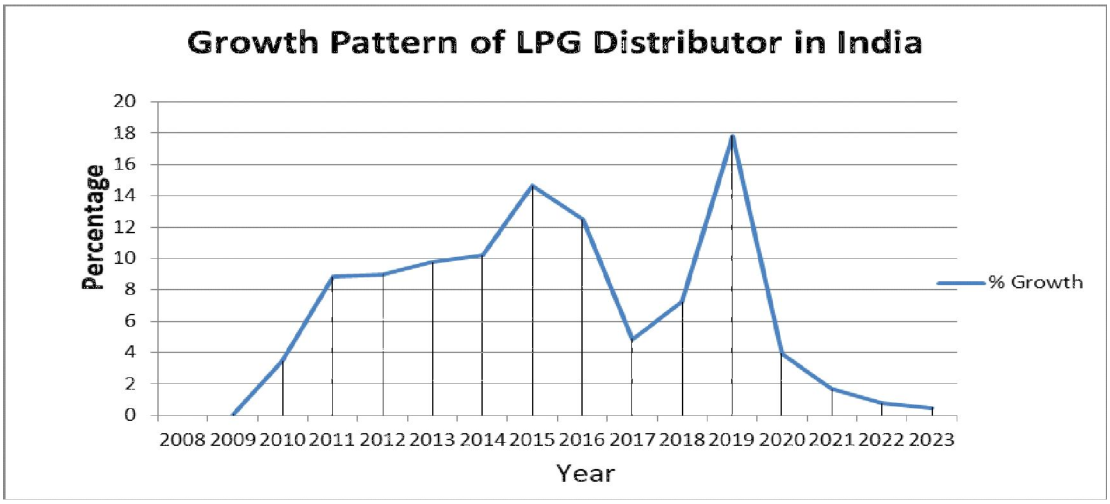
Year	Number of LPG Distributor	% Growth
2008	9365	------------------------
2009	9366	0.01
2010	9686	3.45
2011	10541	8.83
2012	11489	8.99
2013	12610	9.76
2014	13896	10.19
2015	15930	14.64
2016	17916	12.47
2017	18786	4.85
2018	20146	7.23
2019	23737	17.82
2020	24670	3.93
2021	25083	1.67
2022	25269	0.74
2023	25385	0.45

Source- LPG Profile Report 1 April 2023. LPGProfile01042023- 12122023.pdf

Graph Number-04(A)



Graph Number 4(B)



Both Graph 3A and 3B are based on table number-03

In the above graph we are showing the growth rate of LPG distributor from 0.01 in 2009 to 8.83 in 2011 and 14.64 in 2015 these are shows the increasing with increasing rate but after 2015 growth rate of LPG distributor goes down to 4.85 in year 2017 but after this 17.82 in year 2019 and 0.45 in year 2023. Growth rate of distributor are sharply increases from 2008 because government of India committed to zero hunger and environment sustainability which are targeted in Millennium Development Goal and modern energy access and technology at affordable price to all in sustainable Development Goal 7.

4. Summery of the study

4.1 Finding of this study:

- LPG coverage are increasing continuously and boom in 62% in 2016 to 104% in 2022.
- LPG distributorship has been increases from 2008 due to government intervention.
- Total domestic sale of LPG are highly increased from 16041 to 25381 TMT after implementation of PMUY.
- Growth rate of LPG distributor are increases from 9.84 in 2008 to 17.82 in 2019 after this growth rate slow at this time.
- Indoor air pollution are the major issue for live so PMUY scheme are better performing for poorer household of the country.
- Women are empowered from this scheme due to financial inclusion by the subsidy amount. Subsidy amount on LPG riffle are transfer to bank account of beneficiaries.

4.2 Conclusion:

In this study we find the impact of PMUY scheme on various objects.

Consumption- In this study we are studied the trend of consumption of LPG on the basis of domestic sale which are increasing continuously from 2014. In 2014 total domestic LPG sale in India was 16041 thousand metric tons (TMT) and after PMUY implementation total domestic LPG sale increased at 25381 thousand metric tons (TMT) in 2023. LPG coverage of all over India in 2016 was 62% and after PMUY LPG coverage are sharply increases at 104% in 2022 which are shows the impact of this scheme. Before implementation of PMUY scheme government of India launch the very important scheme name as “Give it up”. In this scheme4% register LPG consumer are voluntary resign the subsidy on LPG riffle and help to government for providing free LPG connection to the poorer household of the nation. After PMUY LPG coverage of India are goes up to 100% which are decline the use of hazardous fuel like cow dang cake, crop west, wood, and other solid fuel for cooking purpose. In a study shows the emission of smog from Chulha which are traditional type of making food in rural area. Former Finance Minister Arun Jetly says that “In an hour Chulha emitted smog equal to 400 sigrate smog” in 2016.

4.3 Suggestions:

- ❖ Enhance the subsidy amount on LPG riffle because higher price of LPG are challenging task for poorer household.
- ❖ Improve monitoring system for entire steps of the PMUY scheme for providing free LPG connection avail to actual eligible household.
- ❖ Recognize awareness program to understand the bad effect of using hazardous fuel and good effect of using clean cooking fuel.
- ❖ Build the new plants of LPG for providing cylinder just at time to time and India have largest population of the world so demand of LPG will be increase in future.
- ❖ Expand the distributorship among rural areas because LPG coverage are increasing for providing LPG riffle at time to time.
- ❖ Improve chain system of door step delivery for net and pure LPG provide at door step.

Reference:

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An analysis of India's Health Sector with a Special Context of Asymmetric Information

Suraj Prakash Mishra and Dr. Harshmani Singh

Abstract

Healthcare information asymmetries necessitate all-encompassing approaches that focus on increasing openness, strengthening patient education and health literacy, encouraging patient-provider shared decision-making, putting laws in place to guarantee equitable pricing and quality standards, and investing in technology that makes it easier for stakeholders to communicate and exchange information. Healthcare systems can strive toward more patient-centred, cost-effective, and fair care by tackling these issues. The informality that already existed in the healthcare industry has been made worse by the COVID-19 pandemic. Physicians frequently have to utilize heuristics to diagnose and treat patients due to information asymmetry. Better patient outcomes will come from the deployment of procedures and solutions that disarm hidden biases and remove the requirement for surface-level data by surfacing insights into care unit operations ahead of time. Applications using artificial intelligence (AI) are used to track records that have been reported, retrieved, or expired.

Keywords- *Asymmetric information, health care, health issues, moral hazard, non-communicable disease.*

Introduction

In the context of the health sector, asymmetric information refers to circumstances in which one party—typically the patient or the provider—possesses more information than the other, which results in disparities in the allocation of resources, decision-making, and outcomes. There are various ways that this information asymmetry can appear:

Patients frequently lack the medical knowledge and proficiency that healthcare professionals possess. Due to a lack of knowledge, patients may come to mostly rely on the advice of

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medical professionals without completely comprehending their alternatives or the potential consequences of certain therapies.

Patients might not know much about the calibre of the medical professionals, facilities, or therapies that are available to them. Patients' decisions may be influenced by providers' access to additional information regarding their qualifications, success rates, and the efficacy of various therapies.

It is common for patients to be unaware of the whole cost of healthcare services, including operations, drugs, and treatment alternatives. Patients' decisions may be influenced by providers' greater understanding of insurance coverage, pricing structures, and possible out-of-pocket costs.

Adverse selection happens in the insurance markets when people with higher risk profiles or more extensive medical requirements are more likely to look for insurance. Insurance companies may encounter knowledge asymmetry on the health state of prospective policyholders, which can make it difficult to manage risk and establish fair premiums.

Because they only pay a small portion of the expenses, people may start using healthcare services excessively or participate in risky behaviours after getting insurance. Information asymmetry about people's choices and behaviours may make it difficult for insurers to appropriately evaluate and reduce these risks with effective ways and measures. Compared to patients or government agencies, researchers and pharmaceutical corporations may have greater knowledge about the efficacy and safety of medications or medical procedures. Decisions concerning medication approval, treatment protocols, and patient care may be impacted by this knowledge imbalance.

Aiming to improve transparency, improve patient education, encourage shared decision-making between patients and providers, implement regulations to ensure fair pricing and quality standards, and facilitate information exchange among stakeholders are often necessary interventions to address asymmetric information in the health sector. The negative consequences of information asymmetry on healthcare outcomes and delivery can be lessened with the use of tactics including risk adjustment mechanisms in insurance markets, quality reporting initiatives, price transparency laws, and health literacy programs.

Review of Literature

Modern healthcare systems rely heavily on medical equipment to help with disease and medical condition diagnosis, treatment, and monitoring **(Kale 2019; James and Jaiswal 2020).** There is a huge demand for these devices due to the magnitude of India's population, but there is also a sizable supply gap **(Peter 2018).**

During the 2014 "Make in India" campaign, the medical device industry was designated as a focus area **(Deloitte 2016).** However, these activities have not produced the expected outcomes due to a lack of funding, a lacklustre R&D ecosystem, inconsistent rules, bureaucratic approval processes, disparate manufacturing standards, and restricted capital **(Dang and Sharma 2019; Saini et al 2022)**. On May 2, 2023, the union government passed the National Medical Devices Policy after realizing the difficulties caused by escalating and unaffordable import expenses and accessible medical technology **(Mahal et al., 2006).**

The Indian medical device market is expected to increase significantly, reaching up to $50 billion by 2025 from its estimated $10–$12 billion in 2020 **(India Brand Equity Fund, 2022).** Regrettably, the nation's internal demand for devices is mostly met by imports. Policymakers should focus on this issue right away due to the low per capita income and sizable impoverished population **(Bhat et al 2019).** Japan, China, Germany, and the United States (US) are India's top suppliers of medical devices. The imports were estimated to be worth $6.3 billion in 2020. Additionally, the nation exports medical gadgets worth about $2.7 billion to key export destinations like the US, Europe, Africa, and Southeast Asia. These devices are sold in foreign markets.

It is one of the top 20 worldwide medical device markets and the fourth-largest market in Asia. Less than 2% of the world market is occupied by the nation; the US leads with 40%, followed by Europe and Japan with 25% and 15% of the worldwide market, respectively **(KPMG 2020).**

In the absence of any particular laws, medical devices were previously governed by the Drugs and Cosmetics Act of 1940, according to a study by **Manu and Anand (2022).** The Indian Medical Device Rules were introduced by the CDSCO in 2017 to close this gap. These regulations were modified to become the Medical Devices (Amendment) Rules, 2020, which went into effect in April 2020 to keep up with changing requirements.

These detailed regulations cover a wide range of device-related topics, including post-market obligations, labelling, sales, manufacturing and import, registration, and categorization.

Medical technology accounts for between 30% and 40% of the establishment expenditures of a typical hospital **(Saini et al 2022).** The availability of healthcare facilities is significantly impacted by the high cost of medical technology **(Datta and Chauhan 2020).** Considering that out-of-pocket expenses (OOPE) account for over 60% of all healthcare costs in India, this is still a major issue of concern **(Kumar et al 2023).** Particularly for the poorer and middle-class populations, the enormous expense of a single high-end medical item in a life-threatening circumstance forces them into poverty **(Reddy and Qadeer 2010; Kumar et al 2023).**

Building national MFLs has been approached differently by different nations, and a basic problem in HIS design is the unique identification of health facilities. information infrastructures should be considered instead of information systems **(Nguyen et al., 2015; Hanseth, 2010).** Conventional information systems were usually connected to discrete, stand-alone entities that could only be used by a small number of people and had a limited lifespan. An electronic patient registration system that solely focuses on patient registration, for instance, is insufficient because it must interface with multiple other systems, including blood banks, radiography, and laboratories.

An information infrastructure perspective emphasizes how modifications to one area of the infrastructure affect the operation of other areas and enables us to view these various systems and their interconnections as a whole. Richer insights into the architecture and operation of distributed, complex systems can be gained from an information infrastructure perspective.

With the launch of the National Rural Health Mission in 2005, India initiated systematic national HIS reforms. Among the initiatives were the standardization of reporting and recording formats, the creation of a data dictionary and reporting guidelines, the execution of an extensive program to enhance capacity, and the deployment of a centralized web portal **(Mishra et al 2012).**

By 2010, these initiatives contributed to the National Health Management Information System (HMIS) portal's monthly reporting requirement for all public health facilities **(MoHFW 2011).**

Due to the portal's inability to adapt to these changes and the program data needs that were constantly changing, there was a simultaneous proliferation of systems at the federal and state levels **(Sundararaman et al 2012).**

To achieve this, the present top-down governance model must be drastically altered in favour of a more bottom-up, collaborative approach where standards and procedures are approved according to their applicability and contextual fit. To help provide guidelines on facility standards, rules, protocols, and mechanisms, a national-level committee under the MoHFW with representation from all major stakeholders and voting rights would be supported by working groups (that is, standards, technology, and policy) with the involvement of users and experts. Additionally, to support the daily operations of the site, a full-time, committed team of professionals from the healthcare and technology domains is needed.

The 2016 publication of the first-ever National Mental Health Survey (henceforth NMHS) **(NIMHANS 2016a, 2016b, 2016c)** brought mental health in India to a previously unheard-of level of public attention. As to the report, there is an 83% treatment gap overall for mental health problems (NIMHANS 2016a), and approximately 1 in 40 people and 1 in 20 people, respectively, suffer from previous and current depression. **(NIMHANS 2016b: 16)**

Declaring that "90% of Indians in need simply don't receive mental health care," the President of India warned against a "possible mental health epidemic" and discussed the need to make mental health treatment a "national mission" in 2017, citing data from the **NMHS (Press Information Bureau 2017).**

According to the Press Information Bureau **(2017)**, 11,54,686 qualified allopathic doctors were registered in India in 2018 under the state and national medical councils **(GoI 2019a).** This information was provided during the speech given by the Hon. President of India Shri Ram Nath Kovind on the occasion of the 21st World Congress of Mental Health. This compares to a doctor-to-population ratio of approximately 0.89 per 1,000 people, which is less than the 1:1000 recommended by the World Health Organization (WHO). When AYUSH physicians and dental surgeons are included, the ratio approaches the "finishing line." 10,926 people were served by government allopathic doctors on average **(GOI 2019a).** More than 80% of all specialists—surgeons, obstetricians' gynaecologists, physicians, and paediatricians—are in insufficient supply at CHCs (community health centres), and more than 74% of PHCs lack a female physician. Just 4% of PHCs have four or more physicians, and only 9% of CHCs have a combination of all four specialities (GoI 2017–18).

Impact of information asymmetries on healthcare

Healthcare information asymmetries can have a big influence on patients, providers, the healthcare system as a whole, and overall health outcome. Among these effects are the following: Variations in healthcare service quality might result from information asymmetry. There could be differences in the quality of care because patients don't know enough about the various providers or therapies available to them. Individuals who have restricted information access may find it difficult to decide on the best course of treatment. This can make inequities in access to care worse, especially for vulnerable or marginalized communities where getting information and resources may already be more difficult.

Asymmetry in the availability of information may lead to either excessive or insufficient use of healthcare services. Due to ignorance or insufficient information, patients may undergo needless tests or treatments, which could have negative effects and raise healthcare expenses. On the other hand, if patients don't know about the value of preventative care or the range of treatment alternatives, they might decide not to receive the necessary care. Due to information asymmetries on healthcare expenses and insurance coverage, patients may experience financial hardships. Patients may find it difficult to plan for and manage out-of-pocket costs in the absence of clear price information or awareness of insurance benefits, which could put them in financial difficulty and result in debt from medical bills.

Asymmetric information can lead to an ineffective distribution of healthcare resources. Incomplete information regarding patients' medical histories, preferences, or treatment results may cause providers to allocate resources and provide care that is not optimal. By aggravating already-existing differences in healthcare outcomes, quality, and access, information gaps can be a contributing factor to health disparities. Information asymmetries may disproportionately impact vulnerable groups, including low-income people, members of racial or ethnic minorities, and people with low health literacy. The patient-provider relationship's trust can be damaged by information asymmetry. If patients believe that their healthcare practitioners are hiding information from them or making decisions without fully consulting them, they may feel powerless or suspicious. Shared decision-making and effective communication can help reduce these trust-related problems.

To address this, the government finances and provides healthcare in many nations. Health technology organizations also exist to increase efficiency. The principal-agent dilemma that results from informational asymmetries still exists, though, and one example is the absence of cost consciousness among clinicians. The following analytical model assumes that the doctor has private information and knowledge about medical assistance that leads to moral hazard and adverse selection issues in their relationship, but it does not distinguish between asymmetric information and asymmetric competence impacting the patient-doctor relationship. In other words, the patient only has probabilistic knowledge about the doctor's efficiency and is unable to track the doctor's level of effort.

First, the important variables and objective functions of the doctor and the patient are given within the framework of one-sided knowledge asymmetry. In other words, it is considered that the doctor is the one with access to the patient's personal information.

Health sector status in India

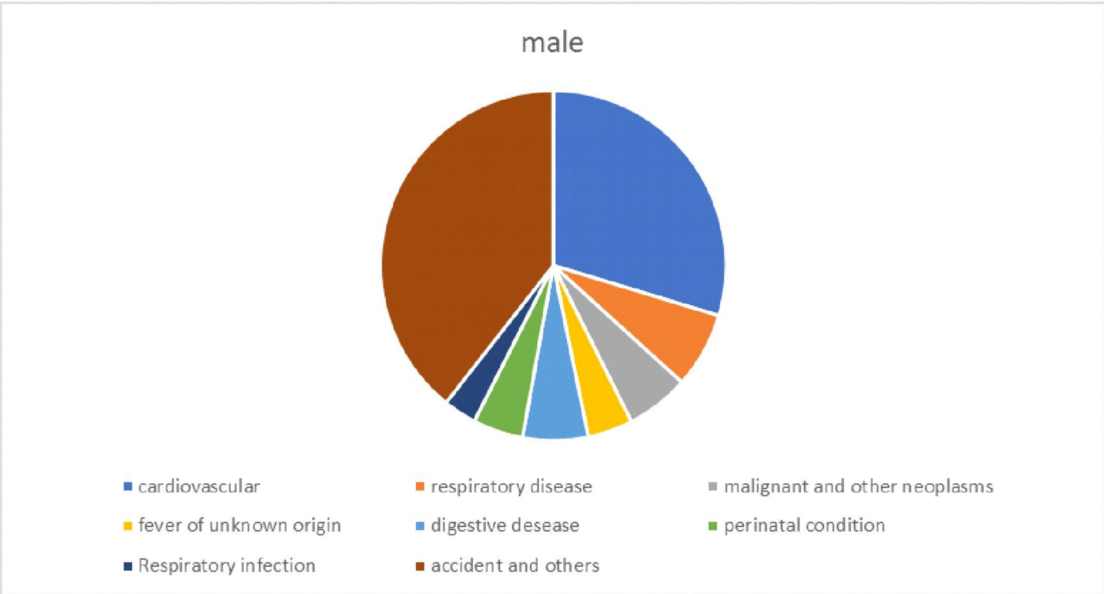
Non-communicable diseases (NCDs) accounted for 65% of all fatalities in India in 2019 (IHME 2019). As indicated by DALYs1, the proportion of non-communicable diseases (NCDs) to the overall illness burden rose from 31% in 1990 to 55% in 2016, while the proportion of communicable and other diseases decreased in tandem. According to the WHO Factsheet on NCD 2021, the most common NCDs worldwide are cancer, chronic respiratory illnesses, diabetes, and cardiovascular diseases (CVD). Well-known NCDs like cirrhosis, diabetes, ischemic heart disease, stroke, and chronic obstructive pulmonary disease (COPD) all showed significant growth in India between 2009 and 2019.

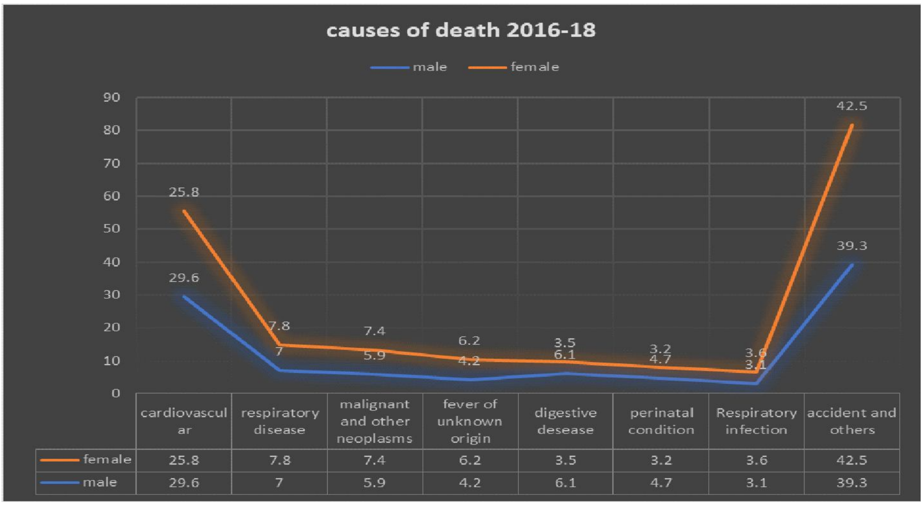
The most troubling trend is the rise in diabetes-related mortality in the nation, accounting for 54% of all deaths. Conversely, infectious diseases exhibit a decline in the same time frame.

Between 2009 and 2019, there was a notable increase in the illness burden due to metabolic risks associated with non-communicable diseases (NCDs), such as high blood pressure, high fasting plasma glucose, high body mass index (BMI), and behavioural hazards like alcohol and tobacco use. The National Medical Devices Policy, 2023 was introduced by the union government to enhance the proficiency, aptitude, and ability of the domestic medical device manufacturing sector.

TOP TEN CAUSE OF DEATH

Causes of Death	Male	Female
cardiovascular	29.6	25.8
respiratory disease	7	7.8
malignant and other neoplasms	5.9	7.4
fever of unknown origin	4.2	6.2
digestive disease	6.1	3.5
perinatal condition	4.7	3.2
Respiratory infection	3.1	3.6
accident and others	39.3	42.5



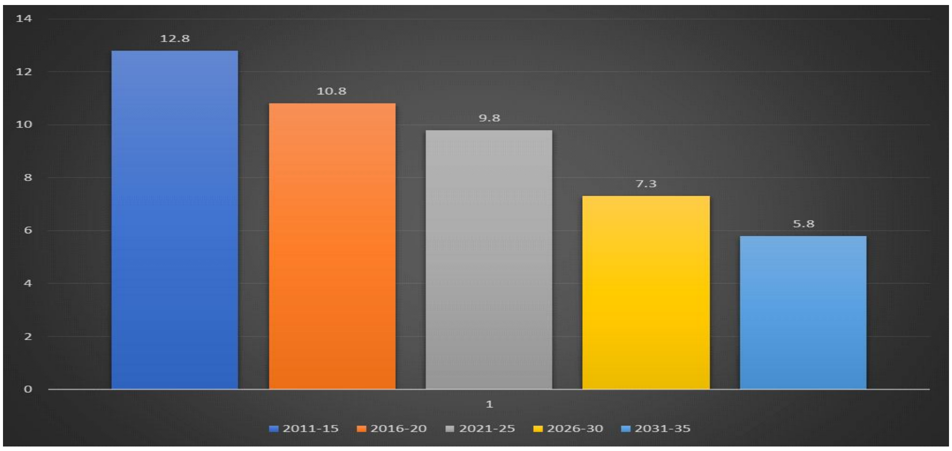


Source -National Health Profile 2022

EXPECTED POPULATION GROWTH

YEAR	EXPECTED POPULATION GROWTH
2011-15	12.8
2016-20	10.8
2021-25	9.8
2026-30	7.3
2031-35	5.8

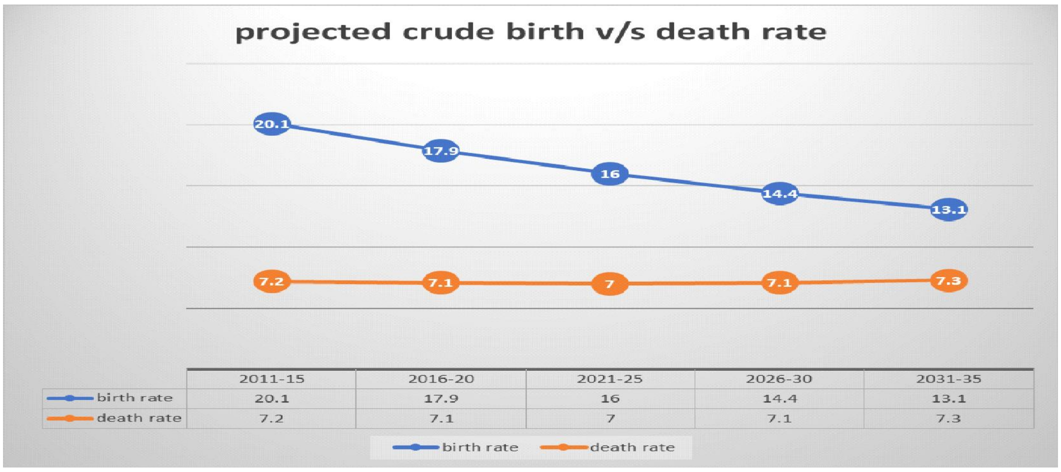
Source- National Health Profile 2022



YEAR-WISE PROJECTED CRUDE BIRTH RATE V/S CRUDE DEATH RATE

YEAR	BIRTH RATE	DEATH RATE
2011-15	20.1	7.2
2016-20	17.9	7.1
2021-25	16	7
2026-30	14.4	7.1
2031-35	13.1	7.3

Source – National Health Profile 2022



YEAR-WISE SUICIDE RATE IN INDIA

YEAR	SUICIDE
2011	134599
2012	135585
2013	135445
2014	134799
2015	131666
2016	133623
2017	131008
2018	129887
2019	134516
2020	139123
2021	153052
2022	164033

Source – National Health Profile 2022

To improve the information flow and transparency between patients, healthcare providers, and other stakeholders, removing information asymmetries from the health sector entails several measures. Here are a few methods: Patients are more equipped to make decisions when they are informed about their rights, treatment alternatives, and medical conditions. Workshops, internet resources, and patient education materials can help achieve this.

To ensure that patients understand their diagnosis, treatment plan, potential hazards, and available options, healthcare providers should engage in open and transparent communication with their patients. This entails speaking clearly and staying away from medical jargon. Patients can actively engage in their healthcare decisions when they have access to their test findings, treatment plans, and medical records. Patient portals and electronic health records (EHRs) make this access easier.

Regulations and standards that encourage transparency and accountability in healthcare practices can help to lessen information asymmetry. regulations for conflicts of interest, price transparency, and medical result disclosure are a few examples of this.

Investing in projects to enhance health literacy in the general public can enable people to better navigate the healthcare system, ask educated questions, and advocate for themselves. To promote open and honest interactions with patients, healthcare personnel should undergo training in shared decision-making, patient-centred care, and effective communication techniques. Patients can make better decisions if they have access to unbiased information about medical research, treatment options, and healthcare providers from independent organizations and platforms.

Patients can obtain healthcare services more easily and the information flow between them and doctors can be enhanced by utilizing technology to support remote consultations and monitoring. Interest alignment and the reduction of information asymmetry can be achieved through the implementation of payment structures and incentives that incentivize healthcare providers to offer high-quality care and transparently disclose outcomes.

Investigating and Creating: Putting money into research to create new tools and processes for sharing information in the healthcare industry can result in creative ways to deal with information asymmetry.

By putting these tactics into practice, health sector stakeholders can strive to lessen information asymmetry and advance an open, patient-centred healthcare system.

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Economics of Sustainable Development: Gandhian Philosophy

Prof. (Dr.) Vikramdev Acharya and Dr. Vidushi Sharma

Introduction:-

The Model of Sustainable Development is multidimensional. It comprises the sustainability of natural, agricultural and economic resources and economic organization based on an equitable and participatory vision of development which recognizes the environment and natural resources as the foundation of economic activity. Agriculture is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate and based on a holistic scientific approach.

According to the United Nation's **Sustainable Development Solutions Network**, in 2023, Bharat has been ranked 112 out of 162 countries in terms of the SDG Index with a score of 63.45 out of 100. Compared to 2019, India's position has improved by 3 and its score by around 3 points.

Gandhi Mahatma, the father of the nation had advocated the model of sustainable development. He used to emphasize on the sustainability of economic and natural resources. Gandhi Baba was of such a strong opinion that **"The Earth provides enough to satisfy the need of everyone, but not the greed of anyone."** He tried to convince the people that Nature is our mother. She feeds us. Whatever we have or keep that has been gifted by her. We should pay due regard to her accordingly. He was against the western culture of consumerism. He referred to follow the principle of trusteeship for the sustainability of resources. The root causes of environmental degradation in various regions of the world must be identified and addressed.

Action plan for sustainable development:- Project Action

1. Revitalizing Growth with Sustainability (The Prospering World)

- ❖ Accelerating Sustainable Development — International Policies , —Domestic Policies

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Integration of Environment and Development in Decision Making

2. Sustainable living (The Just World!) –- (1) Combating Poverty (2) Changing Consumption Patterns

(3) Demographi dynamics & Sustainability (4) Health

3. Human Settlements (The habitable World!)— (1) Human settlements (2) Urban Water Supplies

(3) Sewages and Solid Waste Mgt. (4) Urban Pollution & Health

4. Efficient resources Use (The fertile World!) – (1) Land resources (2) Fresh Water Resources (3) Energy (4) Sustainable Agriculture & Rural Development (5) Sustainable Forest Development (6) Managing Fragile Ecosystems—

(a) Combating Desertification & Drought. (b) Sustainable Mountain Development

(c) Sustainable Development of Coastal Areas. (d) Sustainable Development of Islands

(7) Biological Diversity (8) Environmentally Sound Mgt. of Biotechnology

5. Global and regional resources (The Shared World!)—

(a) Atmosphere (b) Oceans & Seas (c) Sustainable Living Marine Resources

6. Managing Chemicals and Waste (The Clean World!)

(a)Toxic Chemicals (b) Hazardous Waste (c) Radioactive Waste

7. People Participation and Responsibility (The peoples' World!)

a)Education, Training & Public Awareness (b) Strengthening the Role of Major Groups:-

Women; Youth; Indigenous People ; NGOs; Farmers; Local Authorities; Trade Unions; Business & Industry ; Scientific & Technology Community.

Sustainable Living:-

The nations of the world have begun to realize that the Earth's carrying capacity is finite, and that global consumption, production, and demographic patterns must become sustainable as a result, if future generations are to live healthy, Prosperous and satisfying lives. Achieving sustainable living for all requires an environmentally responsible global approach to modify these unsustainable patterns, involving efficiency and waste minimization changes in production processes, less wasteful consumption, reducing demographic pressures and ensuring access to health care. Alleviating poverty is a moral imperative and is essential for sustainable development.

Science &Technology for Sustainable Development:-

Science & Technology play a key role in development and will be required in all areas and programmes to ensure that policies are based on accurate information. Scientific research will be needed to assess global changes, monitoring of various resources etc. National and international scientific capacities and capabilities need to be supported and strengthened. Cost of support for science is expected to be in the reason of $ 2.8 billion per year.

Scientific knowledge should be applied to articulate and support the goals of, sustainable development, through scientific assessments of current conditions and feature prospects for the Earth system. Such assessments, based on existing and emerging innovations within the sciences should be used in the decision making process and in the interactive processes between the science and policy making. **Sustainable Use of Living Marine Resources:-**

There is wide spectrum of different of life forms in the oceans. About 20,000 species of freshwater and saltwater living resources have been identified while many more species remain to be discovered .Of the roughly 9,000 species that are harvested; only 22 support significant fisheries. The commercial harvested, only 22 support significant fisheries. Over 80% of the commercial harvest is marine catch, mainly from the coastal and shelf seas within the Exclusive Economic Zone (EEZs) as outlined in the law of the Sea convention. The high seas fisheries represent only about 5% of total word landings.

The sustainable use & conservation of marine living resources are of social, economic and nutritional important as they can make a significant contribution to national food security. The use of marine species for human food should be increased by promoting direct consumption, avoiding wastage and improving techniques of harvest, handling and transportation. As the world's population will increase to some 6.3 billion by the year 2000, it is necessary to maximize food production from all sources, especially in light of exiting pressure on agricultural land resources.

Demographic Dynamics & Sustainability:-

The world's population reached 5.4 bn in mid-1991. Of these, 77% lived in developing countries and 23 % in developed countries. In the 1960s the global population was growing at about 2.1 per cent annually and this has now declined to some 1.7% per year. The number of people added to the total each year. The number of people added to the total each year, now amounting to 92 million, is higher then ever before. It is projected that world population will reach some 6.3 billion people in the year 2000 and 8.5 billion in the year 2025.

Over 90% of the population increase today occurs in developing countries having risen from 1.7 billion in 1950 to 4.2 billion in 1991, and expected to reach nearly 5 billion people in the year 2000 By the year 20000, some 2.0 billion people in the developing world will be living in urban areas, with over 40 percent of Africans and Asians (excluding Japan) and 76 percent of Latin Americans urbanized. Of the worlds 20 large cities, 17 will be in the developing regions. At present over 40 percent of the urban population in the developing world lives in squalor, without access to essential services such as health care. The migration of large numbers of people within countries and across national boundaries will, more than likely, continue to increase , driven by a combination of factors , including population growth , concentration of wealth and land , poverty and economic polarization .

Sustainable Human Settlements Developments:-

Urban Human Settlements absorb 2/3rd of the total population increase in the developing world. At this rate, close to 2 bn people will populate the urban areas of developing countries by the year 2000, of which some 600 million will have been added during the present decade alone. Another 2 billion people are expected to be added to be urban population of developing countries between 2000 and 2050.

For most city dwellers in the developing, living conditions are worsening as a result of the inability of the city or national government to provide satisfactory services for drinking water, sanitation, solid waste disposal, solid waste disposal, transport and energy for cooking and heating. Fir the urban poor, the environmental priorities remain improved housing and the provision of basic health care, water and sanitation services at affordable costs.

Shelter is fundamental to an individual’s physical, psychological social and economic well being. The Global Strategy for shelter to him year 2000, adopted by the General Assembly of the United Nations in Decembers 1988, requires much greater political and financial support and technical assistance to enable it to research its goal of providing adequate shelter for all by the end of this century. Developing countries should adopted national shelter strategies focused on the use of new and innovative financing mechanisms, such as specific housing schemes. They should support the shelter efforts of the poor and vulnerable groups by facilitating their access to land, reforming existing codes and regulations, financing and building materials and actively promoting and regularization and upgrading of informal settlements. At the national level, the implementation of these national levels, the implementation of these national shelter strategies should be monitored and adopted to changing conditions.

Sustainable Agriculture & Rural Development:-

Hunger & Malnutrition are endemic among developing countries. By the year 2020 about 84 % of the expected global population of 8.5 billion will be living in developing countries. The fundamental challenge facing agriculture in developing countries today is to increase food production in a sustainable way and feed expanding population. Such an increase has to come primary through intensification of current agricultural production, as the potential for bringing new land under cultivation in many countries is very limited. If hunger is to be eventually eradicated in these countries, this intensification must be both ecologically and socio-economically sustainable.

Agriculture is an important sector, if not the backbone, of the national economies of many developing countries, sometimes representing the measure share of export earnings. Over the next 10 years this sector will bear most of the responsibilities for providing rural economic with sufficient growth to offer implement and other remunerative activities to the bulk of their population without this growth , the present rural – urban exodus is certain to accelerate , leading to unmanageable urban squalor and in all likelihood , major socio-political upheavals. Hence the need for sustainable off-form rural development is also critical.

Sustainable Forest Development:-

Increasing attention is being given to the condition of the world's forests and to the they play in local economics and quality and life. While public concern has focused for several years tropical forests, it is now clearly accepted all types of forests should be taken into consideration.. Deforestation is a result of many causes some natural but mainly due to human development such as in appropriate land tenure system and incentives, expansion of agricultural areas increasing forest product demand and lack of information and understanding on the value of forest.

In a program for the sustainable development of forests and woodlands, the first priority should be to secure the multiple roles of trees, forests and forest lands by strengthening national institutions and capabilities to formulate and implement effectively policies, plans, programmes and project relevant to forest issues. The scope and effectiveness of conservation and forest expansion activities should be enhanced, and the sustainable production of forests goods and services in both developed and developing countries should ensure.

Global Action for Women towards Sustainable & Equitable Development:-

Women's crucial role in sustaining the environment and their real and potential contribution to economic development and political decision-making continue to be inadequately addressed. Although many environmental movements throughout the world have been led by women, they are poorly represented in decision making activities and sector related to environment and development, and has been generally excluded from many of the critical decision making bodies at both national and international levels. Ensuring sustainable development requires women's empowerment and their full, equal and beneficial involvement in decision making processes related to sustainable development.

Strengthening the Role of Children & Youth in Sustainable Development:-

Youth (between 14 and 30 years of age) comprise nearly 30% world's population. The majority of the over 1.2 billion youth in developing countries face a difficult future, since often their very basic needs have not been met as children, thus leaving them under equipped for adult life for example, a mere 23% of the world's youth complete secondary education, only 9% of whom live in developing countries. In the industrial world, youth unemployment jump faster than any other society presently reaching levels well over 28%in some countries.

Urban Water Suppliers:-

Today some 2.4 billion people in the world live in urban areas. In the developed world, most of the 900 million urban populations are served with water piped into their homes as well as with municipal sanitation services. In contrast 1.5 billion urban dwellers in developing countries do not have share water, and over 2 billion lack safe sanitation. By the year 2025, the world's urban population is expected to reach over 5 billion, and it is therefore crucial that a high priority be given to the environmentally sound management of water resources.

Role of Rural Energy in Sustainable Development:-

Bicycle & bullocks suggested itself to Mr. Chandrakant Pathak's imagination as a solution was the presence of bicycles and bullocks in nearly every rural house hold. "When I returned one" he said, "I attached a motor pump to an old bicycle and ran it. After a few modifications it worked. It was a real 'eureka' moment for me." In 1995, Mr. Pathak started his own institute, the modern technical centre, in Pune, with the aim of devising gadgets for power self sufficiency in rural areas. Today his first bicycle pump has evolved into several verities of bicycle operated lift and spray pumps to suit different needs.

Mr. Pathak has also devoted considerable attention to is electric power for women. In rural India the entire agricultural an economic system is against women. Women don't own bicycles and bullocks; and even through most of the bicycle powered gadgets invented by Mr. Pathak can be run comfortably by woman, cycling is still anathema for them in many parts of rural Maharashtra. On a sudden inspiration Mr.Pathak landed on the swing – a traditional mode of amusement and play for women and children all over India – as a means of power generation. "The to and fro movement of swing can be used to run a piston pump ten times as powerful as hand-pump".

Need to Generate Power, Not to Buy It:-

The Rural Power-Crisis involves more than just irrigation and very soon Mr. Pathak realize that without the means for actual power production, Rural India can never be power-self-sufficient. Initially he modified his Jaldhara pump by installing a pulley and dynamo on its wheel to generate an electric current the result was what he jokingly calls his 'video coach bullock cart', so called because the power generated by it is sufficient to run a T.V. . At a serious level, this system can be used to charge batteries, which can be use for household power supply in a limited way.

About the power-generation potential of Rural Bharat, Mr. Chandrakant Pathak says that there are some 8, 20,000 bullocks in Maharashtra. Even if just ten percent of these bullocks are put to work on such power-generating machines for two hours a day, plenty of electricity can be produced per day, "So where is the power crisis, tell me?" he asks. There wouldn't be power crisis if we follow Vedic Management.

Conclusion/Findings:

The Wastage of Natural Resources like petroleum, water air has reached to the alarming situation. The huge consumption at large scale of petroleum products has created the risk to finish it in near future within next 20 years. The prices of petroleum products have reached to the unaffordable situation for the common people. The rate of pure water is so high that common people can not afford. After all these, there is no guarantee at all that @ Rs 10/- per liter water is fresh and fit for health. The western culture of consumerism has polluted our ground water as well as air that, these have become harmful for the human beings. The water, air, soil and environmental pollution have generated a very big question for the survival of the universe. If the universe or earth does not exist where will we go? We have to find out the answer. In the field of agriculture & rural development, the organic farming is only the solution to remove the soil, air and water pollution. Biogas, solar, wind & other non conventional source of energy are better option.

Sustainable Agriculture uses locally-available renewable resources, appropriate and affordable technologies, and minimizes the uses of external and purchased inputs. Sustentation requires environmentally modification to these unsustainable patterns, involving efficiency and waste minimization in production processes, less wasteful consumption. Sustainable agriculture respects the ecological principles of diversity, interdependence and uses the insights of modern science to improve rather than displace the traditional wisdom accumulated over centuries since the human civilization took place by millions of farmers around the world.

The Sustainable Use & Conservation of Marine living resources are of social, economic and nutritional important as they can make a significant contribution to national food security. More attention will have to give to these issues in general policy formulation and the design of development plans regarding environment. Sustainable support of rural development may accelerate national growth. Since developing countries do not have sufficient resources and technologies, so they should adopt comprehensive strategies focused on the use of innovative financing mechanisms. Spontaneous & continuing innovation is needed. Management of Waste Resources can be very much fruitful for the S.D.

Peace, diplomacy, and international cooperation are fundamental conditions for the world to progress on the SDGs towards 2030 and beyond. For the second year in a row, the world is no longer making progress on the SDGs. A global plan to finance the SDGs is needed. At mid-point on the way to 2030, policy efforts and commitments supporting the SDGs vary significantly across countries, including among G20 countries. The interactive SDR 2022 Dashboards provide a visual representation of countries' performance by SDG to identify priorities for action.

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future.

At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

The global outlook is uncertain. The world economy has shown resilience, but in most countries near- and medium-term growth outlooks remain subdued and downside risks are elevated. In the context of tightening monetary policy stances to bring down inflation, successive shocks, including Russia's war on Ukraine, are weighing on the economy and on macro-financial stability, including financial sector stress. Inflation has moderated somewhat, but underlying price pressures remain sticky.

Recommendations/Suggestions

The natural world is very complex, with many intricate relationships between species and habitats that we do not always fully understand. Maintain the pattern of interdependent relationships between the various parts of the living world. It is essential for the health of the planet as a whole so vital that we ensure all these components are functioning properly. In biological diversity, India is one of the richest countries in the world. But widespread destruction has already taken place and this is continuing. Urgent measures to reserve the damage are both necessary and possible.

Special attention is to be paid to the introduction of the smart industry concept in the universities that are doing applied research and educate professionals for labor markets. The reform of higher education has constantly been postponed for various political reasons. Digitation will also be needed in the system of higher education and when linked to the big data, one can talk about smart education. There is no point of memorizing facts but learning how to use ICT to search for knowledge sources. Knowledge can be quickly become obsolete with technology changing that fast.

We need to focus on Hybrid Green & Renewable Energy Resources specially Solar, Waves, Cow-dung based CNG & Hydrogen Energy etc. We need special attention to develop the Nano Particles Technology to reduce the cost of solar panel –cells to make it accessible for all in open market without subsidy.

The time has come to leave up the waste model of west and to opt our ever tested model of Sustainable Development for innumerable years (billion/trillion years). In agriculture sector model of Sustainable Development is followed and applied the VDS (Village Centric Development Strategic) Model, using the organic farming & traditional pattern, the cost of agricultural input can be reduced to the minimum level even zero (provided exclusion of labour cost). Thus profit can be maximized. Resultant the prosperity & glorious past of our BHARAT as Golden bird/ Jagat Guru can be brought back again. Our target as developed nation and the economic growth rate of more than 10% can be achieved easily.

Gandhian Philosophy for Sustainable Development is still relevant as it was earlier. Its golden period for Bharat that we have Innovative Visionary Prime Minister Sri Narendra Modi who is integrated approach and follows the Gandhian Socio , Economic, Cultural & Vedic Philosophy for Sustainable Development.

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Environmental and Socio-demographic Factors Associated with Vector Borne Diseases in India: Evidence from 76 Thround of NSSO Survey, 2018

Dewanshi Tiwari and Dr. Arvind Kumar Yadav

Abstract:

Background & objectives: The present study was conceptualized with the intent to look at the probability of occurrence of vector borne diseases in the context of demographic, socioeconomic and micro environmental determinants.

Methods: This study used NSSO data from 76th round to predict vector borne diseases. Probit model has been used for analyses of the determinants.

Results: Ten per cent of surveyed individuals reported having suffered from vector-borne diseases and 11.82% and 7.61% population disclosed problem of stagnant water and human feces around the house respectively while 81.73% households faced problem of flies and mosquitoes in past one year. Age, education, wealth index, sector, caste and religion played an important role in determining vector borne diseases. Additionally, micro environmental factors such as disposal of household garbage, households facing concerns of stagnant water, human excreta observable around the household, existence of animal shelter/poultry farm, and ventilation in household also played critical role for vector borne diseases

Interpretation & conclusion: Filling up the existing research gaps regarding qualitative research and implementation research, coupled with designing and strengthening intervention strategies for environmental sanitation and hygiene is the need of the hour.

Keywords: *Vector Borne Diseases, Environmental factors, NSSO data, Probit Model, India*

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1. Introduction

World Health Organization (WHO) estimates show that more than seven lakh people die each year from vector-borne illnesses, which account for more than 17% of all infectious diseases1.Individuals can contract vector-borne infections through contact with vectors such as mosquitoes, ticks, flies, bugs, and aquatic snails2.The risk of vector borne diseases is even greater than before due to urbanization, climate change, globalization, distorted land utilization patterns (e.g., deforestation)and increased global travel and trade across the world3.These societal, demographic and ecological factors have altered patterns of pathogen spread, causing further amplification, geological spread and changes in transmission dynamics. Inadvertent urbanization, lack of consistent piped water supply, and poor solid waste disposal, may expose huge populations in urban areas to spread of viral infections through vectors like mosquitoes. These factors collectively affect the distribution of the populations of vectors and the transmission behaviors of disease-causing pathogens4.

According to the Global Burden of Disease study, 775,000 individuals died prematurely in 2017 as a result of poor sanitation, which plays a critical role in the transmission and distribution of vector-borne diseases5,6,7. The prevalence of vector-borne diseases is highest in tropical and subtropical areas, where it disproportionately affects the poorest communities5. A convoluted interaction of demographic, ecological, and societal determinants influences the distribution of these diseases8. Malaria, Dengue, Chikungunya, Filaria, Japanese Encephalitis and Kala azar are the major vector borne disease in India. The Water, Sanitation, and Hygiene (WASH) strategy has received little acknowledgement, and the possibility of connecting WASH initiatives with the transmission of malaria and other neglected tropical diseases (NTDs) has largely gone unused9.The biology, virology and ecology of VBDs have been under investigation for decades, Studies have been conducted on the impact of water and sanitation interventions on different vector borne diseases separately6 but to our knowledge, not many researchers have thoroughly assessed the relationship between water, sanitation, housing, hygiene etc. and vector borne infections as a whole. Hence, the current study was conceptualized with the intent to look at the probability of occurrence of vector borne diseases in the context of demographic, socioeconomic and micro environmental determinants.

2. Methodology

2.1 Data source

The present study is based on data obtained from the76th round of NSSO (National Sample Survey Office). NSSO reviewed 'Drinking Water, Sanitation, Hygiene and Housing Conditions' during July -December 2018. The key objective of the survey was to gather data on provision of drinking water, sanitation and housing facilities available at household level along with review of the micro environment surrounding these houses which are vital determinants of the quality of living conditions of communities taken as a whole. This survey involved the whole of the India except the villages in Andaman and Nicobar Islands which were inaccessible.

A stratified two stage strategy was used during the survey wherein the first stage units (FSU) were villages/blocks/sub-units (SUs) and the ultimate stage units (USU) were households in both rural and urban areas.

3. Variables

3.1 Outcome Variable

The outcome variable in this study was vector borne disease (VBD). This variable was coded as yes if household reported having suffered from malaria/dengue/chikungunya/ encephalitis and no if the household did not report suffering from these vectors borne diseases.

3.2 Predictors

Age, education, place of residence, caste, religion, improved facility for defecation, drainage facility, disposal of garbage, flood experience in last five-years, disposal of children's stool below 5 years and monthly per capita expenditure, were taken as the predictor variables in the present study.

Age was categorized as 0-15 years,16-30 years,31-45 years,46-60 years and 61 and above years and above age groups. Gender was coded as male and female. Further, education was labeled as Up to 5th class, up to 12th class, up to graduation and up to post graduation and above. Religion was coded as Hindu, Muslim and others. Caste was categorized into General, Other Backward Castes, Scheduled Caste and Scheduled Tribe. Place of residence was bifurcated into rural and urban. Monthly Per capita expenditure quintiles were characterized as Poorest, Poorer, middle, richer and richest. Under micro environmental variables; drainage facility was bifurcated into improved and unimproved. Underground and covered pucca type of drainage was considered under improved category while open pucca, open kutcha and no drainage was included in the unimproved type of drainage facility. Method of household garbage disposal was again categorized into improved and unimproved; bio gas plant or manure pit were characterized under improved category while household's individual dumping spot, community dumping spots, common places other than community dumping spots (open/street/open drain) and others were taken under unimproved methods. Households having faced problem of stagnant water, flies/mosquitoes in the last 365 days, where human feces were visible around the household, experience of any flood during last 5 years and adequate ventilation in house were also coded as yes and no.

3.3 Statistical Analysis

Descriptive statistics and multivariable analysis were used in the present study. Percentages were calculated for socio demographic variables and after detecting the distribution of random error term with Kernel Density function, Probit model was used.

4. Results

Table 1 depicts the background characteristics of the study population. Highest percentage (29%) belonged to age group of 0-15 years followed by 27.72% in the category of 16-30 years. Males and females were almost equally distributed in the study population. Only 8.95% subjects were post-graduates or above while one third (37.44%) were at least graduates. Majority were Hindus (74.89%) followed by Muslims (14.46%) and others (10.65%). Around one fourth of population belonged to general category, and a major chunk belonged to other backward classes (41.6%), followed by scheduled castes (16.2%) and scheduled tribes (14.2%). Most of the population lived in rural areas (62.5) and approximately 65% of population reported using unimproved drainage facilities. Only 11.82% and 7.61% population reported problem of stagnant water and human feces around the house respectively. Majority of households (81.73%) faced problem of flies and mosquitoes in the house in last one year. More than 60% of population did not have any poultry farm or animal shed. 8.61% population experienced floods during last 5 years and majority of population (87.96%) had proper ventilation in the household. Only 11.11 % of population suffered from VBDs, rest 88.89% population did not report any VBD during last one year.

Table:1-Background characteristics of the study Population

	Percentage
Age-group	
0 to 15 Years	28.57
16 to 30 Years	27.72
31 to 45 Years	22.51
46 to 60 Years	14
60 Years and above	7.2
Gender	
Male	51.57
Female	48.43
Education	
Up to 5th Class	24.11
Up to 12th Class	29.5
Up to Graduation	37.44
Post-Graduation and above	8.95
Religion	
Hindu	74.89
Muslim	14.46
Others	10.65
Caste	
Scheduled Tribe	14.2
Scheduled Caste	16.2
Other Backward Class	41.6
General	27.2
Place of Residence	
Rural	37.37
Urban	62.5
Monthly Per capita consumption Expenditure	
Poorest	19.89
Poorer	19.45
Middle	20.67
Richer	20
Richest	20

Richest	20
Drainage Facility	
Unimproved	64.93
Improved	35.07
Disposal of Household waste water	
Unimproved	99.56
Improved	0.44
Disposal of Household Garbage	
Unimproved	47.11
Improved	52.89
Household Faced Problem of stagnant Water	
Yes	11.82
No	88.18
Human Faeces are Visible around the Household	
Yes	7.61
No	92.39
Household Faced Problem of Flies/Mosquitoes	
Yes	81.73
No	18.27
Existence of animal shelter/Poultry form	
Attached to House	12.02
Detached from the house	25.67
Not present	62.31
Experience any flood during last 5 years	
Yes	8.61
No	91.39
Ventilation in House	
Yes	87.96
No	12.03
Population suffered with Vector Borne Diseases	
Yes	11.11
No	88.89

Source: Authors' estimation based on NSSO unit level data, 2018

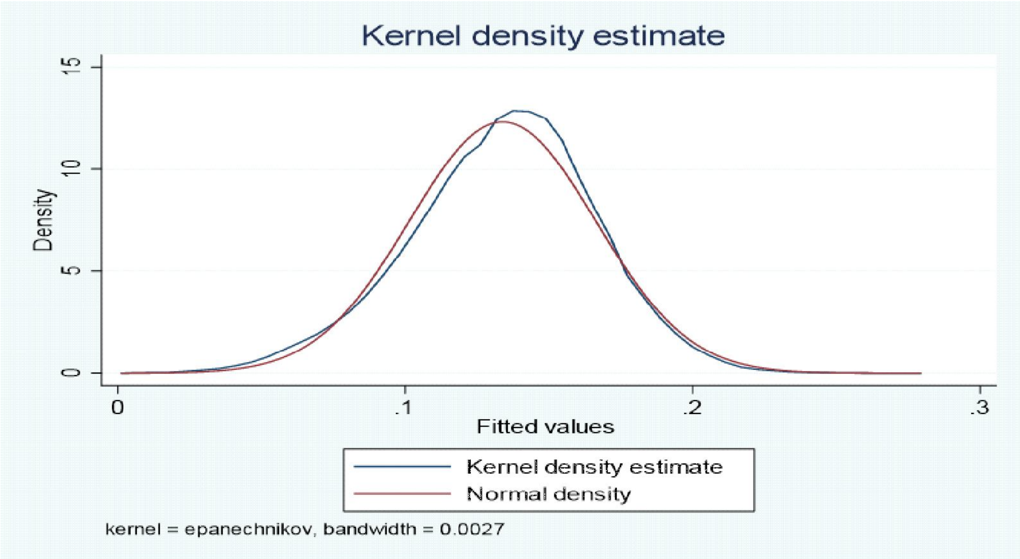

Figure1-Probability Distribution of error term

Kernel density function is showing the normal distribution curve, it means that probability distribution of the random error term is normal.

Table 2 presents the econometric analysis of the impact of Demographic, Micro-Environmental and Socioeconomic factors on vector borne diseases in India. The association between vector borne diseases and demographic factors shows strong relation. The results reveal that the odds of having vector borne diseases is lower among age group of 16-30 years. The probability of having vector borne diseases among males was lower as compared to females. Illiterate population was more likely to suffer from vector borne diseases in comparison to educated population. Muslims and other religious were less likely to suffer from vector borne diseases than Hindus. Population belonging to rural areas had more probability of suffering from vector borne disease as compared to urban population. The odds of vector borne diseases decrease as income level increases. It was observed that households with improved drainage and improved disposal facilities were less likely to contract vector borne disease. Households that faced problem of stagnant water had high chances of vector borne diseases as compared to the reference group. Households that reported facing problem of flies/mosquitoes also had higher chances of contracting vector borne infections. Existence of animal shed/poultry near the household was positively associated with likelihood of vector borne diseases. Households that did not experience any kind of flood during last 5 years and those with good ventilation were negatively associated with vector borne diseases.

Table 2-Effect of Demographic, Micro-Environmental and Socioeconomic factors on Vector Borne Diseases in India.

Predictors	Coef.	SE	Z	P>|Z|	95% CI	
Age: Ref. - 0-15 Years						
16-30 Years	-0.003	0.008	-0.420	0.676	-0.019	0.012
31-45 Years	-0.044*	0.008	-5.760	0.000	-0.059	-0.029
46-60 Years	-0.087*	0.009	-9.970	0.000	-0.105	-0.070
60 years and Above	-0.119*	0.011	-10.470	0.000	-0.141	-0.096
Gender: Ref. Female						
Male	-0.011**	0.005	-2.150	0.031	-0.021	-0.001
Level of Education: Ref. - Illiterate						
Primary	-0.052*	0.007	-7.370	0.000	-0.066	-0.038
Secondary	-0.068*	0.008	-8.960	0.000	-0.083	-0.053
Higher	-0.080*	0.012	-6.580	0.000	-0.103	-0.056
Religion: Ref. - Hindu						
Muslim	-0.025*	0.008	-3.280	0.001	-0.040	-0.010
Others	-0.032*	0.010	-3.300	0.001	-0.051	-0.013
Caste: Ref. - Scheduled Tribe						
Scheduled Caste	-0.051*	0.009	-5.400	0.000	-0.069	-0.032
Other Backward Class	-0.053*	0.009	-6.140	0.000	-0.069	-0.036
Upper Caste Hindu	-0.121*	0.009	-12.820	0.000	-0.140	-0.103
Sector: Ref. Rural						
Urban	0.044*	0.007	6.610	0.000	0.031	0.056
Wealth index: Ref. - Poorest						
Poorer	-0.074*	0.008	-9.730	0.000	-0.089	-0.059
Middle	-0.085*	0.008	-10.840	0.000	-0.100	-0.069
Richer	-0.161*	0.009	-18.580	0.000	-0.178	-0.144
Richest	-0.232*	0.010	-22.570	0.000	-0.252	-0.211
Drainage Facility: Ref. - Unimproved						
Improved	-0.067*	0.006	-10.600	0.000	-0.079	-0.055
Disposal of Household Garbage: Ref. - Unimproved						
Improved	-0.023*	0.005	-4.430	0.000	-0.033	-0.013
Household Faces Problem of stagnant Water: Ref. - Yes						
No	-0.084*	0.008	-10.910	0.000	-0.099	-0.069
Human Faeces are Visible around the Household: Ref. - Yes						
No	-0.211*	0.009	-24.490	0.000	-0.227	-0.194
Household Faced Problem of Flies/Mosquitoes: Ref. - Yes						
No	-0.066*	0.007	-9.810	0.000	-0.053	-0.079
Existence of animal shed/Poultry form: Ref. - Present						
Not Present	-0.272*	0.037	-7.380	0.000	-0.345	-0.200
Experience any flood during last 5 years: Ref. - Yes						
No	-0.050*	0.013	-3.990	0.000	-0.075	-0.025
Ventilation in Household: Ref. - Yes						
No	0.142*	0.006	24.760	0.000	0.131	0.153
Constant	-0.393	0.040	-9.830	0.000	-0.472	-0.315
Number of observations	419,517					
LR chi2	4610.37					

5. Discussion

The relationship of demographic, socioeconomic and micro environmental household determinants with VBDs is tricky, as on one hand, factors such as poor education, lower socioeconomic status, improper drainage, poor garbage disposal , stagnant water, human feces, flies/mosquitoes, animal shed/poultry form and inadequate ventilation in households pose a serious threat for transmission of VBD as reiterated in the present study while on the other hand, suffering from these diseases adversely affects the socioeconomic condition of people further augmenting the already existing health inequalities. The present study focused on the period prevalence of vector borne diseases based on the 76th round of NSSO survey and examined the demographic, socioeconomic and micro environmental factor associated with it.

The findings of the current study show that younger population is at higher risk of vector borne diseases as compared to older age groups. The findings of our study are consistent with another study10. Our results show that among population aged 30 years and above, the odds of vector borne diseases steadily decreased which may be attributed to acquisition of immunity to infectious diseases throughout adulthood. The findings of the present study reveal that females are more likely to suffer from vector borne disease than males. These findings are in tune with other studies11, 12, which may be explained by two factors – first and foremost, women put her own health at risk by caring for other members of their families especially children and secondly women are more likely to seek medical attention than men, resulting in a higher reporting11. However, some studies13, 14 found that males are more susceptible to malaria. While, adult males and females are equally susceptible to malaria, pregnant women are at higher risk of severe malaria15. Men are predominantly engaged in fishing, mining, agriculture, and ranching which puts them at greater risk of exposure to mosquito-borne disease, such as dengue or malaria. Exposure to aedes mosquitoes while working or travelling during daytime which is the peak biting time is one of the likely causes of male excess in adult dengue cases in Singapore16. The findings of our study reveal that education critically affects VBDs in India. Population with higher level of education were less likely to suffer from vector borne disease because they have awareness regarding these diseases and practice appropriate health related behavior regarding the prevention and treatment of VBDs17. As highlighted in the present study, poor people are more susceptible to VBDs since they live in unhealthy and deprived conditions which includes inappropriate infrastructure such as building structure, types of walls, windows, doors and locations18and also have inadequate access to health care services19.In contrast to our results, another study reported higher prevalence in rural communities due to poor waste disposal mechanisms coupled within adequate personal and environmental hygiene practices5.

Our findings suggest that all micro environmental factors affect the probability of suffering from vector borne diseases which reinforces the actuality that improving sanitation facilities around households will reduce the occurrence of VBD. Previous studies are in concordance with this finding5. A study by Harrus & Baneth observed that the deadliest form of malaria (*Plasmodium falciparum)* in the Thar Desert of India was associated with the construction of irrigation canals which reiterates the role of stagnation of water in the transmission of VBDs20. In tune with our findings, other studies also highlight that inadequate drainage facilities, poor disposal of household garbage and problem of stagnant water near the household, favors breeding of mosquitos and flies which propagate the transmission of VBDs6.

The present study has taken self-reported prevalence of the vector borne disease and other health determinants at individual and household level which may be a limitation and the data may also be subject to recall bias.

6. Conclusion:

In the present study, one in ten surveyed individuals reported having suffered from vector-borne diseases in the past one year.11.82% and 7.61% population disclosed problem of stagnant water and human feces around the house respectively and majority of households (81.73%) faced problem of flies and mosquitoes in the house in past one year. Younger age groups, females, being less educated, poor and urban residence were significantly associated with vector-borne diseases.

Households that faced problem of stagnant water, reported facing problem of flies/ mosquitoes and recorded animal shed/poultry near the household were positively associated with likelihood of vector borne diseases while households with improved drainage, improved disposal facilities, that did not experience any kind of flood during last 5 years and those with good ventilation were negatively associated with vector borne diseases.

Multi-pronged population-based interventions, like ecological control, awareness, and mass mobilization through community engagement, have the potential to achieve the desired targets but require sustained inter-sectoral collaborations between major stakeholders. A major determinant of vector-borne disease control is behavioral change. Health education of people is a fundamental pillar especially in low literacy settings. Risk communication, fostering commitment and ownership through community participation and comprehension of health education resources by the masses are prerequisites to the success of any intervention. Customization of interventions according to local need facilitates stronger community engagement e.g., disease control and elimination depend heavily on access to water and sanitation and huge benefits can be reaped by improving the quality of housing by screening out mosquitoes, particularly in urban settings and by reducing the aquatic habitats for Aedes mosquitoes by clearing rubbish and providing regular, piped water so people don’t have tostore water, which provide the aquatic habitats for Aedesaegypti. Especially, in low resource settings, there is an imperative need to give priority to high risk and marginalized populations. Thus, it is understandable that these diseases being majorly environmental diseases, the health care policy managers can endeavor to control most vector-borne diseases by scheming suitable intervention strategies which are in accordance with the living conditions at grass root level.

To conclude, filling up the existing research gaps regarding qualitative research and implementation research, coupled with designing and effectively implementing intervention strategies for environmental sanitation and hygiene is the need of the hour.

7. Policy Suggestions and recommendations:

Currently, disease control funding is heavily weighted towards drug development and immunotherapy to treat and prevent diseases and things like vaccines. But there is a hugely strong case to be made for vector control to be prioritized with respect to funding. In terms of the treatment and drug-based prevention of vector-borne diseases, not all vector-borne diseases are treatable. Dengue, for example, is a hugely growing problem globally and yet still has no specific treatment. And only yellow fever and Japanese encephalitis have viable vaccines. The sustainability of disease control programmes is always a major consideration. And with the growing evidence of drug resistance in disease-causing pathogens, drugs and therapies are not currently considered appropriate for all diseases. It's really important to remember that treating diseases spread by vectors doesn't actually interrupt the transmission cycle or lessen human exposure. So, a more multifaceted approach is required.

Taking a global approach can increase our capacity to prevent future vector borne epidemics. And increasing the international links between people working on vector control can lead to better innovation, implementation, surveillance, and research as most vector-borne diseases can be prevented using vector control.

Vector control programmes are long-term programmes often covering millions of people. So, long-term sustainability of these programmes is absolutely essential to achieve the desired targets. It's absolutely necessary that in any sort of vector control intervention we get community involvement as almost all vector control interventions require the community to accept treatments in the home or to use treatments, for example, bed nets or indoor residual spraying. Communities need to support the intervention that is being put in practice.

Capacity building especially of entomologists is of paramount importance. Public health entomologists have to become ecologists, have to understand what diseases threaten them locally to understand the characteristics of the vectorsand the weaknesses and what the best tools are so as to be able to use evidence-based decision making. Different sectors need to get together at the government level and also regional levels.

Therefore, the control of morbidity and mortality by VBDs is only possible through concerted efforts by the international community to mount a coordinated response to the threat of VBDs.

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Fiscal Pattern of Expenditure on Broad Health in India

Dr. Parul Jain

ABSTRACT

The ultimate objective of planned development is to ensure well-being of people through sustained development in the quality of life. A healthy workforce can contribute more significantly and effectively to economic development. Health is also seen as an important components of human capital formation. With the passage of time, expenditure on health has increased from Rs.1.10 lakh crore in 2011-12 to Rs.5.49 lakh crore in 2022-23(BE). Expenditure on health as percentage of total expenditure and total expenditure on social services has increased during the past decade. However, despite governmental efforts, there are failures in certain areas and there are also certain pitfalls in health parameters. Improvement in health of masses would increase productive capacity and would lead to qualitative improvement in human capital. To improve the health standards, there should be more public-private partnership in the area of health.

Keywords: *Human Resource Development, Health Standards, Broad Health, Public - Private Partnership.*

*** Board Health comprises of Medical, Public health, Sanitation and Water Supply**

INTRODUCTION

The ultimate objective of planned development is to ensure well-being through sustained development in the quality of life of the people, especially the poor and the vulnerable segments of the population. A healthy workforce can contribute more significantly and effectively to economic development. World Development Report 1993 stated in this regard that "Improved health contributes to economic growth in four ways: It reduces production losses caused by worker illness, it permits the use of natural resources that had been totally or nearly inaccessible because of disease, it increases the enrolment of children in schools and makes them better to learn and it frees for alternative uses resources that would otherwise have to be spent on treating illness. The economic gains are relatively greater for poor people, who are typically

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most handicapped by ill-health and who stand to gain the most from the development of underutilized natural resources”.

HELATH AND HUMAN RESOURCE DEVELOPMENT

Health should be viewed not merely as the absence of disease but as a state of complete physical, mental and social wellbeing. The determinants of good health are access to various types of health services and individual’s lifestyle choices and personal, family and social relationships. Improvement in the health of masses increases their productive capacity and leads to qualitative improvement in human capital. Hence, health expenditure helps in building and maintaining a productive labour force as also in improving the lives of the people, as also the quality of society. Since a large number of people in developing countries suffer from malnutrition, the health care programmes in these countries help in improving the level of nutrition.

India’s rank in Human Development Index (HDI), which estimates HDI in terms of three basic parameters, namely (i) to live a long and healthy life, (ii) to be educated and knowledgeable and (iii) to enjoy a decent economic standard of living, has gradually improved from 136 in 2009 to 130 in 2014, 130 in 2017, 129 in 2018 out of a total of 189 countries. The HDI value has also improved from 0.579 in 2010 to 0.624 in 2015, to 0.642 in 2018 to 0.645 in 2019 but was slightly lower at 0.633 in 2021.

AN OVERVIEW OF INDIA’S HEALTH CARE SYSTEM

At present, India’s health care system consists of a mix of public and private sector providers of health system. There is a network of health care facilities at the primary, secondary and tertiary levels. These facilities are run mainly by State Governments which provide either free or very low cost medical services. There is also an extensive private health care sector which covers the entire spectrum from individual doctors and their clinics to general hospitals and super specialty hospitals.

EXPENDITURE ON BROAD HEALTH IN INDIA

The Government of India prepared its programme for raising the health standard in the country on the basis of recommendations made by the More Committee (1946) and Mudaliar Committee (1961). During the Fifth Five Year Plan, health development programmes were integrated with family welfare and nutritional programmes for vulnerable group. The Sixth Plan aimed at better health and medical care services to the poor. During subsequent Seventh and Eighth Plan, hospital facilities were sought to be strengthened. During the Ninth and Tenth Plans, efforts were further intensified to improve health status. Accordingly, expenditure on health in India has increased with passage of time. The total expenditure on health (Centre + State) increased from Rs.29418 crores in 2004-05 to Rs. 70400 crores in 2009-Centre’s health expenditure from Rs.8438 crore in 2004-05 to Rs.25652 crore in 2009-10 and of States from Rs.20980 crore in 2004-05 to Rs.44748 crore in 2009-10. Centre’s core health funding during Tenth Plan was Rs.47011 crore and that of States was Rs.107046 crore. As a percentage of GDP, total Broad Health expenditure (which includes Medical, public health, sanitation and water supply) as a percentage of GDP was 0.56% for the Centre and 1.18% for the States (Total 1.74 per cent). During the Eleventh Plan funding for Health by the Central Government increased to 2.5 times at Rs.119364 crore and of States to 2.14 times at Rs.229928 crore to add up to 1.04% of GDP. Broad Health Expenditure during Eleventh Plan also increased to 0.75% and of States to 1.22%-making total of 1.97% of GDP.

Table 1 provides information in respect of fiscal pattern of expenditure on Broad Health items in selected years from 1990-91 to 2017-18.

Table 1

Fiscal Pattern of Expenditure on Broad Health in India (Rs. Crore)

Centre				States		
Year	Revenue	Capital	Total	Revenue	Capital	Capital
1990-91	707	27	734	5407	547	5954
2000-01	3094	53	3147	17894	3665	21559
2007-08	8769	21	8790	31608	11613	43221
2008-09	10384	719	11103	36417	13754	50171
2009-10	15915	681	16596	45296	14039	59335
2010-11	20210	1009	21219	52455	13151	65606
2011-12	20161	1241	21402	59733	14195	73928
2012-13	22899	1441	24340	66353	17828	84181
2013-14	23532	1377	24909	74464	21568	96032
2014-15	10461	1029	11490	93707	29360	123067
2015-16	15488	1115	16603	113520	30937	143457
2016-17(RE)	24959	1890	26849	145784	39217	185001
2017-18(BE)	29569	3670	33239	155656	49303	204959

Source: Indian Public Finance Statistics. 2015-16 and 2017-18

Expenditure on such heads has increased in both Revenue and Capital accounts by both layers of government. Centre's revenue expenditure increased from Rs.707 crore in 1990-91 to Rs.3094 crore in 2000-01, to Rs. 20210 crore in 2010-11, Rs.23532 crore in 2013-14 and to Rs. 29569 crore in 2017-18 (BE). Similarly, Centre's capital expenditure also increased from Rs.27 crore in 1990-91 to Rs.1009 crore in 2010-11 and to Rs.3670 crore in 2017-18. Thus, total expenditure of Centre (both revenue and capital) on Broad health between 1990-91 to 2017-18 became 45.28 times from Rs. 734 crore to Rs. 33239 crore . Similarly, revenue expenditure of States on Broad Health increased from Rs.5407 crore in 1990-91 to Rs.17894 crore in 2000-01, to Rs.52455 crore in 2010-11 and to Rs. 155656 crore in 2017-18 (28.78

times in 27 years) and capital expenditure increased from Rs. 547 crore in 1990-91 to Rs. 49303 crore (90.13 times) during the same period. Total expenditure by States on Broad Health increased from Rs.5954 crore in 1990-91 to Rs. 204959 crore in 2017-18 (BE) or 34.42 times.

Table 2 provides information in respect of Expenditure on health and certain other parameters during the period 2011-12 to 2022-23 (BE).

Table 2

Expenditure on Broad Health in India by Government (Centre +State)

Centre				States		
Year	Revenue	Capital	Total	Revenue	Capital	Capital
1990-91	707	27	734	5407	547	5954
2000-01	3094	53	3147	17894	3665	21559
2007-08	8769	21	8790	31608	11613	43221
2008-09	10384	719	11103	36417	13754	50171
2009-10	15915	681	16596	45296	14039	59335
2010-11	20210	1009	21219	52455	13151	65606
2011-12	20161	1241	21402	59733	14195	73928
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2014-15	10461	1029	11490	93707	29360	123067
2015-16	15488	1115	16603	113520	30937	143457
2016-17(RE)	24959	1890	26849	145784	39217	185001
2017-18(BE)	29569	3670	33239	155656	49303	204959

Source: Government of India. Economic Survey, 2022-23, p.148

Total expenditure on heath increased from Rs.1.75 lakh crore in 2015-16 to Rs. 2.73 lakh crore in 2019-20 and further to Rs.5.49 lakh crore in 2022-23 (BE). Expenditure on broad health as percentage of GDP which was 1.3 per cent in 2015-16 increased to 1.6 per cent in 2020-21 and to 2.2 per cent in 2021-22 (RE) and was placed at 2.1 per cent in 2022-23 (BE). Expenditure on health as a percentage of total expenditure has increased from 4.7 per cent in 2015-16 to 5.4 per cent in 2017-18 and was 6.69 per cent in 2022-23 (BE). Further, the share of expenditure on health in the total expenditure on social services increased from 21 per cent in 2018-19 to 26 per cent in 2022-23(BE)

HEALTH FOR ALL

Under the Fifth Five Year Plan, health development programmes were integrated with family welfare and nutrition programmes for vulnerable groups- children, pregnant women and nursing mothers. The main objective under Sixth Plan was to provide better health care and medical care services to the poor people, including those living in the rural areas. Under the Seventh Plan, a new health scheme was implemented to provide medical facilities to the relatively neglected sections of the society. During the Eight Plan, hospitals facilities were sought to be strengthened and hospital beds in urban areas were increased. During the Ninth and Tenth Plans, efforts were further intensified to improve health status of population by rectifying the critical gaps in infrastructure, manpower, equipment and essential drugs.

The National Health Policy, 2017 envisaged as its goal "The attainment of the highest possible level of health and wellbeing for all at all ages, through a preventive and promotive health care orientation in all developmental policies, and universal access to good quality health care services without anyone having to face financial hardship as a consequence. This would be achieved through increasing access, improving quality and lowering the cost of health care delivery." Accordingly, the policy recommended an increase in the Government's health expenditure from the existing 1.2 per cent to 2.5 per cent of GDP by 2025. Also the 15th Finance Commission in its Report (para 9.41, iii) had recommended that public health expenditure of Union and States together should be increased in a progressive manner to reach to 2.5 per cent of GDP by 2025.

During the past two decades, Government has undertaken several programmes to improve health status of the citizens. National Health Policy was approved by the Government on March 15, 2017 which embodied universal access to good quality health care services and subsequent launch of Ayushman Bharat which had two components (i) Health and Wellness Centres to provide comprehensive primary health care and (ii) Pradhan Mantri Jan Arogya Yojna (PMJAY) to provide health cover to 10.7 crore poor and vulnerable families up to Rs.5 lakhs per family per year for secondary and tertiary hospitalization. The focus of the Government towards health care has been on four important pillars- preventive health care, providing affordable health care, building affordable infrastructure and mission mode interventions for maternal health, child health and to combat communicable and non-communicable diseases. Ayushman Bharat and PMJAY is the world largest health insurance scheme and is a major step towards providing affordable health care to the identified poor. Under Free Drug Service initiative, substantial funds have been given to States for provision of free drugs. In addition, Pradhan Mantri Bhartiya Jan Aushadhi Pariyojana (PMBJP) and Pradhan Mantri National Dialysis Programme (PMNDP) are also some new initiatives to address the issue of high Out of Pocket Expenditure (OoPE) for drugs and hospital care.

Covid-19 demonstrated the importance of investing and strengthening public health care system. Covid-19 pandemic put to test the health infrastructure of India. Public health measures were taken by the Government in pre-emptive. Pro-active and graded manner based on evolving scenario. In order to provide financial support, "COVID-19" Emergency Response and Health Systems Preparedness Package of Rs. 15000 crore was announced with the objectives of emergency response and health system capacity building efforts. Government undertook several measures, including world's largest vaccination drive to prevent, control and mitigate the impact of Covid-19. A Fit Health Worker Campaign was launched for screening and early detection of non-communicable diseases in the Front –Health care workers. The PMGKP Insurance Scheme for Health Workers Fighting COVID-19 was announced on 30th March, 2020. This scheme provided an insurance cover of Rs.50 lakh to health care providers. The world's largest COVID-19 immunization programme commenced on 16th January, 2021 through indigenously manufactured vaccines COVIDSHIELD and COVAXIN. About 3 crore people, mainly frontline health workers, were offered the vaccine in the first round and about 30 crore were vaccinated in the second round. Further, Accredited Social Health Activists (ASHAs) played a key role in the country's response for prevention and management of Covid-19.

In addition to the National Health Mission, Union Budget 2021-22 announced Ayushman Bharat Health Infrastructure Mission with an outplay of about Rs.64.80 crore in the next five years to develop capacities of primary, secondary and tertiary care Health Systems with the objective of strengthening existing national institutions and create new institutions to detect and cure new and emerging diseases. In order to correct regional imbalances in the availability of affordable healthcare services, Pradhan Mantri Swasthya Suraksha Yojna (PMSSY) is being implemented to augment facilities for quality medical education in the country. Further, Ayushman Bharat Digital Mission (ABDM) was announced on 27th September, 2021 with the aim to develop the integrated digital health infrastructure of the country. In the wake of COVID-19 pandemic, Ministry of Health and Family Welfare upgraded e-Sanjeevani to enable patient-to-door tele-consultation to ensure continuous care and facilitate health services to all citizens free of cost. The Union Budget 2021-22 provided an outlay of Rs. 35,000 crores towards COVID-19 vaccinations.

OUTCOMES OF HEALTH POLICY MEASURES

During the past two decades, on account of increased fiscal expenditure and various measures undertaken by the government, there has been improvement in different health parameters. Maternal Mortality Ratio(MMR) which was 254 in 2004-06 declined to 212 in 2007-09 and to 113 for the period of 2016-2018.Under Five Mortality Rate (U5MR) (per 1000 live births) which was 109.3 in 1992-93, declined to 74.3 in 2005-06 and to 41.9 in 2019-20 (NFHS-5). Similarly, as per NFHS surveys, Total Fertility Rate (TFR), viz, children per women also declined from 3.4 in 1992-93 to 2.7 in 2005-06 and to 2 in 2019-21 (below the replacement level of fertility of 2.1). Infant Mortality Rate (IMR) also declined from 78.5 in 1992-93 to 57 in 2005-06 and to 35.2 in 2019-21. Further, percentage of population living in households that use an improved sanitation facility increased from 17.6 in 1998-99 to 48.5 in 2015-16 and to 70.2 in 2019-21. Percentage of households which use clean fuel for cooking also increased from 25.6 in 2005-06 to 58.6 in 2019-21. On account of increased attention by the government towards health, life expectancy at birth improved to 69.4 years for the period 2014-18, although it varies across the States-it was lowest at 65.2 years in Chhattisgarh and highest at 75.3 years in Kerala and Delhi. Females are expected to live longer

(70.7 years) as compared to males (68.2 years). Access to better health infrastructure is one of the important factor for such improvements.

PITFALLS IN HEALTH PARAMETERS

However, India's health system has suffered from several weaknesses. *First*, health care services both from public and private sectors taken together have been quantitatively inadequate. *Second*, quality of health care services has varied considerably between public and private sectors. Many practitioners in private sector are actually not qualified doctors. According to Dreze and Sen, "the unusual reliance on private health care in India results largely from the fact that the country's public health facilities are limited and quite often very badly run ". *Third*, affordability of health care has been a serious problem for vast majority of the population, especially in the tertiary sector. These problems are likely to worsen in future because, with rising life expectancy and increasing vulnerability to chronic Non-Communicable Diseases (NCD), health care costs are expected to rise. During the past decade, India had to cope with health problems of dual burden of disease and battling communicable diseases. *Fourth,* no regulatory mechanism has been established to oversee malpractices being used by private health players. *Fifth,* health care costs are expected to rise in future. With rising life expectancy, a larger proportion of our population will become vulnerable to chronic non-communicable diseases which require expensive treatment.

TOWARDS A HEALTHY INDIA

The Government of India is committed to achieving the Sustainable Development Goal (SDG-3) for health to 'Ensure healthy lives and promoting well-being for all at all ages' by 2030. Towards this, certain measures must be undertaken. *Firstly*, National Health Policy of 2017, which aims at attaining the highest level of good health and well- being and universal access to good quality health care services, needs to be followed with utmost attention. *Secondly*, free drugs, free diagnostics and free emergency care services should be provided in all public hospitals. *Thirdly*, public health expenditure should be raised both as a percentage of GDP and as percentage of total expenditure. *Fourthly*, there should be more public-private partnership in the area of health. *Fifthly*, there is a strong need to involve Self-Help Group so that the poor are encouraged to contribute small portion of their income for health insurance. *Sixthly,* a large expansion of medical schools, nursing colleges, medical colleges is necessary and public sector must play a major role in the process. *Seventhly,* a workable way should be found out to encourage cooperation between public and private sector in achieving health goals.

CONCLUSION

From the aforesaid discussion, it is abundantly clear that for planned development it is necessary to ensure well-being of the people through sustained development in the quality of life. Improvement in health of masses increases their productive capacity and leads to qualitative improvement in human capital. With the passage of time, total government expenditure on education and health is increasing. It is happy augury that total expenditure on health as also its percentage to GDP, as percentage of total expenditure and as percentage of total expenditure on social services is higher today. Still sector is beset with certain problems. But certain steps need to be taken to improve performance in these areas. To improve health standards, public health expenditure should be increased and there should be more public private partnership.

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Development of Climate Vulnerability Index in India's Agro-Climatic Zones

Nathoo Bharati

ABSTRACT

Climate change is very complex and challengeable issues across the globe, each and every country are facing to these problems. India place is seventh most vulnerable country. The objective of this study is to analysis the vulnerability condition in India (all agro-climatic zones except to Island Region). This study followed to Indicator approach method and used IPCC's AR4 methodology, further data taken from various source of Indian government viz., Indian meteorological department (IMD), NSSO, Ministry of Agriculture and Farmer Welfare and Census. Furthermore, on the basis of existing data developed exposure index, sensitivity index, adaptive capacity index, potential climate vulnerability index and climate vulnerability index. These types of indices revealed to socio-economic condition of every agro-climatic zones due to extreme climate variation. This study clarify that the majority of regions or agro-climatic zones are highly exposed more sensitive and less adaptive capacity so these are highly vulnerable due to extreme variation in temperature and rainfall. In this way, Eastern Himalayan Region, Lower Gangetic Plain Region, Upper Gangetic Plain Region and Trans Gangetic Plain Region are highly exposed relatively other regions. Further, Eastern Plateau and Hill Region, Gujrat Plateau and Hill Region are more sensitive and under trans Gangetic Plain Region, Lower Gangetic Plain Region have more adaptive capacity. The potential climate vulnerability index and climate vulnerability index advocates similar things viz., Eastern Plateau and Hill Region Eastern Himalayan Region are highly vulnerable while Western Himalayan Region and Middle Gangetic Plain Region are least vulnerable relatively others. Further the study suggests policy recommendations: In order to first, government needs to develop a separate body which focuses to smart and innovative adaptation policy according to region wise availability of resources. In order to second, needs to stablish a climate informed infrastructure in each and every agro-climatic zone.

Keywords: *Indicator Approach, IPCC Exposure Index, Sensitivity Index, Potential Climate Vulnerability Index, Climate Vulnerability*

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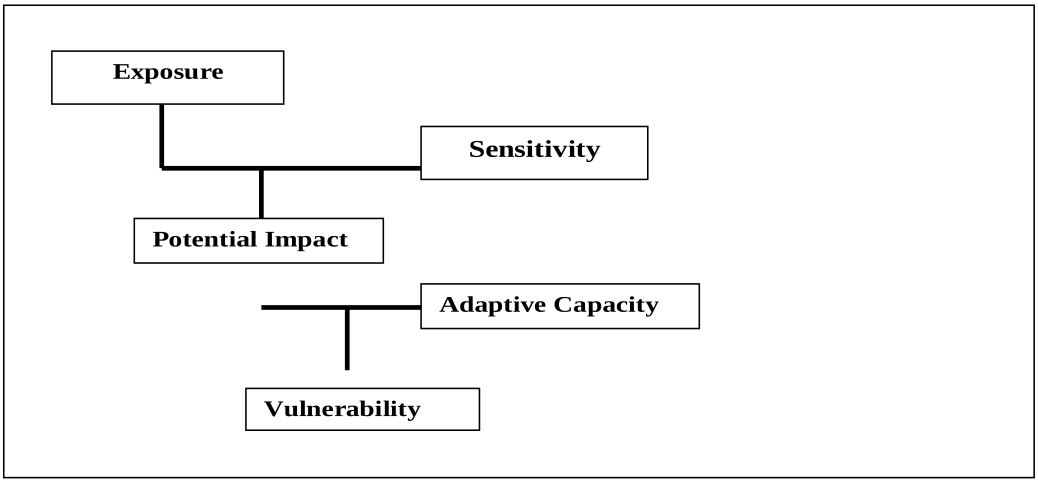
1. Introduction

Global, regional, and national economies are all being affected by climate change. Impacts threaten the viability of traditional farming, cattle, and forestry businesses, as well as pre-existing community infrastructure (Singh, 2020a). Inadequate precipitation, high temperatures, and the introduction of harmful pests and diseases are just a few of the ways in which climate change has been shown to damage agricultural production across the world (IPCC, 2018). Crop failure and sterile soil are all direct consequences of climate change, as are the declines in water-holding capacity, economic development, income distribution, and agricultural demand (FAO, 2008). Prices of agricultural goods and services will rise because of the global economic crisis, having a knock-on effect on the agricultural sector. Because of agricultural productivity declines, increased food prices, and reduced purchasing capacity, climate changes will have a significant effect on crop production stability and food availability (Singh and Sanatan, 2014; Singh, 2019; Singh, 2020a & b; Singh and Sanatan, 2020; Jatav et al., 2021a & b; Jatav, 2022).

The concept of vulnerability has been defined in many different ways and several conceptual frameworks have been developed to categorise vulnerability factors and describe the various vulnerabilities (McCarthy et al., 2001; Fussel, 2006; Kumar et al., 2016; Singh, 2020a & b; Balaganesh et al., 2020; Datta et al., 2022). (Singh, 2020b). McCarthy et al (2001) and Fussel (2006) defines vulnerability as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (Fig. 1). The exposure of a system to climate stimuli depends on the level of global climate change and, due to the spatial heterogeneity of anthropogenic climate change, on the system's location. The sensitivity of a system denotes the (generally multi-factorial and dynamic) dose- response relationship between its exposure to climatic stimuli and the resulting impacts. Adaptation refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Further, Singh, (2020a & b) presents a conceptual framework of vulnerability that combines a nomenclature for describing any vulnerable situation in terms of the vulnerable system, the hazard(s) of concern, the attributes(s) of concern, and a temporal reference; a classification scheme for vulnerability factors according to their sphere and knowledge domain; and a terminology for vulnerability concepts that is based on the vulnerability factors included. The conceptual framework allows to concisely describe any vulnerability in the literature as well as the differences between alternative concepts (Kumar et al., 2016; Balaganesh et al., 2020; Datta et al., 2022).

Figure 1: Conceptual Framework of Climate Vulnerability



Source: IPCC, 2001

The "capacity or inability to be adversely impacted by climatic variability and severe climate events and support them" is a straightforward definition of vulnerability in the context of climate change. Vulnerability assessment is a difficult task because of the complex relationships between many parts of natural systems and human interventions. However, among the many tools necessary for the adaptation of social and biological systems, vulnerability assessment is often regarded as the most crucial.

The current research defines vulnerability as the extent to which climate change threatens food crop output. The idea of vulnerability has emerged as an important tool in the study of climate change in recent years. This is because of the crucial function it plays in helping us comprehend, quantify, and appraise the predicament of communities and individuals in the face of climate-induced catastrophes (Singh, 2020b). In order to better create adaptive measures and build resilience in the face of climate change, the Intergovernmental Panel on Climate Change (IPCC, 2018) stresses the need of conducting a thorough evaluation of the susceptibility of places to climate change.

2. Review of Literature

A growing corpus of research indicates that rural farmers in the Bundelkhand region are particularly at risk. Singh (2020b) looked at the different kinds and levels of susceptibility to economic hardship faced by farming households in the Bundelkhand region. The empirical findings reveal that farmers belonging to Scheduled Tribes (ST) groups were the most susceptible to climate change and the least prepared to respond. In a similar vein, a study by Derbile et al (2022) in Ghana, Africa, found that farmers there were vulnerable to several climatic extremes, with drought being the most often and influential adverse event that considerably impacted agricultural production. As a result, crops were damaged by the subsequent high temperatures and/or plenty of sunshine. All crops investigated, including maize, rice, millet, and soybeans, were very sensitive and susceptible to strong sunshine and temperatures, but the findings showed that rice and corn were the most sensitive and delicate to drought.

In addition, Kumar et al (2016) conducted a study in Karnataka, India, using an indicator approach and a development risk score for several districts. Losses in grain, pulse, and oilseed production were shown to be higher due to climate variability in the Gulbarga and Raichur areas. It is also estimated that over 70% of the farmed land is under risk, which is important since it provides food and shelter for 60% and 67% of the state's livestock and rural inhabitants, respectively. Balaganesh et al (2020) did something similar for 30 districts in Tamil Nadu, India, and compiling agricultural and dairy data into a new composite drought vulnerability index (CDVI). The IPCC method was used to determine the index's value; this method took into account the factors of exposure, vulnerability, and adaptability. The study found that 12 districts are extremely vulnerable to drought, 8 are moderately vulnerable in the eastern and southern agro-climatic zones, a few districts in Tamil Nadu's Cauvery delta and western zones are extremely vulnerable, and most districts in the north-western, and high rainfall zones are less vulnerable. The vulnerability of three smallholder agricultural systems in Telangana, India was also studied by Kuchimanchi et al (2021), (i) crops without livestock (CWL), (ii) crops with small ruminants (CSR), and (iii) crop with dairy (CD). They found that people's beliefs of their own vulnerability to climate change, the accessibility of resources to support themselves, and the methods they utilised in their farming all had a role in how susceptible their own families were. Households in CWL areas were more susceptible to total precipitation decreases and higher maximum temperatures, whereas those in crop-and-cattle farming areas were more exposed to higher maximum temperatures and more erratic rainfall.The opinions of farmers are also valuable in determining risk. Datta et al (2022) meta-analysis found that, consistent with meteorological data, many Indian farmers had seen an increase in temperature and an increase in the frequency and/or reduction in rainfall. It seems that Indian farmers have used a broad variety of incremental and systemic adaptation strategies. Farmers are also increasingly adopting radical adjustments such as shifting their land usage, resource and labour allocations, occupational patterns, and agricultural methods. In addition, factors like family income, farm size, gender, and resource endowment, among others, often impact the adoption of adaptation methods.

3. Methods and Materials

3.1 Study Area

India has categorised seventh largest country among the world behalf of area perspectives. It is (India) situated under the Indian plate which is touches Indo-Australian plate on northern side. The waterbody surrounded to Indian subcontinent which is recognisable on world map. Furthermore, the location of India is represented: extends between 8°42 North and 37°62

North latitudes and from 68°72 East and 97°252 East longitudes. So latitudinal and North-south distance is 3214 km and 2933 km represent East-west extent. India 2.42 percents land area of entire world. In this way, Tropic line of cancer (23°302 North) is divided to India into two equal parts viz., North India and south India. it means this line passes through centre of India. Same order East longitude represents 82°302 and passes to middle of India. Thus, it is called standard meridian of India (Sing Amit, 2022) the information mentioned from Indian Institute of Public Administration's Report 2022.

India consists 28 states, 8 union territory and 640 district as per census 2011. Furthermore, the whole India divided on the basis of Agro-Climatic Zone (ACZ). NICRA (National Innovation in Climate Resilient Agriculture) categorised 15 ago-climatic zone to entire India on the basis of climate variation. Each and every ACZ consist one or more than one states and districts.

3.2 Estimation Method

Conducting a vulnerability assessment is a multistep exercise and requires setting a clear goals and objective that will determine the type of vulnerability assessment as well as the scale, sector, tier, indicators, and methods to be adopted. Because each of the sub-components is measured on a different scale, it was first necessary to standardize each as an index. Hence, equations 1 and 2 (min-max method) was used to normalized the data as follows.

$$Index_{SV} = \frac{S_v - S_{min}}{S_{max} - S_{min}} \qquad (1)$$

$$Index_{sv} = \frac{S_{max} - S_v}{S_{max} - S_{min}} \qquad (2)$$

Equation 1 was used if the indicator is positively associated with the targeted index, while equation 2 was used if the indicator is negatively associated. In the equations 1 & 2, *sv* is the original sub-component for the district d, and S_{min} and $S_{\max}$ are the minimum and maximum values, respectively, for each sub-component determined using the data from all 13 districts. For example, forest area ranged from 110054 to 120154 hectares in all 13 districts. These minimum and maximum values were used to transform this indicator into a standardized index so it could be integrated into the sensitivity component of the vulnerability index. For variables that measure frequencies such as the 'percent of household having access of safe drinking water', the minimum value was set at 0 and maximum value at 100. Moreover, equations 3, 4 & 5 were used to develop exposure, sensitivity, and adaptive capacity indices.

$$Index_E = \frac{MaxTK + MaxTR + MaxTA + MinTK + MinTR + MinTA + RK + RR + RA}{9} \qquad (3)$$

Where, $index_E$ is an exposure index, while MaxTK, MaxTR, MaxTA, MinTK, MinTR, MinTA, RK, RR and RA are maximum kharif season temperature, maximum temperature rabi season temperature, annual maximum temperature, minimum kharif season temperature, minimum temperature rabi season temperature, annual minimum temperature, kharif season rainfall, rabi season rainfall, and annual rainfall.

$$Index_s = \frac{F+ANSA+NSA+BPL+SR+PD+DPG+House+Bathroom+Latrine+Safe\ Water}{11} \text{... (4)}$$

Where, $index_s$ is sensitivity index, while F, ANSA, NSA, DL, BPL, SR, PD, DPG, House, Bathroom, Latrine and Safe water are forest area, area not available for cultivation, net sown area, degraded land, population below poverty line, sex ratio, population density, decadal population growth, access of all seasonal house, access of bathroom, access of latrine, and access of safe drinking water.

$$Index_{aci} = \frac{Road+PS+ACS+Livestock+labour+PCI+Training+MGNREGA+LR+Land}{10} \text{... (5)}$$

Where, $index_{aci}$ is adaptive capacity index, while road, PS, ACS, Livestock, labour, PCI, Training, MGNREGA, LR and Land are all seasonal approach roads, households having access of power supply, membership of agricultural credit society, ownership of livestock, agricultural labourers, per capita income, formal agricultural training, population working in MGNREGA, literacy rate and mean land size.

Once the values of exposure, sensitivity, and adaptive capacity for the district level had been calculated, two contributing factors (exposure and sensitivity) were combined using equation (6) to obtain the district-level potential climate vulnerability index (Tripathi, 2017).

$$PCVI_d = Exposure\ Index_d + Senstivity\ Index_d \text{........................ (6)}$$

Where, $PCVI_d$ is the potential climate vulnerability index for the district d; $Exposureindex_d$ is the calculated exposure index for the district *d*; and $Senstivityindex_d$ is the sensitivity index for the district *d*. Adaptive capacity, represented by ACI_d (equation 7), was taken into consideration to develop a climate vulnerability index (CVI) for the district *d*as follows.

$$CVI_d = (Exposure\ Index_d - Adaptive\ Capacity\ Index_d) * Senstivity\ Index_d \text{...... (7)}$$

PCVI and CVI were scaled so that −1 denotes the least vulnerable and +1 the most vulnerable.

4. Results and Discussion

The Table 1 deals the value of exposure index which has included 9 variables viz., annual minimum temperature, kharif minimum temperature, rabi minimum temperature, annual maximum temperature, kharif maximum temperature, rabi maximum temperature, annual rainfall kharif rainfall, rabi rainfall. That data of this table stated that ACZ or reason 2(0.604), 3(0.598), 5(0.595) and 7(1.00) are highly exposed relatively other reasons caused by high variation in minimum, maximum temperature and rainfall i.e., ACZ 2 represent about minimum temperature: annual (0.784), kharif (0.778) and rabi (0.84). In case of maximum temperature ACZ 2 represent: annual ((0.831), kharif (0.549) and rainfall of ACZ 2 is: annual (0.336)), kharif (0.341) and rabi (0.408). Same thing employing in rest of other regions which is more vulnerable i.e., ACZ (3,5,7). The data of 2 reason revealed that the minimum temperature is very low in all season and maximum temperature is very high and rainfall is very low relatively others ACZ, so these factors are one of the most reason of vulnerability these types of factors adverse effects to ACZ which drives too highly vulnerable. In this this table the highest vulnerable region is 7 (1.00) and least vulnerable is 1(0.336)

Table 1: District-wise Exposure Index

	Minimum Temperature			**Maximum temperature**			**Rainfall**			
Agro-Climatic Zone	Annual +	Kharif +	Rabi +	Annual +	Kharif +	Rabi +	Annual +	Kharif +	Rabi +	Exposure Index
ACZ_1	0.313	0.374	0.330	0.094	0.406	0.373	0.408	0.292	0.529	0.236
ACZ_2	0.784	0.778	0.845	0.831	0.549	0.405	0.336	0.341	0.408	0.604
ACZ_3	0.752	0.790	0.655	0.886	0.494	0.856	0.101	0.168	0.486	0.598
ACZ_4	0.468	0.811	0.416	0.801	0.776	0.561	0.270	0.276	0.237	0.435
ACZ_5	0.811	0.747	0.690	0.750	0.650	0.726	0.387	0.420	0.253	0.595
ACZ_6	0.595	0.668	0.574	0.537	0.634	0.465	0.311	0.314	0.282	0.348
ACZ_7	0.366	0.295	0.377	0.396	0.495	0.432	0.453	0.426	0.251	1.000
ACZ_8	0.152	0.362	0.235	0.466	0.060	0.092	0.182	0.434	0.073	0.453
ACZ_9	0.117	0.237	0.000	0.453	0.000	0.017	0.125	0.249	0.077	0.457
ACZ_10	0.020	0.985	0.778	0.000	0.214	0.000	0.540	0.700	0.497	0.492
ACZ_11	0.265	0.990	0.489	0.151	0.584	0.380	1.000	1.000	1.000	0.524
ACZ_12	0.557	0.961	0.888	0.768	0.759	0.826	0.359	0.724	0.432	0.431
ACZ_13	0.830	0.701	1.000	0.704	1.000	1.000	0.193	0.667	0.249	0.446
ACZ_14	0.323	0.871	0.801	0.612	0.342	0.393	0.210	0.338	0.077	0.529

Source: Authors estimation, 2024

This table 2 depicts value of sensitivity index of all (14) agro-climatic zones in India. In this index 11 variables included what are mentioned in equation (2). These types of variables determined to sensitivity index of every ACZ. The statistics of this table indicates ACZ 3(0.479), 7(0.513) and 13(0.486) are highly sensitive relatively other regions because of different variables are unstable condition what are determine to sensitivity index viz., ACZ 3 represents that decreases forest area (0.922), uncultivated area is high (0.410), population density is high ((0.294) and least access to bathroom (0.623). ACZ 7 represents: deceases in forest area (0.674), decrease in net sown area (0.655), sex ration is high ((0.708), least access to latrine (0.660), least access to bathroom (0.642) and least access to pucca house (0.624). ACZ 11 also vulnerable which represents: least forest area (0.716), increase in uncultivated area (0.404), sex ratio is high least access to latrine (0.593) least access to bathroom (0.590). These variables are major responsible factors which is drive to more sensitivity. After analysing to this table, the result indicates that ACZ 7 (0.513) is very highly vulnerable relatively rest of other ACZ while the ACZ 6 (0.312) is very least vulnerable compare to other regions caused by under the ACZ 6 approximately each and all variables are in better or stable condition except to forest area.

Table 2: District-wise Sensitivity Index

Agro-Climatic Zone	Percentage of forest area	Percentage of area not	Percentage of net sown area	% of BPL Population	Sex ratio	Population Density	Decadal population	Drinking Water	% of Access Latrine	% of HH Access of	Pucca house	Sensitivity Index
	-	+	-	+	+	+	+	-	-	-	-	
ACZ_1	0.709	0.230	0.669	0.173	0.543	0.116	0.507	0.226	0.318	0.387	0.291	0.479
ACZ_2	0.747	0.503	1	0.364	0.367	0.655	1	0.078	0.778	0.521	0.007	0.507
ACZ_3	0.937	0.52	0.697	0.298	0	0.444	0	0.468	0.524	0.365	0	0.358
ACZ_4	0.924	0.741	0.566	0.494	0.082	0.874	0.441	0.281	0.417	0.569	0.005	0.456
ACZ_5	0.903	0.908	0.629	0.218	0.592	0.981	0.369	0.689	0.719	0.615	0.005	0.561
ACZ_6	0.762	0.848	0.693	0.51	0.918	0.383	0.811	0.219	0.875	0.798	0	0.575
ACZ_7	0.961	0.669	0.834	0.408	0.347	0.621	0.754	0.25	0.708	0.8	0	0.531
ACZ_8	0.307	0.792	0.242	0.575	0.449	0.234	0.581	0.839	0.667	0.819	0.018	0.472
ACZ_9	0.131	0.422	0.616	0.596	1	0.119	0.458	0.594	0.719	0.75	0.008	0.462
ACZ_10	0.92	0	0.86	0.394	0.245	0.575	0.538	0.786	0.692	0.708	0.01	0.486
ACZ_11	0	0.743	0.773	0.489	0.898	0	0.547	0.625	0.218	0.197	0.01	0.39
ACZ_12	0.029	1	0	0.616	0.653	0.345	0.5	0.406	0.5	0.417	0.01	0.386
ACZ_13	0.858	0.247	0.837	0.272	0.816	0.552	0.606	0.906	0.406	0.479	0.011	0.51
ACZ_14	0.747	0.503	1	0.364	0.367	0.655	1	0.078	0.778	0.521	0.007	0.479

Source: Author estimation, 2024

This table 3 depicts agro-climatic zone wise adaptive capacity of all ACZ in India. The adaptive capacity index determines 10 different variables which has explained in equation (). The data of this table revealed that ACZ 3 (0.542), 6(0.56) and 11 (0.510) have more adaptive capacity relatively other regions or ACZ. In this way, there are multiple factors (variables) are key drivers which are push to increase in adaptive capacity viz., ACZ 3 represents high mean land size (0.662) more participation in MGNREGA ((0.564), more Percentage of population which take formal training in agriculture (0.337), more access to power supply (0.918) and more agriculture labour of total population; under ACZ 2: literacy rate is high (0.650), more formal training in agriculture ((0.343), per- capita income on constant price is better (0.378), access to power supply is better (0.945), livestock is more (0.831) and pucca approach road is also better (0.884); ACZ11 represents : literacy rate is better (0.642), more participation in MGNREGA (0.641), more access to power supply (0.886), more agriculture labour of total population (0.624) and more access to pucca approach road (0.731). these types of factors are more effective determinants to increase in adaptive capacity. Furthermore, pointed out that the ACZ 6 have high adaptive capacity which value is 0.567 while the ACZ 5 represents very least adaptive capacity which value is 0.316.

Table 3: District wise Adaptive Capacity Index

Agro-Climatic Zone	Average land size	Literacy Rate	% of Participation in MGNREGA	% of HH taken formal Training in	Per Capita Income (2011-12@constant	Power Supply	% of Livestock	Agricultural Credit societies	% of Agricultura labours to total	Pucca approach roads	Adaptive capacity index
	+	+	+	+	+	+	+	+	+	+	
ACZ_1	0.385	0.509	0.491	0.128	0.194	0.878	0.732	0.197	0.257	0.506	0.418
ACZ_2	0.796	0.924	0.066	0.813	0.382	0.124	0.01	0.094	0.773	0	0.398
ACZ_3	0.789	0.96	0.071	0.851	0.409	1	0	0.426	0.668	1	0.617
ACZ_4	0.775	0.893	0.099	0.813	0.304	0.098	0	0.438	0.725	0.556	0.47
ACZ_5	0.755	0.893	0.099	0.867	0.304	0.836	0.004	0.2	0.702	0.611	0.527
ACZ_6	0.838	0.995	0.051	0.906	0.261	0.304	0	0.328	0.604	0.528	0.481
ACZ_7	0.783	0.888	0.094	0.781	0.373	0.2	0.005	0.313	0.619	0.944	0.5
ACZ_8	0.462	0.909	0.108	0.807	0.317	0.036	0	0.645	0.592	0.833	0.471
ACZ_9	0.459	0.981	0.072	0.813	0.435	0.099	0.05	0.75	0.661	0.625	0.495
ACZ_10	0.442	0.976	0.108	0.696	0.292	0.166	0.038	0.554	0.706	0.639	0.462
ACZ_11	0.444	0.898	0.088	0.781	0.46	0.018	0.009	0.656	0.626	0.472	0.445
ACZ_12	0.453	0.958	0.089	0.969	0.376	0.143	0.006	0.75	0.721	0.889	0.535
ACZ_13	0.633	0.984	0.139	0.656	0.342	0	0	0.875	0.586	0.486	0.47
ACZ_14	0.796	0.924	0.066	0.813	0.382	0.124	0.01	0.094	0.773	0	0.398

Source: Author estimation, 2024

This table 4 depicts agro-climatic zone wise potential climate vulnerability index (PCVI) and climate vulnerability index (CVI). Under the PCVI two variables i.e., exposure and sensitivity included while climate vulnerability index determine three variables i.e., exposure, sensitivity and adaptive capacity. Adaptive capacity is one of the most relevant factors which is made change one (CVI) to other (PCVI), it means adaptive capacity creates differences between PVCI and CVI value. Under the PCVI data represents: ACZ 2 (0.994), 3(1.077), 7(1.513) and 14(0.986) are more vulnerable relatively other regions. In this way, highly vulnerable region is ACZ 7 value is 1.513 (PCVI value) and least vulnerable region is ACZ 1 which value is 0.732 (PCVI value). Furthermore, in case of climate vulnerability index the value are change; Maximum ACZ comes under the climate vulnerability it means they are more vulnerable relatively others i.e., ACZ- 2(0.101), 3 (0.027), 5(0.099), 7(0.299), 10(0.002), 11(0.005) and 14(0.044). Hera the data indicates that the maximum regions or ACZ are vulnerable, highly vulnerable region is 4 which value is 0.299 (CVI value) and least vulnerable region is ACZ 1(-0.033) and ACZ 4(-0.033). One thing pointe here ACZ 3 and ACZ7 are highly vulnerable in both indices i.e., PCVI and CVI further the exposure value and sensitivity value is very high under ACZ 7 so this region one of the most (very high) vulnerable region in India.

Table 4: District wise Vulnerability Index

	Exposure Index	sensitivity index	Adaptive capacity index	Potential climate vulnerability index	climate vulnerability index
ACZ_1	0.228	0.479	0.427	0.707	-0.095
ACZ_2	0.142	0.507	0.398	0.649	-0.13
ACZ_3	0.415	0.358	0.617	0.773	-0.072
ACZ_4	0.651	0.456	0.47	1.107	0.083
ACZ_5	0.697	0.561	0.527	1.258	0.095
ACZ_6	0.705	0.575	0.481	1.28	0.129
ACZ_7	0.441	0.531	0.5	0.972	-0.031
ACZ_8	0.316	0.472	0.471	0.788	-0.073
ACZ_9	0.391	0.462	0.495	0.853	-0.048
ACZ_10	0.621	0.486	0.462	1.107	0.077
ACZ_11	0.217	0.39	0.445	0.607	-0.089
ACZ_12	0.36	0.386	0.535	0.746	-0.068
ACZ_13	0.555	0.51	0.47	1.065	0.043
ACZ_14	0.228	0.479	0.427	0.707	-0.095

Source: Author estimation, 2024\

5. Conclusions

The study revealed that majority of agro-climatic zone are more vulnerable due to extreme climate variation i.e., maximum, minimum temperature and rainfall. In this order the data indicated that maximum ACZ are highly exposed, highly sensitive, and low adaptive capacity. Further some regions are adversely susceptible due to extreme increment in maximum temperature and some are affected due to very low rainfall. The variation in temperature results to increase or decrees in rainy days and hit waves. Finally, the Study founded that there are large disparity or differences in among all agro-climatic zone in India. The study suggest policy that it is needs to argent stablish a body in every region which takes certain smart adaptive strategy.

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Significance of Economy- Environment Nexus in Achieving Sustainable Developmet

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ABSTRACT

This research paper investigates the relationship between environmental sustainability, economic growth, and India's journey to sustainable development. Our primary objectives are two. Firstly, we investigate if India follows the Environmental Kuznets Curve (EKC) by analyzing CO2 emissions and GDP per capita from 1991 to 2020 taking CO2 emissions as a dependent variable and GDP per capita as an independent variable. This study used regression analysis to know whether India follows the EKC hypothesis or not. The study found that India is moving toward EKC but hasn't reached the point where growth reduces emissions significantly. Secondly, this research paper examine the role of renewable energy and energy efficiency. Over the same period, we see a rise in renewable electricity output and a decrease in energy intensity, showing India's progress toward cleaner energy and better efficiency. These findings highlight India's journey toward a greener and more efficient future, crucial for global sustainability efforts.

Keywords : *Sustainable development, CO2 emissions, Environmental Kuznet Curve (EKC), Economic growth, Environmental sustainability, Renewable energy.*

INRODUCTION

There is no longer any doubt that environmental preservation and sustainable development interact favourably and significantly. As the earth seeks to progress towards sustainable economic growth, it encounters several environmental issues that the world has acknowledged and has started to actively pursue sustainability from both an economic growth viewpoint and an environmental standpoint.(Houssam et al., 2023).To achieve sustainable development, it is vital to comprehend the complex interaction between the economy and the environment. Any nation always aspires to accomplish economic growth while also preserving its natural resources; it has become more clear that a harmonic and balanced approach to the economy-environment nexus is critical for long-term sustainable development.

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The concept of sustainable development came into existence after realizing the adverse effects of economic growth on the environment and society. It emphasizes the need to meet to present generation without compromising the needs of the future generation. Achieving sustainable development requires a perfect balance between environmental preservation and economic growth. The 17 Sustainable Development Goals (SDGs) were approved by global leaders in 2015 with the stated purpose of "freeing humanity from poverty, securing a healthy planet for future generations, and building peaceful, inclusive societies as a foundation for ensuring lives of dignity for all("sustainable development goals report 2017") These 17 goals are backed by 169 targets and more than 200 indicators. Regardless of income levels, all nations have vowed to work towards achieving the SDGs by 2030. However, five years later, the future for the SDGs is dismal: new evaluations reveal that inequality is spreading, hunger is increasing, ecosystems are degrading at an alarming rate, and climate change threatens the entire SDG agenda (Jeffrey D. Sachs, 2019).

The relationship between the economy and the environment is very crucial to understand. Achieving sustainable development requires balancing economic growth with environmental protection. The Environmental Kuznets Curve (EKC) hypothesis examines the relationship between economic growth and environmental degradation. It suggests that environmental degradation initially increases with economic growth but eventually decreases as countries become wealthier and more environmentally conscious. In this study, we will use the EKC hypothesis to examine the significance of the economy-environment nexus in achieving sustainable development in India. The Environmental Kuznets Curve (EKC) hypothesis is an empirical hypothesis that tests whether there exists a link between economic growth and environmental damage. The theory argues that there is an inverse U-shaped relationship between income and environmental damage, that is, the environmental damage will initially increase with economic development later it will decrease as countries become richer and more environmentally friendly. The EKC hypothesis examines an inverted U-shape nexus between environmental degradation and economic growth. Grossman and Krueger (1991) first pioneered this inverted U-shape relation, while the term "Environmental Kuznets Curve" was coined by Panayotou (1993) The EKC hypothesis builds from the argument that as countries grow, they get more efficient in their resource consumption and adopt cleaner technologies resulting in less environmental degradation. (Mahmoodi & Dahmardeh, 2022) The EKC hypothesis is relevant to the economy-environment nexus because it suggests that economic growth can lead to environmental degradation, but it can also lead to environmental improvement if countries adopt sustainable practices and technologies The theory behind the EKC (Environmental Kuznett Curve) hypothesis has been well-researched in the literature and has been used to shape and inform environmental policies and sustainable development strategy(Naveed et al., 2022)

Our study revolves around two key objectives that hold immense significance in achieving sustainable development. First, we explore the Environmental Kuznets Curve (EKC) hypothesis to understand if India follows a pattern where economic growth affects CO2 emissions. We do this by analyzing how GDP per capita relates to CO2 emissions over a specific time period.

Second, we focus on Sustainable Development Goal 7 (SDG 7), which aims to provide affordable and clean energy for all. Specifically, we investigate how adopting renewable energy and improving energy efficiency (measured by energy intensity) can contribute to sustainable development. Our study aims to uncover the vital connection between the economy and the environment so that we can prosper in our economic growth while maintaining our environmental health in the long run.

LITERATURE REVIEW

Tiwari, Aviral Kumar and Muhammad, Shahbaz(2013): This study analyzed the relationship between coal use, economic growth, trade openness, and CO2 emissions in India. They found a long-term connection between these factors and observed a pattern called the Environmental Kuznets Curve, where pollution initially rises with economic growth but eventually decreases. They found both coal use and trade openness contributed to higher CO2 emissions. The study also revealed a feedback loop between economic growth and CO2 emissions, as well as between coal use and CO2 emissions.

Ritu Rana and Manoj Sharma(2018): In this study, the relationship between foreign direct investment(FDI), economic growth(GDP), carbon emissions and trade in India was analysed. It used data from the World Development Indicators of the World Bank Group from 1982 to 2013. The study found that FDI is causing exports, exports are causing imports, imports are causing CO2 emissions, and CO2 emissions and GDP are causing each other in India. This study also found that India imports more pollution-intensive manufactured goods, and FDI is causing GDP in India but through CO2 emissions. The study concluded that both the Pollution Haven Hypothesis and the Environmental Kuznets Curve hypothesis exist in India. The Pollution Haven Hypothesis suggests that countries with weak environmental regulations attract further pollution-intensive industries. The Environmental Kuznets Curve hypothesis suggests that environmental degradation firstly increases with economic growth but ultimately decreases as income rises beyond a certain threshold.

Tafadzwanashe Mabhaudhi (2021): This study examines whether the rise in environmental degradation is associated with economic growth and the potential channels through which environmental degradation could affect economic growth. The study used a global panel comprising 140 countries from 1980 to 2021 and found that environmental degradation has a delaying effect on economic growth. Emissions show an inverted U-shaped relationship with economic growth, while ecological footprint indicators of environmental degradation have a U-shaped relationship with economic growth. Health, foreign direct investment, and technological innovation are the potential channels through which environmental degradation could retard economic growth. The study’s findings have policy implications for developing non-conflicting environmental and structural policies.

Doaa Salman & Nadine Amr Hosny(2021): This study looked at how things like using renewable energy for electricity, carbon dioxide emissions, exchange rates, and unemployment affect Egypt's economic growth. Developing countries like Egypt want to grow their economies sustainably. They used data from 1990 to 2019 and an autoregressive distributed lag(ARDL) model to do this. Their findings showed that government support is really important for making renewable energy, carbon dioxide emissions, and exchange rates have a positive and significant impact on Egypt's economic growth. However, dealing with carbon dioxide emissions is still a big challenge for sustainability. They also identified some policies that can help Egypt build a better energy system for the future.

Nourhane Houssam (2023): This study examined the relationship between the green economy and three dependent variables (GDP per capita, total unemployment rate, and poverty level) in 60 developing countries in 2018 using a GLS approach. The study found a positive relationship between the green economy and GDP per capita and the total unemployment rate, while there was a negative relationship between the green economy and the poverty rate. The study recommends promoting and adopting a green economy for sustainable development, job creation, and poverty reduction in both the private and public sectors. This study is the first to explore the relationship between a green economy and sustainable development using a GLS approach in developing countries

Rui Chan, Muhammad Ramzan, Muhammad Hafeez, Sana Ullah(2023): This study looks at how environmental innovations and global financial connections impact the green growth of BRICS economies(Brazil, Russia, India, China, and South Africa). They used a CS- ARDL model for their analysis and what they found is that when these countries invest in eco-friendly technology and get more patents for environmental inventions, it helps them achieve green growth in the long term and also, when they become more connected to the global financial system, it boosts their green growth. This suggests that policymakers in these countries should encourage research and development in green technology to promote green economic growth.

OBJECTIVES

1.To investigate whether India follows the Environmental Kuznets Curve (EKC) hypothesis by analyzing the relationship between CO2 emissions and GDP per capita over a specific time period.

2.To evaluate the role of renewable energy adoption and energy intensity in promoting sustainable development in India.

DATA AND METHODOLOGY

In this study, we conducted an analysis to address two objectives related to the environmental and economic dynamics of India. To address the first objective we examined data from 1991 to 2020 sourced from the World Bank specifically focusing on CO2 emissions (measured as tons per person) and GDP per person (measured in current US dollars of 2015). Our approach involved conducting regression analysis to assess the relationship between these variables and test the validity of the Environmental Kuznets Curve (EKC) hypothesis. As for our other objective we also utilized World Bank data covering the same timeframe, which included information on renewable electricity production (in megawatt hours) and energy intensity (measured as energy consumption per unit of GDP) in India. Our analysis revolved around examining trends in renewable electricity output and energy intensity to understand their contributions to sustainable development.

Below is the data on CO2 emissions and GDP per capita spanning from 1991 to 2020 of India We have converted GDP per capita value into natural logarithms to obtain efficient and consistent

TABLE 1.1 DATA ON CO2 EMISSIONS (METRIC TONS PER CAPITA) AND GDP PER CAPITA (CURRENT US$) OF INDIA STARTING FROM 1991 TO 2020

India			
YEARS	CO2 emissions (metric tons per capita)	GDP per capita (current US$)	L.N
1991	0.68309	303.850438	5.7
1992	0.69007	317.5587347	5.8
1993	0.70314	301.5007864	5.7
1994	0.72562	346.2273931	5.8
1995	0.76519	373.6282338	5.9
1996	0.78723	399.5773066	6.0
1997	0.81736	414.8986835	6.0
1998	0.81872	412.5093558	6.0
1999	0.86624	440.9614546	6.1
2000	0.88508	442.0347789	6.1
2001	0.88375	449.9111249	6.1
2002	0.89724	468.8444283	6.2

2003	0.90546	543.8437989	6.3
2004	0.95547	624.1050944	6.4
2005	0.98426	710.5093449	6.6
2006	1.03653	802.013742	6.7
2007	1.12360	1022.732476	6.9
2008	1.18036	993.5034125	6.9
2009	1.27887	1096.636136	7.0
2010	1.33803	1350.634457	7.2
2011	1.39688	1449.603301	7.3
2012	1.49820	1434.017978	7.3
2013	1.52767	1438.056995	7.3
2014	1.64247	1559.863772	7.4
2015	1.63132	1590.174322	7.4
2016	1.63991	1714.279541	7.4
2017	1.70493	1957.969814	7.6
2018	1.79560	1974.37773	7.6
2019	1.75253	2050.16379	7.6
2020	1.57609	1913.219721	7.6

Source: world bank

To address our second objective we have taken the data of India from world bank which is spanning from 1991 to 2020. Below the table is shown

TABLE 1.2 DATA OF RENEWABLE ELECTRICITY OUTPUT(% OF TOTAL ELECTRICITY OUTPUT) AND ENERGY INTENSITY LEVEL OF PRIMARY ENERGY (MJ/$2017 PPPGDP) OF INDIA STARTING FROM THE YEAR 1991 TILL 2020

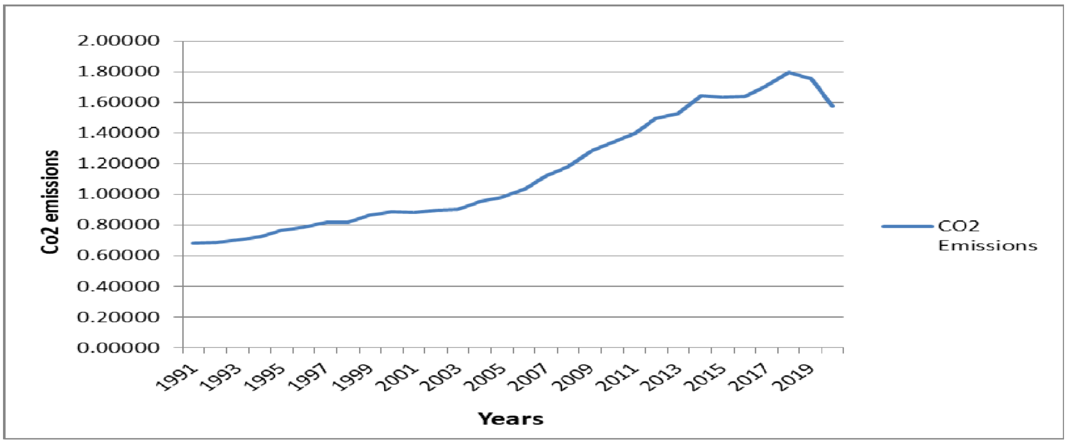
Country Name	India	India
YEARS	Renewable electricity output (% of total electricity output)	Energy intensity level of primary energy (MJ/$2017 PPP GDP)
1991	22.80740221	..
1992	20.75265214	..
1993	19.55881334	..
1994	21.21909967	..
1995	17.26053911	..
1996	15.76729394	..
1997	16.01513081	..
1998	16.70110829	..
1999	15.25807575	..
2000	13.59094803	6.42
2001	13.20704353	6.22
2002	12.05516116	6.16
2003	13.46942476	5.84
2004	14.4825005	5.73
2005	16.61901808	5.52
2006	17.54042472	5.39
2007	17.86408569	5.31
2008	16.50983374	5.43
2009	15.66005525	5.5
2010	16.04374444	5.34
2011	17.31696286	5.28
2012	15.73297336	5.29
2013	17.34931383	5.11
2014	16.25383982	5.08
2015	15.34305035	4.82
2016	..	4.54
2017	..	4.47
2018	..	4.4
2019	..	4.28
2020	..	..

Source: world bank

DATA ANALYSIS

Firstly we will see the trend of co2 emissions in India

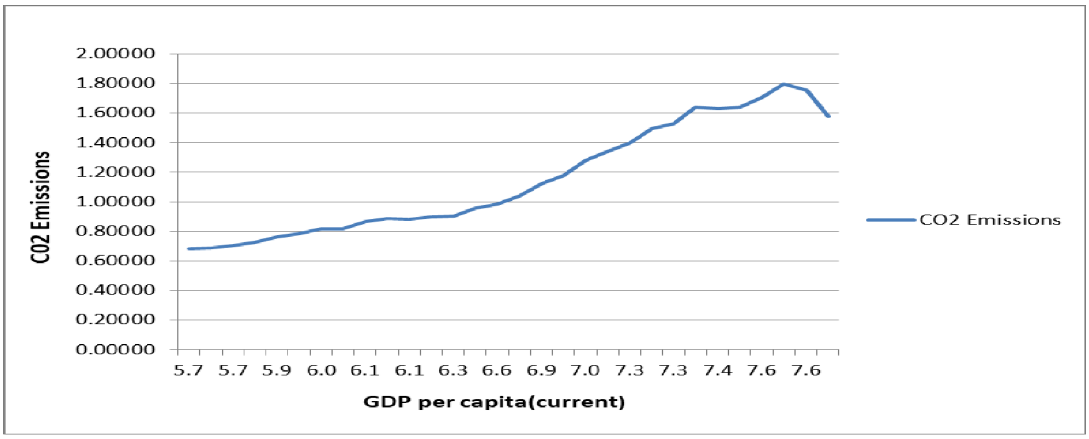
Trend of CO2 emissions in India



As we can clearly see around early 1990s to 2000 carbon emissions gradually increased .Around early 2000s we see steeper increase in co2 emissions indicating faster rate of increase. As we move towards mid 2000s we see a gradual increase indicating slow rate of increase in co2 emissions. In the most recent years(2017 to 2020) we see a slight decrease in co2 emissions.

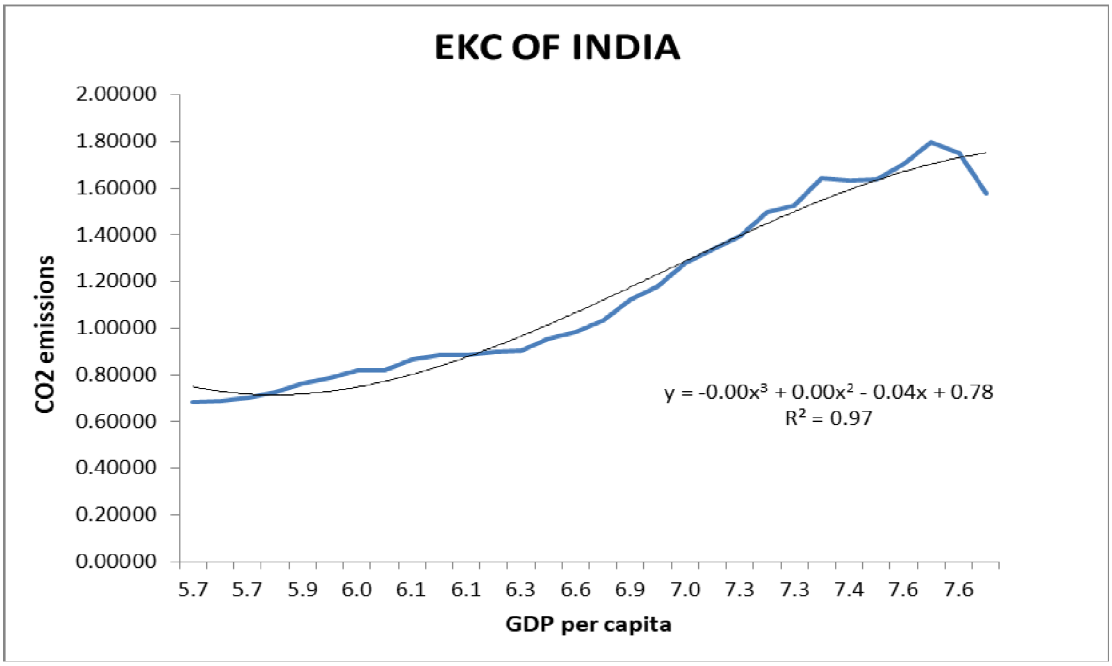
Applying EKC hypothesis on the data taken for the study we get a line chart which is shown below:

EKC AND CO2 EMISSIONS: INDIA



On the horizontal axis we have taken GDP per capita (current US$)as an independent variable and on the vertical axis we have taken carbon emissions as a dependent variable, emissions measured in metrics tons per capita. We have converted GDP per capita value into natural logarithms to obtain efficient and consistent results. The data is spanning from 1991 to 2020. As we can clearly see the early years 1991 to 2000 GDP and CO2 emissions increased gradually this shows that as the economy grew so did carbon emissions. Around the early 2000, we see a steeper increase in GDP per capita indicating faster economic growth though CO2 emissions were also rising but not steeply. As we move to mid mid-2000s and beyond we see a gradual increase in CO2 emissions despite continuous economic growth, this shows that India is becoming more energy efficient or shifting towards cleaner energy. In the most recent years i.e. 2017 to 2020, we notice a slight decrease in CO2 emissions while GDP per capita continues to grow this indicates efforts are being made to reduce carbon emissions while maintaining economic growth.

Now if we add a trendline in the above line chart and use the polynomial regression model we will be able to derive some results



We get a polynomial regression equation i.e y = -0.00x3 + 0.00x2 - 0.04x + 0.78

R^2 = 0.97 where the value y represents the amount of CO2 emissions and x represents the GDP, per capita. With a coefficient of determination (R^2) of 0.97, it shows that the equation fits the data nicely and accounts for 97% of the changes in CO2 emissions based on GDP per capita. According to this equation as the GDP, per capita rises so do the CO2 emissions. This correlation has been supported by studies. From examining the trendline we can say that India is currently in the early stages of EKC where its Co2 emissions and GDP per capita are increasing. However, the rate of increase is slowing down, suggesting that India is approaching the turning point where its emissions will start to decline. we can conclude that India is on the path of EKC however it has yet to reach the turning point of EKC.

To address our second objective we have focused on SDG 7 i.e. Affordable and clean energy. We take sustainable development indicators under which one is renewable electricity output and the other is energy intensity. Let us clearly define our variable Renewable electricity output (% of total electricity output)**-** Renewable electricity is the share of electricity generated by renewable power plants in total electricity generated by all types of plants. Energy intensity level of primary energy (MJ/$2017 PPP GDP)**-** The energy intensity level of primary energy is the ratio between energy supply and gross domestic product measured at purchasing power parity. Energy intensity is an indication of how much energy is used to produce one unit of economic output. A lower ratio indicates that less energy is used to produce one unit of output.

Table no.1.2 shows two significant variables for India spanning from 1991 to 2020. These variables are “Renewable electricity output (% of total electricity output)” and “Energy intensity level of primary energy (MJ/$2017 PPP GDP).” The Renewable electricity output represents the proportion of electricity generated from renewable sources concerning the total electricity production, offering insights into India’s adoption of clean and sustainable energy sources. The data reveals a gradual increase in renewable electricity output over the years, starting at approximately 22.81% in 1991 and fluctuating up to 2015. However, it is worth noting that data becomes unavailable from 2016 to 2020. The “Energy intensity level of primary energy,” measures the amount of primary energy consumed per unit of economic output, indicating energy efficiency. A decreasing trend in this variable is seen, from 6.42 MJ/ $2017 PPP GDP in 2000 to 4.28 MJ/$2017 PPP GDP in 2019, which signifies India’s progress toward greater energy efficiency. Unfortunately, data is absent for the years 1991 to 1999 and from 2016 to 2020. Still, these trends suggest a shift towards cleaner energy sources and improved energy efficiency in India’s energy sector, reflecting efforts toward sustainability and environmental responsibility

RESULTS

The polynomial regression equation($y = -0.00x3 + 0.00x2 - 0.04x + 0.78$) which was used to determine ekc of India demonstrates a strong correlation between GDP per capita and co2 emissions in India from 1991 to 2020 with a high coefficient of determination $R^2= 0.97$, it is evident that this equation fits the data perfectly and explains that approximately 97% of the variability in co2 emissions based on GDP per capita.The coefficient on the x3 is negative which means that the rate of change of Co2 emissions with respect to gdp per capita is declining and the coeficient of x2 is zero which means that there is no quaratic relationship between co2 emissions and gdp per capita. The coefficient on the x term (0.04) is positive which means that co2 emissions increase with gdp per capita.The constant term (0.78) is rhe intercept of the regression line which represents the predicted co2 emissions when gdp per capita is zero. The equation's negative coefficients for the x^3 and x^2 terms show a non-linear relationship, implying that as GDP per capita increases CO2 emissions initially increase supporting the concept of Environmental Kuznet Curve (EKC). However, this analysis also indicates that India has not yet reached the turning point of the ekc where further economic growth reduced CO2 emissions. From examining the trendline we can say that India is currently in the early stages of EKC where its Co2 emissions and GDP per capita are increasing. However, the rate of increase is slowing down, suggesting that India is approaching the turning point where its emissions will start to decline. We concluded that India is on the path of EKC however is yet to reach the turning point of EKC.

The data regarding the proportion of electricity generated from renewable sources as a percentage of total electricity production offers valuable insights into India's transition towards cleaner and more sustainable energy resources. The continuous increase is observed from approximately 22.81% in 1991 to 2015indicating increasing use of renewable energy sources in the energy mix. However, The absence of data from 2016 to 2020 leaves a gap in understanding recent developments. Still, this trend aligns with global efforts to reduce carbon emissions and combat climate change. It implies that India is moving in the right path by utilising more renewable energy in the production of power, which can help to reduce CO2 emissions.

By examining the decreasing trend in the energy intensity level of primary energy from 6.42 MJ/$2017 PPP GDP in 2000 to 4.28 MJ/$2017 PPP GDP in 2019 we can say that India is progressing towards greater energy efficiency. This metric reflects the amount of primary energy consumed per unit of economic output and is a key indicator of energy efficiency. A lower energy intensity level indicates that less energy is required to produce a given amount of economic value which is beneficial for the environment. The full analysis of India's long-term energy efficiency initiatives is still constrained by the absence of data for the years 1991 to 1999 and 2016 to 2020.

In conclusion, the data suggests that India is making progress, towards an energy system that's both eco-friendly and sustainable. The embrace of energy sources and advancements in energy efficiency are actions towards lowering CO2 emissions and achieving a more harmonious balance between economic growth and the environment. However, it remains crucial for India to persist in these endeavours of reducing CO2 emissions while effectively tackling any remaining obstacles, on the journey to sustainability.

CONCLUSION

In conclusion, when we look at India's environmental and energy situation from 1991 to 2020 we see some positive trends. To see whether India follows the EKC hypothesis we used polynomial regression and concluded that India is on the path of ekc however the turning point of ekc is yet to be achieved. From examining the trendline we concluded that India is currently in the early stages of EKC where its Co2 emissions and GDP per capita are increasing. However, the rate of increase is slowing down, suggesting that India is approaching the turning point where its emissions will start to decline. On the other hand, India has been using more renewable energy sources like solar power and wind energy which is good for the environment. Also, India is using energy more efficiently which means India is getting more value from energy use which is a better thing for both the environment and the economy. We can say that India is on the right track towards cleaner and more sustainable energy. India has been using more renewable sources and becoming more energy efficient. But it still has to work on making the economy even more environmentally friendly and sustainable.

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Achieving Sustainable Development Goals in Urban India: Emerging Challenges

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Abstract:

The Sustainable Development Goals (SDGs) are global benchmarks of the Agenda for Sustainable Development, a global transformation initiative launched by the United Nations General Assembly in September 2015. By 2030, the SDGs should be accomplished. The sustainable development goals are a comprehensive set of 17 objectives that are intended to shed light on the social, economic, and environmental conditions of a country. The SDGs are an international strategy for all nations to guarantee prosperity for everyone, eradicate poverty, and safeguard the environment. There are 17 goals total, with 169 targets included. India's development schemes and programmes have been synchronised with the global goals in order to fulfil its commitment to achieving the Sustainable Development Goals (SDGs). Multiple fronts must be addressed in order to meet the global agenda, and the Ministry must figure out how to increase the Missions' scope by mobilising resources when needed or by providing incentives for the cities to assume responsibility for the objectives. Certain States and towns are intensifying their endeavours and launching such projects to demonstrate their interest in accepting responsibility for accomplishing the global goal. Against this backdrop, present paper attempts to review the status of SDGs in urban India. It also highlights the emerging challenges in achieving SDGS in Urban areas.

Keywords: *SDGs, Urban Development, Environment, Economic, United Nations*

Introduction:

At the start of its 70th Session in September 2015, the United Nations General Assembly adopted the 17 Sustainable Development Goals (SDGs) and the 169 targets that correspond with them. These goals became effective on January 1, 2016. Even though they are not legally enforceable, the SDGs have become global commitments that have the ability to change

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national priorities over the next fifteen years. It is envisaged that countries will be responsible for creating their own national frameworks in order to achieve these objectives. It is important to emphasise that the SDGs are really only tools for benchmarking and monitoring that help guide and assess national development processes. The execution and effectiveness of sustainable development policies, initiatives, and programmes can only be guaranteed by a nation's own policies. The SDGs are part of the 2030 Agenda, which also highlights the importance of having reliable, high-quality, and disaggregated data in order to assess the goals' progress and ensure that no one is left behind. Every one of the 17 SDGs on the agenda had certain targets and indicators established by the UN. A global action plan consists of 213 indicators and 169 targets (United Nations, 2017). With global activity by businesses, industry, civil society organisations, governmental and non-governmental organisations, research, and technological advancement, the SDGs are an agreed road map needed for shared and sustainable prosperity (Khaled et al., 2021). However, there are still a lot of challenges to overcome, which emphasises how important it is for people, industries, and countries with varying rates of economic growth to interact (Staford-Smith et al., 2017). It is also possible to observe the significant interdependencies between the outcomes of other goals and the failure or delay in implementing one goal (Randers et al. 2018; Dáz-López et al. 2021). Because of the intricacy of these relationships, it is crucial that scholars assess the current state of SDG research, for instance by mapping out the body of knowledge or creating new knowledge to support the UN's goals and allow for the abolition of previous partial approaches to sustainable development (Belmonte-Urea et al. 2021; Bordignon 2021). It is widely acknowledged that the success of the 2030 Agenda as a whole would be significantly impacted by India's progress towards the SDGs. It is caused by the magnitude of the population as well as the resilience and flexibility of the Indian economy. Furthermore, India has taken the lead internationally in the struggle against hunger and poverty. Four years after the ambitious plan was adopted, it is time to evaluate the country's progress towards specific SDGs. This attempt to represent the progress profile of India was based on the SDG India Index: Baseline Report 2018 that was released by the NITI Aayog.

Institutional Set-up :

The task of overseeing the SDGs' national implementation has fallen to the NITI Aayog. As part of this implementation process, the NITI Aayog has finished mapping all SDGs, Central Ministries, and Centrally-sponsored Programmes. It is also consulting with other stakeholders, including as States and Union Territories, on a national and local level. The 2018 Baseline Report for the SDG India Index (December 2018) two publications that NITI Aayog published in July 2019 are Localising SDGs: Early Lessons from India, 2019 and... Apart from the performance-based categorization of States and Union Territories into Achievers, Front Runners Performers, and Aspirants, NITI Aayog has selected over 100 aspirational districts for focused interventions. The Ministry of Statistics and Programme Implementation is one of the main players in the SDGs' implementation. In order to assess the progress and level of target and goal achievement in India, the Ministry has created 306 national indicators in compliance with the 169 SDG objectives and the Global Indicators Framework. Among the 306 indicators, 62 important indicators have also been identified to monitor India's most important developmental objectives.

The rapid rise of certain cities and the collapse of others, the increase of the unorganised sector, and the role that cities play in either generating or mitigating climate change are the main urban challenges of the twenty-first century. Global evidence indicates that these issues have not been adequately addressed by modern urban development. The most obvious effects include the growing susceptibility of hundreds of millions of urban residents to rising sea levels, coastal floods, and other climate-related hazards, as well as urban expansion and unplanned peri-urban development. With approximately 54% of the world's population currently residing in urban areas and expected to increase to 67-89% by the mid-21st century, the United Nations views urbanisation as an essential component of national development, regardless of a country's size, location, or status.7. Experts like Dobbs and Remes note that "cities now form the foundation of the global economy, and their management of their affairs will have a profound impact on the lives of over half of humanity." India's urbanisation rate (31.14 percent; 2011 census) is modest to moderate.10 However, the significance of India's urbanisation lies less in the country's level of urbanisation than in two other areas: first, the rate of urban population growth, which is currently estimated to be around 9 million people annually and is expected to reach 10–11 million by 2021; and second, the remarkable increase in the number of cities in India with a population of one million or more. The 52 cities having a population of one million or more were home to 42.4% of all urban residents in the nation in 2011. The emergence of Census Towns is a second aspect of India's urbanisation that directly affects concerns of sustainability, resilience, and inclusiveness. This is a phenomenon linked to the expansion of urban population outside of cities. Known by various names such as urban sprawl, peri-urban development, urbanisation beyond municipalities, and suburbanization, 2,532 of these towns were added to India's hierarchy of settlements between 2001 and 2011. In 2011 these municipalities accounted for 14.4% of the urban population. According to recent studies, there have been many obstacles to this kind of outer expansion, including uncontrolled growth, a lack of planning and development restrictions, inadequate services, and informal expansion.

Urbanisation, Growth, and Access to Services:

Access to essential utilities including power, water, and sanitary facilities has significantly increased for homes as a result of growing urbanisation and the related economic factors. Urban poverty peaked in 2004–2005 at 25.7 percent; it has since fallen to 13.7 percent in 2011–12. There are now 27 infant mortality rates (IMR) for every 1000 live births. Despite the advances that come hand in hand with urbanisation and attest to its good impact on quality of life and infrastructure indices, there are still significant gaps in households' access to housing, services, and other SDG-associated variables.

Inadequate Access to Cheap Housing and Basic Services: The 2011 census found that 29 percent of urban households reside in temporary and semi-temporary structures, and 21.7% of urban households live in slums. Notably, a bigger number of these homes can be found in larger cities, suggesting that there are increasing issues associated with city size. Thirteen million urban families (19 percent) lack access to sanitary facilities, while 36 million households (46%) lack tap water within their homes.

Widespread Poverty in Metropolitan Areas: Roughly 53 million people, or 14% of the population, live in poverty as a result of their current spending levels not being sufficient to provide them with 2100 calories per day and other necessities to remain above the poverty line. The fact that the impoverished live in unstable, high-risk housing, with a dubious water source, and face other environmental hazards, exacerbates the severity of their poverty.

Low Quality Environment: Most cities suffer from air and water pollution, poor solid waste management, low-quality home fuel, and inadequate wastewater and solid waste collection and treatment. Just over 23% of the solid waste produced is submitted to structured processing and treatment, according to the CPCB (2015). Similarly, it is stated that states can only collect and process up to 38 percent of wastewater. There is almost no official system in place in small and medium-sized cities for the collection and disposal of various waste types. The urban poor bear a heavy financial burden in terms of decreased income, decreased productivity, and a lower standard of living due to the lack of collection and treatment services. Even though precise statistics on the number of homes and properties destroyed by natural disasters are hard to come by, they are considered to be sustained.

"India is a fast urbanising country and is witnessing a steady increase in migration from rural areas to urban centres," according to the NITI Aayog (2018) Report. This procedure puts additional strain on the cities' already overworked infrastructure, which includes clean water and sewage treatment, housing, and transportation-related services. Therefore, it is crucial to support inclusive and sustainable urbanisation and build the capacities necessary for integrated, participative, and sustainable planning and administration of human settlements. Four national-level indicators are specified to assess India's progress towards SDG 11, and two of the ten SDG targets for 2030 are included in this goal (Table 5). According to this calculation, the SDG Index score for states falls between 23 and 71, and for UTs, it falls between 6 and 64. The states and Union Territories are divided into four categories by the NITI Aayog: achievers (100 percent); front runners (65–99 percent); performers (50–64 percent); and aspirants (0–49 percent). Similar exercises have also been carried out by a number of states, which have registered performance on several SDGs using data from the numerous government sponsored missions. It is impossible to claim that towns and cities with sizable populations lacking access to cheap housing and essential amenities will be inclusive and sustainable in the long run. Furthermore, cities with 17 percent of the population living in slum settlements and 14% to 15 percent below the poverty line cannot be sustained over the medium-to-long term. The most obvious example of urban unsustainability is the incapacity of cities to effectively handle population growth. Important obstacles to attaining sustainability are presented by the fact that such a situation persists even in the face of low urban population growth and a variety of municipal initiatives.

Status of Urban Services:

Initiatives aimed at urban development seek to accomplish balanced development in all spheres of an urban resident's life, including the physical, social, and economic. The structure for evaluating the urban industry. Under the main liveability standards, the framework is divided into four main components: government, social services, natural resource management, and infrastructural services. Housing is seen as essential to people's health and well-being and promotes economic expansion. However, urban residents around the world are having difficulty finding cheap housing (MGI, 2014). Its role in improving the family is multifaceted; in addition to offering a place to live, it influences access to jobs, healthcare, education, and a host of other indicators, including poverty level (Gopalan & Venkataraman, 2015). In general, PMAY (U) has a major focus on improving this area across a number of liveability-related concepts through a number of complementary and multifaceted projects carried out as part of the Mission. The bottom end of the income pyramid's access to housing is another area of attention for NULM. Basic services are provided by AMRUT and SBM (U), which permits habitat growth generally and raises living standards. Alignment with the Sustainable Development Goals (SDGs) is one way to see how the result approach has become more prominent in recent years. "Adequate housing" is defined as "adequate privacy, adequate space, adequate security, adequate lighting and ventilation, adequate basic infrastructure and adequate location with regard to work and basic facilities - all at a reasonable cost" in the United Nations' "Global Strategy for Shelter to the Year 2000." Thus, adequate habitat creation is required; simply matching demand figures does not solve sufficiency. The availability of necessities like power, septic tanks, and drinking water are important factors in determining one's quality of life. 75.3 percent of the homes had separate kitchens, 90.9 percent had access to safe drinking water, 99.1% had electricity, and 96.2 percent had access to sanitary facilities, according to the NSS (NSSO, 2018). The Indian government is taking a number of steps to ensure that the poorest segments of society have access to decent housing, such as offering financial support for the building of homes with the most basic facilities. These facilities include water connections under AMRUT, electricity under the Saubhagya scheme (NITI Aayog, 2019), health coverage through Ayushman Bharat, LPG gas connections through Ujjwala Yojana, among other things under the Angikaar Campaign (MoHUA, PMAY(U) Angikaar Presentations, 2019), and toilet construction under the Swachh Bharat Mission (SBM).

Water is an essential natural resource that is also a valuable commodity. Freshwater resources are distributed unevenly on Earth. India, home to around 17% of the global population, has only 4.5 percent of freshwater resources (WaterAid, 2018). A sufficient and clean supply of water is essential for inhabitants' health and well-being. The phases of source, treatment, transmission/distribution, and residential water supply in the last mile are generally followed by the water supply service chain. Within this broad value chain, there are numerous models, though. From the viewpoint of the end user, families could get their water from several sources. The goal of AMRUT is to provide water connections to every HH at 100%. The programme has made available 77,64,458 tap connections since its inception. Together with AMRUT, SCM has worked on water supply projects that have a combined project cost of about Rs. 2000 crores, primarily in alignment with AMRUT. It is critical for family members' health and a key indicator of the socioeconomic standing of the populace to have access to clean drinking water. The primary and secondary sources of water in India are divided into many categories. Rivers, ponds, lakes, tanks, precipitation, glacier melts, groundwater, hand pumps, borewells, tubewells, covered and uncovered wells, seawater, and atmospheric water are examples of primary sources. Canals, dam reservoirs, bottled water, tanker supply, treated and untreated tap water are examples of secondary sources (WaterAid, 2018). The primary source of drinking water in 2018 was mostly piped water into the dwelling unit (40.9%), followed by piped water to the garden or plot (16 percent). In addition, as shown in the accompanying figure, bottled water, tubewells, public taps/standpipes, and hand pumps also contribute significantly to the total number of primary sources of drinking water (NSSO, 76th Round, 2018). These main sources, which highlight the state of household drinking water accessibility, are located both on and off campus. The percentage of urban homes with on-site drinking water facilities was 76.8% in 2012 (NSSO, 2012), and it increased very slightly to 80.7% in 2018 (NSSO, 76th Round, 2018). Twenty percent of urban families still have to travel every day in order to get their basic supply of drinking water; of these, thirteen percent must travel up to 0.2 kilometres, thirty-six percent must travel up to half a kilometre, and two percent must travel more than half a kilometre. Yet, according to the NSSO, 76th Round, 2018, the percentage of families with exclusive access to their primary source of drinking water has increased from 46.8 percent in 2012 to 57.5 percent t in 2018. This improvement can be partly due to AMRUT's concentrated emphasis on ensuring that everyone has access to water. Even if individual connections have gotten better over time, they still fall short of the coverage rates of 86% in South Africa and 91% in China. Water availability per capita, according to WSP, is between 90 and 120 lpcd (WSP, 2014). As of 2014, hardly a single large Indian city provided water to all of its inhabitants around-the-clock. Three trials with positive outcomes were conducted in the Karnataka cities of Hubli, Dharwad, Belgaum, and Gulbarga (World Bank, 2014). The water supply length in Indian cities is mainly between one and six hours, but in Brazil, China, and Vietnam, it is 24 hours and 22 hours, respectively (WaterAid, 2018). This indicates a significant disparity in the sector.

Proper wastewater management and sanitation are essential for a city's citizens' health and quality of life. Black water from toilets and grey water from other household chores like dishwashing and showering are both considered wastewater; sanitation focuses on the former. An estimated 1,20,000 tonnes of human waste are produced daily in India. The contamination of soil and drinking water sources by untreated human waste on open land or directly dumped into waterbodies can pose serious health dangers. Many studies have linked the prevalence of vector-borne and water-borne illnesses, including diarrhoea, to poor sanitation and wastewater management. Additionally, one of the leading causes of death for children under five is diarrhoea. Nearly 90% of paediatric diarrheal illness deaths are caused by unsanitary conditions, poor hygiene, or tainted water, according to UNICEF. UNICEF (2013). Targeting a separate link in the sanitation service chain, AMRUT includes a component on increasing sewer connections. While SBM's implied focus is on Faecal Sludge and Septage Management (FSSM), with a particular emphasis on toilets and user interface, AMRUT is explicitly focused on expanding the sewerage network. Along the sanitation service chain, safe management of faecal sludge and septage generated by onsite systems has substantial consequences for environmental and public health outcomes, even though toilet coverage and sewer networks are the most visible aspects of the programmes.

Access to the sanitation infrastructure is possible via a mix of IHHL, CT, and PT. According to NSS statistics, access increased from 91.2% to 96.2% between 2012 and 2018—a 5% improvement (NSSO, 2018). The mission MIS indicates that a significant portion of this growth may be ascribed to SBM, which has resulted in the construction of over 6 lakh CT/PT blocks and over 61 lakh IHHLs. Out of all the access kinds, IHHL access grew significantly by 13.7 percent between 2012 and 2018, which means that fewer homes now depend on CT/PT. The total access rate in urban India is currently over 100 percent despite the lack of a more recent breakdown by access type. This is because, in 2019—with the exception of 52 ULBs in West Bengal—all ULBs in the nation received ODF status under the Mission. Merely 32.7 percent of homes had access to sewage lines at the time of the 2011 Census (Census of India, 2011). AMRUT has invested close to 32,500 crores in sewerage, directly addressing this issue by giving residential connections. As of April 1, 2020, 45 lakh (or 31%) of the 145 lakh intended sewer connections had been established. Approximately 5.5% of all urban homes have obtained sewer connection under AMRUT, calculated by dividing this by the 8.08 crore urban households recorded in the 2011 Census. Should AMRUT reach its goal of 145 lakh overall sewer connections, this proportion would rise to almost 18 percent . Regarding treatment infrastructure, there are 816 STPs with a combined capacity of 23,277 MLD in India, as per CPCB's 2015 STP incentive programme. Only 522, however, are in use; the remaining 79 are inactive, 145 are being built, and 70 are planned for development. With 61,754 MLD of total sewage generation, this leaves only 18,883 MLD of operating capacity. This indicates that only about 30 percent of the total wastewater is treated, even if all operational treatment plants run at maximum capacity. The overall capacity of sewerage treatment anticipated by building new STPs and expanding current STPs is 8,456 MLD, according to the AMRUT MIS dated April 1, 2020.

According to the Standing Committee on Urban Development (2019), India produces over 65 million tonnes of solid trash yearly, of which 45–50% is organic/wet waste, 20–25 percent is recyclable, and 30–35 percent is inert garbage. Since 2011, when it was projected that there were approximately 46.5 million tonnes of garbage generated overall, this has increased by about 33 percent The overall amount of garbage generated is projected to rise by 2.5 times to 165 MTPA in 2031 and by 7 times to 436 MTPA in 2050 in the absence of any efficient waste reduction measures. About 40% (3.4 MTPA) of the 9.4 MTPA of plastic produced in India are left untreated (MoHUA, 2019). A particular emphasis has been placed on the results and effects of SWM initiatives through the National Urban Policy Framework, the Municipal Performance Index, the Ease of Living Index, Garbage Free Cities, and Swachh Survekshan. SCM is primarily focused on quality, adequacy, and sustainability, whereas SBM(U) is primarily focused on enhancing access, adequacy, equity, and environmental sustainability. Through SBM and SCM, desirable goals such as improved public awareness and behaviour modification, cleaner neighbourhoods and cities, modern and scientific waste management, and collection services are effectively targeted.

Conclusion:

The report on the Sustainable Development Framework (UNSDF) 2018–2022 published by the governments of India and the United Nations should also be consulted. In order to meet the development needs of the impoverished, vulnerable, and marginalised populations in India and to scale up creative development solutions, the UNSDF notes that it is “an instrument for the Government of India and the UN to work together in a coordinated and coherent manner.” Urban service delivery, in particular the supply of health services, needs to target “vulnerable areas” in cities as well as the most impoverished residents, including those living on pavements, the homeless, and those living in unofficial slums. (Kanitkar & Kapadia-Kundu, 2002) By 2050, it is predicted that there will be 6.3 billion people on the planet, with developing nations in Asia and Africa expected to have the fastest growth. Lynch and Lucicci (2016) India’s urban population is expanding quickly due to the establishment of new towns, the expansion of suburban and peri-urban areas, and an increase in the country’s overall population. The cities of Delhi, Mumbai, and Kolkata have grown to encompass adjacent districts beyond their municipal administrative boundaries. These regions are now known as the National Capital Region (NCR), Greater Mumbai, and Greater Kolkata, respectively. Numerous push and pull migration variables interact to increase the population of these Indian Class I towns and metropolises. It’s a common misconception that the socioeconomically disadvantaged individuals who live in rural poverty transfer to urban areas and exacerbate urban poverty. However, when one considers the cost of living and economies of scale, it becomes extremely difficult to draw comparisons between rural and urban areas, particularly larger cities. In contrast to cities where public utilities are paid for, villages offer tax breaks and non-taxable service utilities to the farming industry. However, families are still migrating to the cities due to the hardships faced by the farm sector and their attraction to city life, with hopes of achieving social and professional mobility as well as relative caste and religious obscurity. The quality of life suffers when large populations congregate in cities, particularly for low-income and impoverished households. Slums and squatter communities have multiplied as a result of the migration of the landless, marginal farmers, agricultural labourers, and other groups from villages and smaller towns into cities. The majority of these slums are located in fragile and disaster-prone areas. Within a city, there is a great deal of inequity between the non-slum and slum neighbourhoods due to the makeup of marginalised slum people. Unprecedented slum expansion has resulted in unstable living circumstances for both current residents and future generations. According to a United Nations research, two to four out of every five people live in slum settlements across the world, highlighting the marginalised living conditions in urban areas (Bolay, 2006). According to Davis (2004), slums are a direct result of “urban sprawl, environmental degradation, and urban hazards.” In the past, slums were seen to be collections of unethically developed spatial land uses that didn’t belong in cities, seemed out of place, and needed to be cleared out in order to make middle-class and upper-class households’ lives easier. The public conversation around India’s slums has gradually shifted from advocating for slum demolition and removal to one that emphasises in-situ rehabilitation and upgrading. Similarly, there have been minor advancements in urban management due to urban reforms and the adoption of sustainable technological efforts including “low-cost housing, low-cost sanitation, and rain water harvesting” (Dhar Chakrabarti, 2001).

In addition to Central Sector Schemes (CSS), MoHUA and other Central Government Ministries carry out a plethora of different projects that both directly and indirectly advance national priorities and international development goals. Sanitation and clean water are the objectives that are aided by numerous important indicators. Further indicators falling under these goals are being addressed by these CSSs as they develop and grow. In response to the growing water problem, the Indian government recently announced the “Jal Shakti Abhiyan” (JSA), which aims to achieve SDG 6 on water efficiency and conservation. JSA-AMRUT 2.0 was introduced as a water conservation initiative, with individuals serving as the primary resource for its execution. The campaign’s primary focus was on water-stressed districts nationwide, which included 756 ULBs. The campaign’s short-term goals have been to manage local water supply and demand in an integrated manner, with a focus on rainwater harvesting (RWH), reusing treated wastewater, revitalising water bodies, and planting trees. ULBs are in charge of carrying out the projects, and in the event that a city falls under this mission, money must go through AMRUT. Cities that fall outside of AMRUT’s purview must make use of state funding, grants made possible by CFC and SFC, as well as money from other outside sources. In addition, AMRUT and SBM (U)’s growing emphasis on resource efficiency will aid in the achievement of a number of indicators in the following years, including ambient water quality in water bodies, water usage efficiency, degree of water stress, etc. MoHUA and other organisations will need to develop methods to measure and track some of the SDG indicators because they are challenging to quantify. Take catastrophe resilience or the quality of the air in cities. In order to create urban resilience, the Central Government initiated the “National Mission on Sustainable Habitat” (NMSH) in 2010 in response to the growing challenges brought about by environmental degradation and climate change. This was introduced as part of the first “National Action Plan on Climate Change” (NAPCC), along with seven other missions. Promoting awareness of climate change, its mitigation and adaptation, energy efficiency, and the preservation of natural resources has been the mission's main focus. Urban Missions have consistently emphasised the need to curb environmental deterioration and enhance urban resilience. However, a more practical strategy is required to develop more sustainable, climate- and disaster-resilient cities. SDG 11 is all about building "resilience," particularly in the face of catastrophic calamities. India is frequently hit by cyclones, earthquakes, urban flooding, and other natural disasters, and the frequency and severity of these events are growing over time. MoHUA's emphasis on these areas is shown by SCM and AMRUT's targeted approach to storm water management and PMAY (U)'s growing focus on resilient building development. Due to their high population and numerous seismically sensitive buildings, Indian cities are a prime example of why infrastructure needs to be earthquake resistant.

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Unlocking the Plant Resources to Support and Promote the Food Security and Sustainability

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Abstract

Biodiversity is critical to food security and nutrition either locally and internationally. This study focuses on unlocking natural resources, such as fruits and vegetables and various edible flowers, and their possible uses in the production of bioclorants. Natural colorants provide a combination of antioxidant and nutritive properties. Colours are the most essential component of any food item since they enhance its attractiveness and acceptance; nevertheless, the majority of colour is lost during preparation. Several varieties of synthetic dyes are available on the market as colorants; nevertheless, synthetic dyes create serious health problems and environmental damage. Natural colorants are derived from renewable sources, having most of them being plant-based. The most common natural colorants consist of carotenoids, flavonoids, anthocyanins, chlorophyll, and betalain. presently natural colorants are widely used in multiple types of industries, such as the food industry, fabric, and pharmacy. Natural colorants have the potential to establish local jobs, reduce environmental impact, as well as provide businesses with a benefit over competitors. Therefore, from the viewpoint of sustainability, it may be desirable to increase the use of natural colorants beyond the so-called green market. The objective of this study is to deliver an up-to-date status of the various issues raised by the use of colour additives in the food and apparel sectors. reduce the usage of synthetic colours in food and industry. In this study, we will look at some of the edible flowers that are used to generate natural colours. And their potential applications.

Keywords: -*Plant resources, Floriculture, Edible f lowers, Food security, Sustainabil*ity

1. Introduction

Most rural poor people in nations that are emerging rely substantially on agriculture for a living. Farmers tend to find themselves in situations where they are degrading their natural

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resources and have little recourse to more productive and sustainable technologies; thus, empowering these farmers to influence the types of technologies that are being developed has the potential for improving agriculture's contribution to productivity, sustainability, and food security**. (Nancy L. Johnson et.al 2003)** The growing demand for ecologically friendly products has contributed to greenhouse producers' interest in sustainable production technologies. Floriculture is a field of agriculture which focuses on decorative plants and economically substantial floral products**. (Stephanie Burnett et.al 2011)** It involves cut flowers, cut greens, house plants, flowering landscaping, and so on. Floriculture has become a rapidly growing business as an outcome of urbanization and rising living standards, which have led to greater demand for flowers and floral products. Thus, floriculture is emerging as one of the most significant commercial trends. because flowering crops play a vital role in different industry Edible flowers are used in the food industry for decorating desserts, make salads, develop products, and create natural colours. Natural flower colours have been produced using a wide range of methods. Natural colours have been used in the processing of various types of foods, including jam, jelly, squash, food products, ready-made drinks, and dairy products. It also adds nutritional value to food and aids to avoid synthetic colours, which are very harmful to human health. Edible flowers are also high in antioxidants, phytosterols, carotenoids, phenolic compounds, and vitamins C and E. Flowers provide major contributions to food security and the environment. **(Muneeb Ahmad Waniet.al 2018)**

Types of flower crop: -

- Ornamental flowers
- Cut flowers
- edible Flowers

1. **Ornamental flower-** Ornamental flowers are not locally grown and enhance the overall beauty of garden. **Examples Roses, Tulips, daffodils, petunia, bougainvillea etc.**
2. **Cut flowers-** Cut flowers generally grown in local garden. cut flowers are used in the preparation of floral baskets as corsages, flower arrangements and for decoration **examples Gerbera, jasmine, lilies etc.**
3. **Edible flowers-** Flowers that can be consumed safely and some of them may even offer health benefits. **Roses, Hibiscus, Marigold, Blue pea, etc.**

2.Importance of floriculture

1. Economic value

a) **Economic products from flowers:** The value-added products like rose water, marigold oil. perfumes of tuberose etc., are prepared and sold in the markets. flower pigments are also extracted and used in for preparation. apart from this, flowers are dried, preserved and used for making value added products.

b) **Medicinal value:** There are some flowers which are used in medicines and drugs **(e.g. hibiscus, Glorius superba, vinca rosea etc.)**

c) **Edible flowers:** It is estimated that about 100 types of common garden flowers are edible. The demand for edible flowers is picking up even in developing countries. most popular flowers are marigold, rose, pansy, lily, blue pea, hibiscus and lavender etc. flowers are rich in vitamins and minerals. Flowers are also nearly calorie free.

2. Aesthetic Value

The planting of beautiful plants in gardens and parks provides a healthy environment and leads to a genuine improvement is taste and contemplates beauty in an atmosphere of peace. flowers and ornamental plants are used to decorate the indoors or outdoors which add the value of beautification. Flower petals are used for garnishing food items. on dining tables in plates, which increase appetite and attracts delegates for food.

3. Religious Value

Flowers are used for various purposes in our daily life like worshipping, social functions and wedding. flowers are considered essential for people in their worship and offering to God.

Table1. Major Importing countries in Floriculture:

S.NO	Country	Qty (MT)	Value (US$ Mill)
1.	Germany	8,57,256	3,088
2.	Netherlands	7,28,957	1,993
3.	USA	2,46,206	1,916
4.	United Kingdom	3,60,259	1,699
5.	France	3,08,603	1,305

Table2.Major Exporting Countries in Floriculture:

S.NO	Country	Qty (MT)	Value (US$ Mill)
1.	Netherlands	35,80,857	8,790
2.	Columbia	1,61,026	1,236
3.	Germany	4,82,547	956
4.	Equandor	90,251	792

Table3. Example of Edible Flowers Reported in Literature

S. No	Flower	Pigment	Edible Use
1.	Roses	Carotenoids and Anthocyanins	Tea, candy
2.	Marigold	Carotenoids	Soups and Pesto
3.	Pansy	Anthocyanins	Salad, Tea
4.	Hibiscus	Anthocyanins	Tea
5.	Blue Pea (Aparajita)	Anthocyanins	Natural food Colorant Tea
6.	Lavender	Anthocyanins	Salads and Cocktails
7.	Sunflower	Beta Carotene	Salads
8.	Chamomile	Flavonoids	Soups, jam and Tea
9.	Dahlia	Anthoxanthin	Cocktails
10.	Squash Blossom	Beta Carotene	Soups

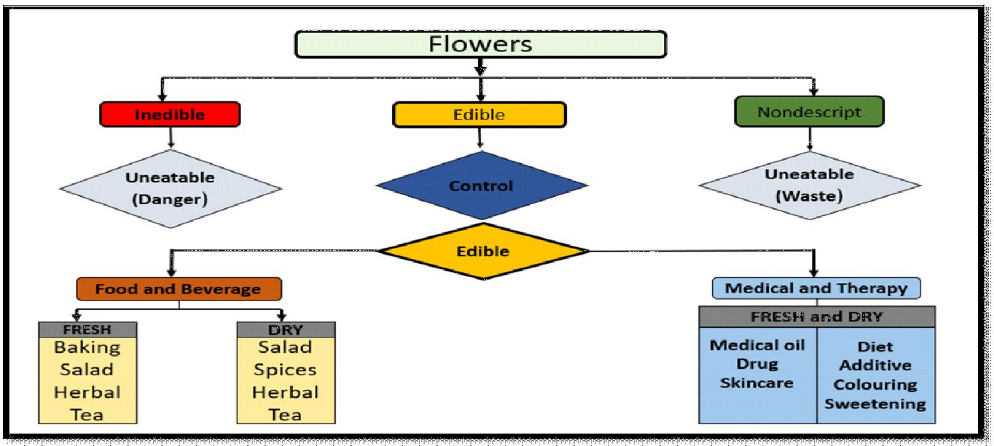

Fig.1 Description of Edible flower.

3. Consumption of Edible flowers

The diets of individuals are changing throughout the world, they were looking for healthier, more functional foods. Edible flowers are used to adorn as well as contributes sensory attributes (colour, taste, aroma, and flavour). Flowers are a rich source of antioxidants; antioxidant activity is connected with their phenolic chemicals, which have a mechanism of action that involves intercepting or halting chain reactions induced by free radicals.

The consumption of food rich in natural Antioxidant enable to prevent coronary heart disease, diabetes, cancer, and degenerative diseases. **(Tânia C.S. P. Pires, et.al2019)** individual diets are changing all throughout the world due to individuals seek healthier, more functional meals. Edible flowers are used to decorate as well as add sensory qualities (colour, taste, scent, and flavour). Flowers are high in antioxidants; antioxidant activity is related to their phenolic components, which have a mechanism of action that involves interrupting or stopping chain events caused by free radicals.

4. Reasons of consumption of edible flowers

The reasons for consuming edible flowers are represented in Figure 2 .and nutrition suggested for most people the option of eating flowers. in fact, flowers, have many colours, many times it's due to the presence of pigment which include anthocyanins, which are powerful antioxidant compounds with antioxidant activity.

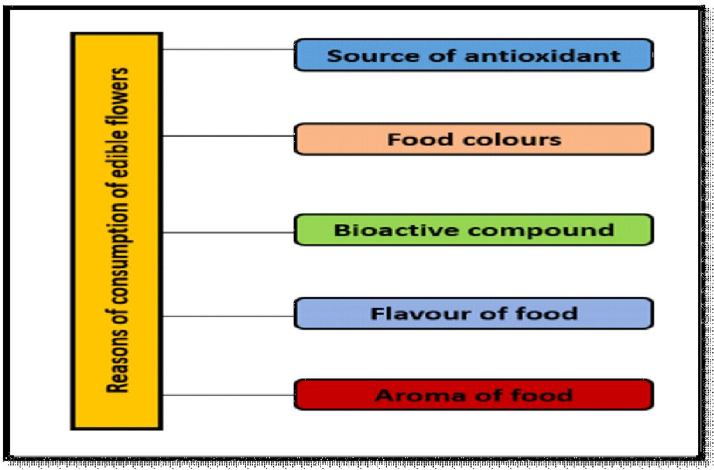

Fig.2 Reasons for consuming edible flowers.

5. Strategy of consuming edible flowers

Cooked edible flowers are eaten the most (98.4%), while fresh flowers contributing only 43.8%. Fresh flowers allow for the better preservation of the flowers' nutritional and bioactive properties, as well as their aromas and taste. It's important to note that not all flowers are edible, and some can be toxic, it's essential to do through research and ensure that the flowers you are using are safe and edible.

6. non-nutritional characteristics in consumer acceptance

Some flowers, mostly classified as attractive species, have important characteristics such as a range of colours. texture and aromas being also edible. Specifically, for acceptance of flowers in diets, besides sensory characteristics, packing characteristics, and the price are always analysed by consumers, because flowers are most known as education. gender, income also affect acceptability Overall, it is clear that two factors have a most crucial role in determining the possibility that edible flowers are used. The primary one is visual perception. with colour being the first sensory attribute observed by the consumer, as flower as much pigmented, colours arise curiosity, the second deciding factor, only after eating the consumer adhere to other sensory aspects such as taste, aroma and texture thus, Edible flowers are excellent possibilities and potential foods that can be included in a balanced diet due to their offer a satisfying sensory experience as maintaining health.

7. Production and advertising of edible flowers

Data on the production, marketing, and consumption of edible flowers is not found in the literature or on official government websites. The global market for floriculture, which includes the cultivation of ornamental plants, is expected to total USD 3.65 billion by the end of 2027.with, Orchid, Lilly, and rose are the most attractive flowers. The ornamental plant industry is significant, including cut flowers, seedlings, and flowers in vases, among other categories, with the Netherlands contributing to 43% of cut flower exports Europe is currently the largest revenue provider in this segment. Notably, due to rising demand for cut flowers in France and Germany, the Netherlands is predicted to be the biggest exporter of bulbs and cut flowers in 2027.Currently, edible flowers are commonly marketed in nature in portable plastics containers kept under refrigeration, dried, preserved in sugar and in distillates faced with an array of attributes and potential in edible flowers. The industry has shown interest to accelerate its commercialization and investing in specialization to improve edible flower quality for longer periods of time, with the goal to provide economic benefits.

8. Application on edible flowers in food sector

Numerous kinds of edible flowers are used to enhance their marketability, as well as improve the aesthetic value of food Edible flowers have been widely utilized due to their potential therapeutic and medicinal uses.

8.1 Utilization of edible flowers in colours development

Bio-colours are used for the potential of foods. large number of synthetic colours are used in food industry, synthetic food colours are incorporated in food that are believed to cause serve problems to humans and the environment. **(Iqra Bashir et.al 2023)** Bio-colouring additives have been used in a wide range of industries, including medicine, food, and beverages.

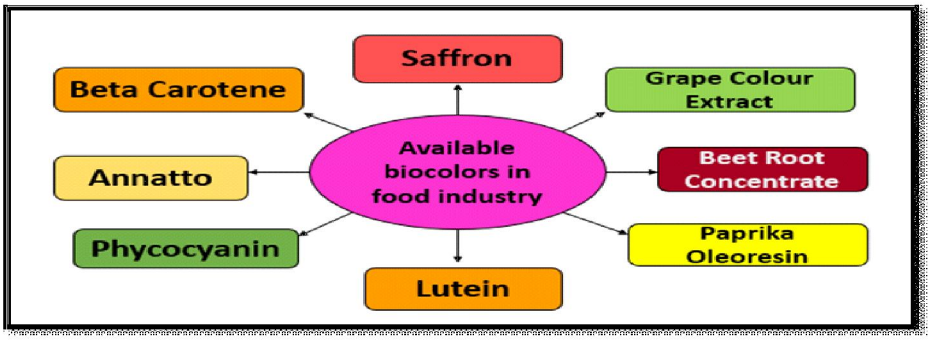

Fig.3 Bio-colours in food industry

8.2 Utilization of edible flowers in bakery products

Cake, muffins and pan cake are most popular baked products. Edible flowers must be used for the decoration of cake and muffins as well as other bakery items to attract consumers.

Fig.4 edible flowers in bakery products

8.3 Utilization of edible flowers in beverages.

Edible flowers are frequently used for potential applications of fruit juice-based beverages, and flowers play a vital role in the making of tea. i.e. rose tea, blue pea flower and hibiscus tea as well as mocktail and cocktail.

Fig.5 Edible flowers in beverages

8.4 Utilization of edible flowers in confectionary

Confectionary belongs to a fast-paced industry of the food industry. many confections to attract the buyers. Jam, jellies, candies and pan coated sweets are example of confectionary products, most of the edible flower's petal are used for candies making.

Fig.6 Edible flowers in confectionary

8.5 Utilization of edible flowers in dairy products

Rose and blue pea flowers are most common edible flowers used in dairy products, rose flower petal extract used in dairy products. Rose flower petals extract used for the preparation of flavoured milk and curd and blue pea flowers extract were also used for the preparation of sweets.

Fig.7 Edible flowers in dairy products

9. Conclusion

Edible flowers were previously employed in different cultures and are now becoming a new food trend. The demand for edible flowers appears to have expanded quickly worldwide in recent years. Consumers' and professional chefs' views that edible flowers are safe, may improve flavour, add colour, and improve the appearance of food Edible flowers (such as blue pea, roses, day lilies, marigolds, and hibiscus) are abundant in natural resources, having most of them that includes vital nutrients and phytochemicals significant health benefits.nowdays.as the global market demands for longer shelf life and safety of food products. Since the synthetic colours side effects are increasing day by day so there is desperate need to overcome the side effects of synthetic colour by using natural or bio-colours in foods, in this chapter we discussed the application and importance of edible flowers as a natural resource.

10.Future Perspective

Future of edible flowers looks promising and growing interest and awareness sustainability, health eating, and culinary diversity some possible future developments for edible flowers are:

1.Increased availability and accessibility: - More people become interested in edible flowers, we can expect to see an increase in the availability and accessibility of these blooms. This might involve more farmers and florist growing and selling edible flowers. as well as expansion of edible flowers option in grocery stores and markets.

2.health benefits: - some edible flowers are already known to have health benefits, and research into the health benefits of different varieties of edible flowers is ongoing.

3.Sustainability: - With an increasing focus on sustainability, there may be more emphasis on growing and consuming edible flowers as a sustainable food source.

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Trade- Offs in Ecomomic Development: Balancing Growth and Biodiversity

Prof. Sandeep Kumar and Nupur Singh

Abstract

The word "biodiversity," which comes from the word "biological diversity," sums up the diverse range of life on Earth. It includes the diversity of living things, the genetic variations among them, and the many habitats they call home. The amazing variety of life forms that have evolved over millions of years is demonstrated by biodiversity, which spans from the tiniest microbes to enormous trees and from the bottom of the ocean to the top of the highest mountain peaks. The complicated interactions between different species provide vital functions like pollination, water purification, and climate management, all of which support the robustness and health of the ecosystems on our planet. It plays an important role in preserving natural harmony, delivering ecosystem services, and enhancing human welfare. On the other hand, economic development necessitates the exploitation of natural resources, often leading to habitat destruction, pollution, and the depletion of ecosystems. This pursuit of growth can result in the loss of biodiversity, threatening numerous plant and animal species. World's second biggest issue is biodiversity loss, after climate change being the first one. Striking a balance between economic development and biodiversity conservation requires navigating intricate policy decisions, considering factors such as land use planning, resource management, and the integration of conservation initiatives into economic frameworks. In this regard, the present paper is divided into VI sections and covers different aspects of this with a focus on the efforts to conserve biodiversity. This paper delves into knowing the economic justification for biodiversity conservation and it's optimal level. The intricate relationship between economic development and biodiversity conservation, shedding light on the inherent trade-offs that arise as nations strive for growth. It explores the case studies of biodiversity loss, consequences, and potential solutions associated with striking a balance between fostering economic prosperity and preserving biodiversity.

Keywords – *Biodiversity Conservation, Ecosystem Services, Economic development, sustainability, trade-off.*

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INTRODUCTION

The loss of biodiversity is the second international environmental problem to be concerned of, after climate change. At the Convention on Biological Diversity, (1992), biodiversity was defined as **'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.'** It includes all the native species; it is not limited to just one specie but is concerned for whole ecosystem; it also shows the interdependencies of ecosystem on each other. Biodiversity refers to the variety of life forms on Earth, including plants, animals, and microorganisms, as well as the ecosystems and ecological processes that support them. Biodiversity is essential for maintaining the balance of the Earth's ecosystems and provides numerous benefits to humans, including regulating climate, providing food and medicines, and supporting the economy through tourism, recreation, and other industries. Mankind is benefitted from biodiversity as it has positive effects on the productivity and resilience of natural ecosystems (Tallamy 2007). Biodiversity conservation is important for all the life forms to make them sustainable.

The foundation of all economic activities and human well- being is biodiversity. In addition to essential life- supporting ecosystem services like food and clear water, it also offers largely unseen benefits including pollination, nutrient cycling, flood protection, and water filtration. However, the rate at which mankind is depleting natural capital is unprecedented, presenting serious but frequently disregarded threats to the financial sector, the economy, and the welfare of present and future generations (Biodiversity, Natural Capital and the Economy: A Policy Guide for Finance, Economic and Environment Ministers, 2021).

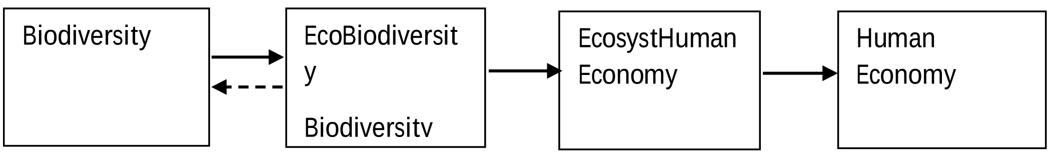
Understanding the intricate relationship between economic development and biodiversity is paramount. Economic activities, ranging from industrialization to urbanization and agriculture, contribute significantly to habitat degradation and loss, disrupting ecosystems and endangering numerous species. The challenge lies in navigating the delicate balance between meeting the needs of a growing global population and preserving the irreplaceable biodiversity that underpins ecological stability and resilience.

The purpose of this paper is to clarify the complicated dynamics of relationship between economic development and biodiversity conservation by highlighting the trade- offs and complexities that inevitably arise when societies attempt to progress while simultaneously balancing the need to conserve biodiversity. The paper is divided into **VI** sections. The section I highlights the economic rationale of biodiversity conservation; section II throws light on the theoretical background of biodiversity conservation; section III gives an in- depth analysis of trade- offs between economic development and biodiversity conservation with few examples in India ; section IV reviews and evaluates policy instruments aimed at reconciling the trade-offs between economic growth and biodiversity conservation; section V explores the sustainable practices into economic development; section VI concludes this research paper.

SECTION (I)

ECONOMIC RATIONALE OF BIODIVERSITY CONSERVATION

Ecosystems with a greater number of species generally work more efficiently and are more robust and stable against external shocks. More specifically, a *diversity* of species results in higher biomass and reduced soil erosion and nutrient loss because they are better able to use the inputs of water, sun, and nutrients than a single or small number of species. Additionally, diversity helps the natural system withstand and adjust to weather extremes, disease, and climate change. Thus, biodiversity leads to increase the flow of ESS and also brings sustainability in these services. By boosting up the stability and productivity of natural ecosystems would increase the flow of ecosystem services. The final link that determines values between natural ecosystems and the human economy is ecosystem services.



There is a *linear* relationship between the biodiversity, ecosystem functions and the supply of ESS. Conversely, because ecological interactions are dynamic, they can have important secondary and tertiary impacts. For instance, a significant side consequence of biodiversity is the decline in the *variability* of ESS. It implies that biodiversity not only supports increased flow of ESS but also increasing the reliability of this flow over a period.

The existence of multiple species that carry out same type of role allows nature to establish ecological *redundancy*. If due to some reasons few specie is not available, then the other species will manage and will make up for the others. The presence of a wide range of species will ensure that few of the species will perform well in the ecosystem and protect it. This makes a significant point that biodiversity gives an 'insurance value'. For example, wild bees and their importance in pollination, arguing that depending solely on honey bees could be risky, as wild bees offer more diversity in pollination and are effective in certain conditions. The wild bees are conserved for both agricultural and ecosystem health.

Among all the three variables, the ESS is the most important link between the human economy and natural ecosystem. The ESS shares a positive correlation with the biodiversity. So, in order to conserve the biodiversity, investment is required to reduce the loss of biodiversity and ESS. Government incurs cost on the scarce resources to mitigate the loss of biodiversity and ecosystem degradation. This results in a better ecosystem and increased flow of ecosystem services.

Biodiversity is measured through the index of species richness denoted by 'R', which varies from 0 to 1. '0' means lack of biodiversity and '1' means large degree of diversity. To attain a higher value of R more amount of investment is required. The investment gives return which is measure by the flow of ecosystem service. The flow of the ecosystem services is measured in terms of unit here and the variable of ESS lies between 0 to infinity. To increase the biodiversity index i.e. to increase the specie richness, the investment should be increased.

The figure below shows the relationship between the biodiversity richness (R) and flow of ecosystem services (S). It is evident from the figure that R and S are positively related, as R moves up, S also goes up. Though the increase in S is not proportionate to increase in R, S does not increase in the same manner as R increases. The graph below, shows the functional relationship between input and output, where the output is flow of ESS and input is the use of land, labour and capital to achieve biodiversity richness.

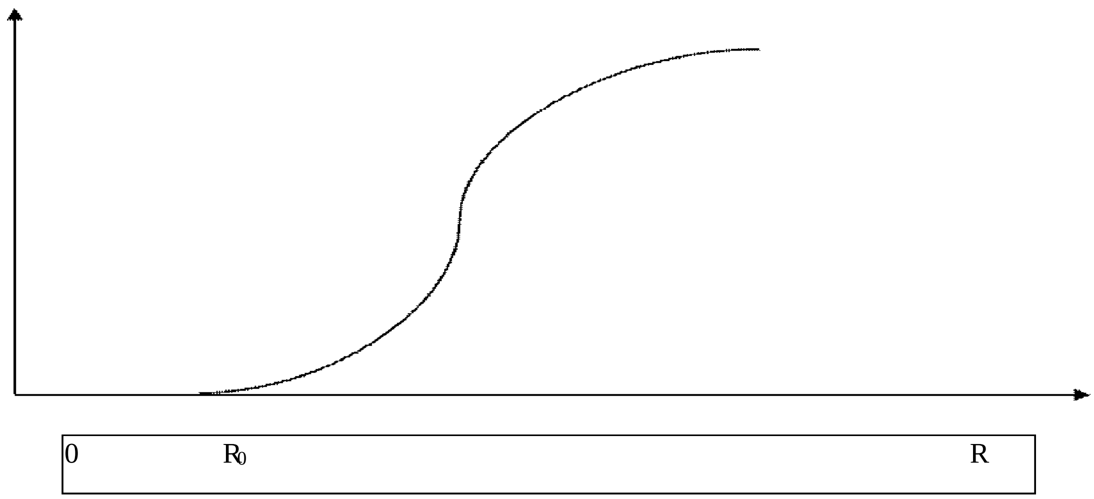


Figure 1- functional relationship between biodiversity conservation and investment in biodiversity conservation

SECTION (II)

THEORETICAL BACKGROUND: THE OPTIMAL LEVEL OF BIODIVERSITY CONSERVATION AND ESS

The achievement of biodiversity as measured by species richness, R, and ensuring that ecological services, S, are provided in a way that maximizes the net benefit to society is the optimality. The balancing of advantages and disadvantages of all actions is necessary to improve biodiversity through increasing biodiversity conservation at the margin. The increased ecological services show the benefits of biodiversity conservation. The ESS consists of heterogenous goods and services. It is assumed that ESS is divided into two main categories which depends whether or not the marginal willingness to pay (i.e., the demand price) for the services can be entirely captured through the normal market mechanism.

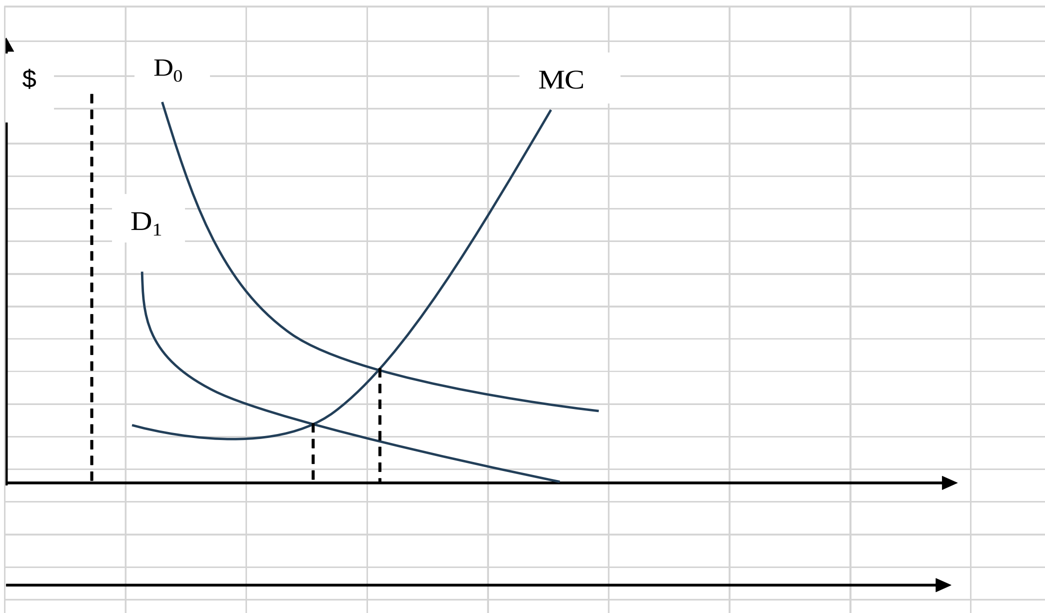


Figure 2- Optimal level of biodiversity conservation and ESS is where MC= D2.

DEMAND SIDE (BENEFIT)

In the figure, the two demand curves, D1 and D2, shows the two approaches of willingness to pay. The vertical axis shows the monetary value of ESS. The horizontal axis shows the level of biodiversity which is measured by index of species richness, R. Also, the horizontal axis shows the value of ecological services which is measured in terms of physical quantity. There is a positive correlation between both the values, R and S, both increases but S increases at a diminishing rate. The first demand curve, D1, measures the value marginal willingness to pay of ESS whose market price is given, for example, food crops, timber etc. The second demand curve, D2, measures the marginal willingness to pay of market whose price is not given, for example, climate regulation, pollination etc.

There could be difference between the willingness to pay and the actual payments made which could be seen from the difference between the magnitude of both the demand curves, (D1 and D2). The demand curves follow law of demand as both are negatively sloped. This has a significant implication: for every unit increase in ESS, S, the marginal values (or willingness to pay) associated with ESS will decrease monotonically. It has an important inference that biodiversity conservation measures are not undertaken before the extinction stage which results in loss of social benefits.

SUPPLY SIDE (COST)

The resources are obtained at a cost to achieve the level of biodiversity. The marginal cost is the cost incurred on land, labour, capital and management resources to conserve the biodiversity. As shown in the figure it is upward sloping which is due to diminishing returns. The production function of R is governed by the law of diminishing marginal product, the positive slope of MC is expected. It also shows the opportunity costs as the costs are incurred on conserving biodiversity which could be used for any other purpose or projects which would be beneficial for the society. For example, a land could be used as biodiversity reserve for flora and fauna which is governed by some law of Government. The same land could be used for cattle grazing.

OPTIMALITY

Through the cost and benefit, the optimal level of ecosystem services is procured. The optimal point is where the marginal cost is equal to the marginal benefit. The optimality is attained at S*, where the marginal benefit of ESS (here it is demand curve D2) is equal to the marginal cost curve. The optimal point of both the species richness (R) and ESS (S) is achieved simultaneously i.e. R* and S*. Any deviation from this point will lead to non- optimal situation. In the left side of R*, the marginal benefit of biodiversity conservation is greater than that of the marginal costs. It is better to increase the biodiversity conservation to manage the increment in marginal benefits. In the right side of R*, the marginal cost is greater than that of the marginal benefits. In this case, it is beneficial to reduce the efforts to conserve biodiversity.

SECTION (III)

TRADE-OFFS BETWEEN ECONOMIC DEVELOPMENT AND BIODIVERSITY CONSERVATION

Economic development and biodiversity conservation have long been seen as conflicting goals. Economic development, defined as the sustained growth of a country’s economy, often prioritizes the exploitation of natural resources in order to generate profits and create jobs. However, biodiversity conservation is directed towards the preservation and sustainability of different species in our planet. These two goals, however, can be contradictory with economic growth that demands natural resources and in turn brings habitat loss, pollution, etc as tools that threaten biodiversity. It is in the context of economic sectors such as agriculture, forestry, mining and tourism where one can see the interaction between economic development and biodiversity conservation.

For instance, there is that case of land which in the agricultural industry it would turn away from natural habitats to farmlands implying that biodiversity will be lost. This expansion of agricultural land is driven by the increasing demand for food and biofuels. Economic development has deforested a section of the forest in the sectors of forestry which is to enable timber production as well for paper manufacturing besides creating space for agricultural lands. This has affected biodiversity significantly since forests are majorly categorized as habitats for many different species of plants and animal. Another important industry, which is responsible for biocentric damages, is the mining such as: Belo Monte Dam in Brazil has led to an irreversible loss of wildlife during evacuations and construction.

Much though tourism is considered a source of economic growth, the inverse is also true in biodiversity and its environment stating that tourism can impoverish whatever are found on the ground both living entities and not. Whenever hotels, resorts and the rest of touristic infrastructure gets developed, natural habitats are destroyed and local settlements are displaced.

The relationship between economic development and biodiversity loss becomes even more complicated through the fact that many of developing countries, where economic development is the highest demanded, have high levels of biodiversity. These countries where there are many resources that can be exploited to promote economic development and yet they have limited finances hence making them work under so much pressure for them to ensure that the resources in the nation help develop the economies while curbing off biodiversity conservation which is a very tough. India, an incredible and fast-growing country represents the complex issues relating to trade- off between development and conservation of biodiversity. The examples from real cases and actual scenarios of the trade-offs that have been observed

Conservation problems: Cases in India-

- **Deforestation and the Western Ghats-** Over the last century, the incidence of economic activities such as charcoal-making, agriculture and infrastructural projects has pose a great danger to the Western Ghats, which is a UNESCO World Heritage Site. The trade-off emerges as these activities contribute to deforestation, fragmenting habitats and endangering numerous endemic species. Although economic development in the region is a necessity, the habitat loss due to human activities as well as climatic variation extend risks to the water security, climate regulation and livelihoods of communities that depend on ecosystem services.
- **Urbanization and Wetland Destruction in Mumbai-** Mumbai has seen an unprecedented rate of urbanization, while its only wetlands have continually given up to rapid development and immateriality in the last few decades. The pursuance of human engagement such as land reclamation for real estate and industrial projects has resulted in loss of some critical habitats that were used by migratory birds and other species. This trade-off between urban development and biodiversity things are very evident, which has greatly affected the ecological balances there anything from touts to wetlands cannot be able to provide these essential services such as water purification and flood control.
- **Industrial Expansion in the Eastern Ghats-** Forested areas in the Eastern Ghats have turned into mining and industrial zones due to 'liberalization' towards growth

and industrialization. This has led to loss of habitats and populating the areas, thereby destroying biodiversity, such as endangered species. Cost-benefit analysis should be done between the costs of long-term ecological imbalances that industrial expansion will incur and economic benefits to allow for a discussion on sustainability practices and preservation efforts.

- **Agricultural Intensification in the Gangetic Plains-** It seems the adoption of the intensive agricultural practices such as pesticides and monocultures have been in the Gangetic Plains to satisfy demand for foods. This has contributed to declining the quality of soil, polluting waters and the depreciative currents of biodiversity in agroecosystem. The trade-off between food security and biodiversity conservation seeks innovation in agriculture by embracing practices that emphasize on sustainable management of land and soil as well as promotion of native vegetation.
- **Hydropower Projects in the Himalayas-** The plan to construct such hydropower projects has been a way of solving the energy needs in Himalayan region. Nevertheless, such water projects frequently take a form of river damming disrupting the habitat causing an inward flow of water and aquatic biodiversity threats. The fact that there is a need to strike a balance between the demand for clean energy and protection of Himalayan ecosystems can only be obtained through proper planning which should include exploration of other energy sources in addition to minimizing the environmental repercussion by hydroelectric projects.

SECTION (IV)

POLICY INSTRUMENTS FOR RECONCILING TRADE-OFFS BETWEEN ECONOMIC GROWTH AND BIODIVERSITY CONSERVATION

Addressing the trade-offs between economic growth and biodiversity conservation requires thoughtful policy interventions. Governments and organizations worldwide have implemented various policy instruments to navigate this delicate balance. This section explores key policy tools aimed at reconciling these trade-offs and promoting sustainable development.

- **Protected Areas and Reserves-** In order to conserve the critical habitats and biodiversity, setting and bespoke management of protected areas is necessary. It aims at conservation of ecosystems, prevention of habitat destruction, and protection of biodiversity alongside permitting regulated economic activities in the neighbouring areas. Appropriate enforcement, community participation, and linkages between the protected areas play a vital role towards the effectiveness of protected areas.
- **Payments for Ecosystem Services (PES)-** Providing direct financial incentives for landowners or communities who preserve or restore ecosystems that provide essential services by ensuring that they derive value from the provision of the services. The main objective of it is to manage interests from an economic point of view with

conservation and cooperating by covering the opportunity costs that come with sustainable land use. It should have rigorous monitoring, the right of ownership, and the fairness in distribution of benefits.

- **Biodiversity Offsetting-** This may include the practice of allowing certain destruction of a part of biodiversity for saving, integrity, or restoration of an equivalent or more significant area elsewhere. Avoiding the negative effects of development projects with regard to biodiversity by implementing net gain in biodiversity. The debate about credit programs is associated with fears of equivalence, additionality, and danger that offsetting may become a permission to continue habitat destruction.
- **Environmental Impact Assessment (EIA)-** Mandating assessments of potential environmental impacts before approving development projects. Ensuring informed decision-making by considering the environmental consequences of proposed activities. Its effectiveness depends on the rigor of assessments, transparency, and the integration of biodiversity concerns into decision-making processes.
- **Sustainable Forest Management-** Implementing relevant policies that encourage the proper use of forest resources as well as ensure that sustainability is guaranteed. It aims at finding a sustainable balance between economic benefits from timber and NTFPs and their conservation of biodiversity and provisioning ecosystem services. It needs well defined laws, community participation and surveillance to ensure that illegal felling and over harvesting is avoided.
- **Regulatory Measures and Zoning-** Setting in regulations and land-use zoning that have rules that prohibit some activities in ecologically sensitive places. Also, controlling incompatible economic activities that threaten to affect national critical habitats and biodiversity. It should, therefore, involve effective enforcement, regular updates based on scientific knowledge and flexibility that will allow them to respond promptly to the changes encountered during implementation.
- **Green Infrastructure Planning-** Using natural elements in urban design and constructing urban infrastructure is also a good step towards increasing the ecological network connection and function. Integrating economical realm with preserving biodiversity, particularly in cities. Such a significant process is very challenging, as it demands joint efforts of urban planners, ecologists, and policy makers to develop green infrastructure.
- **Community-Based Conservation Initiatives-** Delegating the authority to local communities actively involved in biodiversity measures. The purpose of this is building of ownership, sustainable resource management, and also promoting economic incentives that are consistent with conservation purposes. The participation of the community in the development process especially during decision-making, capacity building and benefits' distribution.

SECTION (V)

INTEGRATING SUSTAINABLE PRACTICES INTO ECONOMIC DEVELOPMENT MODELS

The smart use of eco-friendly technologies, green infrastructure, and responsible resource consumption is an important key towards finding the balance between a progressive economy and ecological stability. In this regard, we focus on the most effective approaches to this integration and highlight best practices that reveal successfully implemented strategies.

- **Adopting Eco-friendly Technologies:**

Embrace renewable energy sources, energy-efficient technologies, and sustainable production processes.

-Best Practices:

-Renewable Energy Transition: Countries like Denmark and Germany have successfully transitioned to a significant share of renewable energy, demonstrating the viability of wind, solar, and hydroelectric power.

-Green Manufacturing: Implementing eco-friendly practices in manufacturing, such as lean production and circular economy principles, as seen in companies like Interface and Patagonia.

- **Green Infrastructure Planning:**

Incorporate natural elements into urban planning and infrastructure development to enhance ecological connectivity and function.

-Best Practices:

- Singapore's Biodiversity Corridors: Singapore integrates green spaces, parks, and biodiversity corridors into urban planning, creating an urban environment that coexists with nature.

-Portland's Sustainable Stormwater Management: Utilizing green infrastructure for stormwater management, Portland, Oregon, demonstrates how cities can reduce runoff and improve water quality.

- **Responsible Resource Management:**

Implement sustainable practices in agriculture, forestry, and fisheries to ensure the responsible use of natural resources.

Best Practices:

- Precision Agriculture: Utilizing technology for precise resource application in agriculture, reducing waste and environmental impact.

- Certification Programs: Forest Stewardship Council (FSC) and Marine Stewardship Council (MSC) certifications promote responsible forest management and sustainable fishing practices.

- **Promoting Sustainable Transportation:**

Encourage the use of public transportation, electric vehicles, and other sustainable transportation modes.

Best Practices:

-Amsterdam's Cycling Infrastructure: A city renowned for its cycling-friendly infrastructure, Amsterdam showcases how sustainable transportation can reduce emissions and improve urban livability.

- China's Electric Vehicle Push: China's efforts to promote electric vehicles demonstrate a commitment to reducing reliance on fossil fuels in the transportation sector.

- **Incentivizing Innovation for Sustainability:**

Provide incentives and support for research and development of innovative, sustainable technologies and practices.

Best Practices:

- Research and Innovation Hubs: Countries like Sweden and Finland invest in innovation hubs and research centres focused on sustainable technologies, fostering a culture of innovation for sustainability.

- Government Grants and Subsidies: Governments incentivize sustainable practices through grants, subsidies, and tax breaks for businesses adopting eco-friendly technologies.

- **Education and Awareness:**

Foster a culture of sustainability by educating the public and businesses about the importance of environmentally friendly practices.

- Best Practices:

- Environmental Education Programs: Countries like Costa Rica incorporate environmental education into school curricula, building a foundation for sustainable practices from a young age.

- Corporate Sustainability Training: Businesses invest in training programs to raise awareness among employees about sustainable practices and their role in achieving environmental goals.

SECTION VI

CONCLUSION

The biodiversity contributes to pollination, soil fertility, water purification and disease regulation, which are fundamental for agricultural productivity and human well- being. Navigating complex trade- offs is necessary to achieve a healthy balance between economic progress and biodiversity. Prosperity depends on economic growth, yet this progress frequently comes at the expense of biodiversity. Achieving a sustainable balance necessitates thoughtful policies, innovative technologies and cooperative efforts. The societies can aim to promote both vigorous economic advancement and biodiversity preservation for a more sustainable future by including conservation measures into development goals, encouraging eco- friendly behaviours and encouraging responsible resource management.

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Industrialization, Environment and Sustainable Solution: An Analysis

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Abstract:

Industrialization gained its popularity by 19th century even though it was initiated in the 18th century by the European Countries. Industrialization witnessed a drastic change in the living of humans economically as well as socially. By the development of industrialization the industrial pollution also came into existence. There is no such doubt that, Industrialization is a central pillar of the development of economy of a country in the world. This paper focuses on environmental conflict associated with industrialization and their weak governance system, which takes an important place in the economic, social and environmental science literature in the present scenario. Green Industry should strengthen for industrial production and development that does not come at the cost of the health of natural systems or lead to adverse human health outcomes. Green Industry is aimed at mainstreaming environmental, climate and social considerations into the operations of enterprises. Green Industry is therefore an important pathway to achieving sustainable industrial development. Experiences shows that environmentally sound interventions in manufacturing industries can be highly effective and significantly reduce environmental degradation. We have the technological capabilities for cleaner industrial production today. Green industry can be promoted to deliver environmental goods and services. The need for environmentally sustainable modes of production and a more efficient use of resources i.e. Green Industry, is becoming increasingly evident.

Introduction:

Industrialization gained its popularity by 19th century even though it was initiated in the 18th century by the European Countries. Industrialization witnessed a drastic change in the living of humans economically as well as socially. By the development of industrialization the industrial pollution also came into existence.

There is no such doubt that, Industrialization is a central pillar of the development of economy of a country in the world. This paper focuses on environmental conflict associated

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with industrialization and their weak governance system, which takes an important place in the economic, social and environmental science literature in the present scenario. In fact, there are many loop holes to the way of industrial management system. This is also true that fast industrial growth has made water, air and hazardous waste increases environmental problems. Industrial emissions combine with vehicle exhausts which causes extensive air pollution, while concentrations of heavy metals and ammonia loads are often high enough to cause major threat to life in industrial areas. The lack of hazardous waste facilitates the problem, with industrial wastes often discarded on fallow or public lands, in rivers, or in sewers designed to carry only municipal wastes.

This is the major finding of "Our Common Future", (the 1987 report of the United Nations' World Commission on Environment and Development), is that environmental, economic and social concerns must be integrated if the world's peoples are to advance and develop without endangering the natural environment on which all life depends.

Although today we cannot define the needs of future generations, the challenge for today's leaders is to make policies that will leave available an amount of choices for future generations to meet their own needs.

We define sustainable industrial development in terms of three parameters:

- growth of endogenous productive capacities for innovation;
- improvement in the environmental action of industry; and
- improvement in living standards and there reduction of inequality.

It can be used to measure economic sustainability, social sustainability, institutional sustainability as well as environmental sustainability. The environmental sustainability in industry, is the main theme of this paper, covers the protection of the resource base, the reduction of negative externalities and the promotion of positive externalities.

The present paper establishes the Effect of Industrialization on Environment and Sustainable Solution. The paper is divided into five sections. **Section I** deals with the causes of Industrial Pollution; **Section II** explains major pollutants of Industrial Pollution and Types of wastes ; **Section III** discusses the Effect of Industrial Pollution of various industries and its controlling; **Section IV** explains the benefits of Sustainable Industrial Development and its barriers **.**In the last, **Section V** provides recommendation with conclusions.

Objectives: The objectives of the present study are:

- To study the effects of industry on Environment;
- To study the causes and effect of Industrial Pollution ;
- To give suggestions regarding achievement of Sustainable Industrialization.

Data Source and Methodology: The present study is based on secondary data obtained from various national and international Sources. Research studies, articles, books and journals are the sources to obtain in this background. Present study is exploratory in nature which is based on secondary data. The study is not formula based.

Literature Review:

Sustainable Development will only come about if three goals - economic, environmental and society-related - can be reconciled. To determine the limits of acceptability and scope for action requires a set of conventions which society at large accepts as valid.

1. **Greg Skeleton et al. (1996)** has explained that the global chemical industry, as represented by the International Council of Chemical Associations (ICCA), recognizes that it should put forward an international position on Sustainable Development - supported by local, national or regional activities.
2. **S. Erkman (1997)** presented that through an essentially analytical and descriptive approach (basically an application of materials-balance principle), aimed at understanding the circulation of the materials and energy flows linked to human activity, from their initial extraction to their inevitable reintegration, sooner or later, into the overall biogeochemical cycles.
3. **Jingfu Gu et. al. (2011)** says that Industrial ecology describes that the Traditional linear industry is a short-sighted unsustainable development mode of the economy.

Process Causing Pollution:

The main processes causing pollution are:

- Burning of coal and other fossil fuels.
- Use of chemical solvents in tanning and dyeing industries.
- Emancipating of untreated gaseous and liquid wastes into the environment.
- Improper disposal of radioactive wastes.
- Unchecked noise emanating from machines which is used in oil exploration and drilling constructions.
- Operations working in night shifts increase production but it creates light pollution and various other health issues.

Section (I)

Causes of Industrial Pollution: The Main Causes of Industrial Pollution are:

- **Lack of various policies to control pollution** – Many industries bypass rules and regulations made by the pollution control board (CPCBÈs & PCBÈs) because of lack of effective policies and poor enforcement. This is generally done to avoid the high costs of disposing wastes correctly or installing waste treatment facilities which is expensive in nature.

- **Unplanned industrial growth** – As development and economic growth supercede over environmental or health concerns, rules and norms are violated which are responsible for unplanned growth among industries.
- **Use of old technologies** – This is done to avoid the higher cost of updating technologies. Older machinery produces larger amounts of pollution and wastes.
- **Presence of large number of small scale industries** – Small scale industries usually don't have enough capital and depends on governments grants to run their daily business. When they are classified as small scale, they do not have more rules and regulations by the government and thus create more pollution.
- · **Inefficient waste disposal**– Untreated wastes causes various types of pollutions (especially water and soil pollution) directly. It affects the quality of air in surrounding areas. Industrial pollution is major cause of chronic health related problems.
- **Leaching of resources from our natural world**– This is the main characteristics of the mining industry which extracts raw material from the core of earth which release radioactive materials radiation . Sometimes Oil leaks during transportation are also a cause of marine pollution.

Section (II)

Major pollutants in Industrial Pollution:

There are huge number of pollutants which is responsible for industrial pollution for example Harmful Gases like nitrous oxide, sulphur dioxide, nitrogen dioxide, sulphurous oxide, chlorine gas, carbon dioxide, carbon monoxide, sulphuric acid, mercury, particulate matter, smoke coal dust , fly ash, fluorine, inorganic waste pigments, Alkalis, Phenols, chromates, organic wastes, heavy metals and even hot water.

Types of Wastes:

- **Process Wastes** – The waste generated in an industry due to washing and processing of raw materials which may be organic or inorganic. Both the wastes are toxic to living organisms.
- **Chemical Wastes** – The chemical substance generated as a by-product (waste) during the preparation of a product are the chemical waste product. These products include heavy metals and their ions, detergents, acids and alkalis etc.

Section (III)

Effects of Industrial Pollution:

- **Effect on Human Health-** Industrial pollution has always been responsible for the contamination of water, air and the environment and has affected the health of the people also. Industrial toxic waste is responsible for diseases like cancer, lung infection, asthma, and other dangerous health problems.

- **Low Agricultural Productivity -** The waste materials dumped by the industrial units causes soil and groundwater contamination. Thus, it affects the fertility of the soil and, the consumption of contaminated crops causes health problems.
- **Global Warming -** Global warming increases Earth's temperature which leads to rising water levels due to the melting of glaciers, a constant threat of natural disasters like tsunamis, and several Storms. Moreover, global warming is jeopardizing various animals and fishes.
- **Effect on Wildlife-** Increase in Industrial pollution and industrial activities had led to the destruction of animals' natural habitats. As a result, many wildlife species face extinction due to these factors.
- **Depletion of Green cover and Biodiversity-** The green cover helps in balancing the earth's temperature. Therefore, it is necessary to protect areas and human health affected by rising temperatures due to global warming. Moreover, maximization of industrial activities has been responsible for the loss of green cover and biodiversity loss.
- **Economic Consequences:** As we all know that rapid industrialization is a sign of progress and development but the costs associated with pollution control and clean-up of polluted water sources and areas are extremely high. There is a decrease in tourism revenue every year. There is a huge amount of money spent on health care. In some cases, entire communities must be relocated.
- **Water Pollution:** The effects of industrial water pollution are far-reaching and liable to affect the ecosystem for many years to come. Many of the industries require large amounts of water for their production. When involved in a series of processes, the water comes into contact with heavy metals, harmful chemicals, radioactive waste, and even organic sludge which are either dumped into open oceans or rivers. As a result, many of our water sources have a high amount of industrial waste in them, which seriously affects the health of our ecosystem. The same water is then used by farmers for irrigation purposes, which affects the quality of food that is produced by them. Water pollution has already rendered many groundwater resources useless for humans and wildlife. It can be recycled for further usage in industries.
- **Soil Pollution:** Soil pollution is creating problems in agriculture and destroying local vegetation of farmers. It also lead to chronic health issues for the people that come into contact with such soil on a regular basis (farmers).
- **Atmospheric Deposition:** Cadmium enrichment of soil can also be associated with industrial pollution. Industrial effluents are commonly discharged to surface water drainage

systems after clarification in tailing ponds systems. Recent investigations have disclosed very high concentrations of Cadmium in the overbank and bottom sediments of the rivers.

❖ **Air Pollution:** Air pollution has led to a rapid increase in various illnesses, and it continues to affect us daily. With so many small, mid-sized and large-scale industries coming up, air pollution has taken a toll on the health of the people and the environment.

Effects of Different Industries on Environment:

NAME OF INDUSTRY	EFFECTS ON ENVIROMNET
Construction Industry	Emission of carbon dioxide, methane and other waste products that pollute the air and are believed to contribute most to Global climate change. Global cement industry contributes 5% of global carbon dioxide emission in the world.
Electronics Industry	It results in a large amount of hazardous household waste that is often irresponsibly discarded. When electronics are not recycled properly, the raw materials them leech toxic chemicals into the ground, spoiling both water and food supply for decades.
Chemical Industry	Climate changes across the global fertilizers consists of substances and harmful chemicals like methane, carbon dioxide, ammonia and nitrogen, the emission of these has contributed to a great extent in the quantity of greenhouse gases harming the environment. This is leading to global warming and climate changes.

Textile Industry	During the production of textiles a large amount of energy is used to provide power to factories. This creates more amount of pollution such as carbon dioxide. Dyeing, bleaching or adding finishes to fabrics often involve using highly toxic chemicals. Water used in these processes is pumped into rivers and sewage harming wildlife and humans beings. Increasing raw materials such as cotton requires large amounts of pesticides which are harmful and often affect birds, the water system and insects.
Mining Industry	It leads to water pollution, Loss of Biodiversity, Soil erosion and pollution, Formation of sink holes.
Food and Beverage Industry	Food accounts for over a quarter (26%) of global gas emissions. Half of the world's habitable (ice and desert free) land is used for agriculture. 70% of global freshwater withdrawals are used for agriculture.

Controlling Industrial Pollution:

There are various ways to control Industrial pollution such as:

- **Control at Source:** Source control is a method by which careful selection of raw materials, proper maintenance of machinery, adoption of latest technologies and, setting up efficient functioning of waste treatment facilities etc.
- **Selection of industry site**: This is a very important factor considering the environment around the factory as the production damages the environmental sites.
- **Treatment of industrial wastes**: Industrial Wastes must be treated before disposal to avoid pollution through the help of modern technologies.
- **Plantation:** We need to plant and grow more trees as these acts as buffers and natural purifiers for the environment as plant work as a best absorber of harmful gases specially CO2 which is the major cause of global warming.

- **Strict Government Action:** Government agencies such as the Environmental Protection Agency must be allowed to take stringent action against defaulters and corporations that break the made by government for creating pollution.
- **Assessment of Environmental Impact**: Environmental impact assessment should be carried out regularly which plans to identify and evaluate the potential and harmful impacts of the industries on natural ecosystem.
- **Strict implementation of Environmental Protection Act**: To inspect the air pollution by industrial plants, and chimney wastes, several measures are adopted to remove particulate matter and gaseous pollutants from the scraps. The most common equipment used for removal is cyclone collectors, electrostatic precipitators, bag filters and scrubbers.

Section (IV)

Benefits of Sustainable Industrial Development:

A. The Economic Goal of Sustainable Industrial Development - The interrelation of an economic system is complex, which depends upon the variety of relationships among countries. Multi-national chemical companies apply common standards in spreading investment capital and stimulating markets around the world, which provide the scene for the world market, which play a constructive role in Sustainable Development of Industries and also facilitates for the freedom and fairness in international trade. Robertson says that " Trade as an engine of economic growth" which is essential for Sustainable Development of Industries. The studies shows that the growing intervention of governments in industry and their increasing demands to raise income by taxation, thus imposes inappropriate load on the business community which generate wealth creation and profits which plays a fundamental role for Sustainable Development. They sustain economies and contribute, via re-investment and Research & Development which is essential for new technologies and environmental improvements. Profits are needed to create flexible company structures oriented towards economic, environmental and society-related requirements.

B. The Environmental Goal of Sustainable Industrial Development: The selected integrated approach must be adopted for environmental protection and waste minimization in a consistent manner. The aim should be to integrate environmental protection considerations among products and processes as early as possible in the development phase. Integrated environmental protection also increases plant and product safety and allows waste disposal to be improved and made more efficient. This parameter clearly shows the Responsible Care initiative among various industries.

C. The Society-Related Goal of Sustainable Industrial Development - Waste-management and recycling in the informal sector are an important source of income in many developing countries, but income and working conditions are often poor. Green Industry should aim not only to bring this sector into the formal economic sphere, but to modernize its techniques and processes. Improvement in systems for recycling and reuse of materials would ensure that valuable resources should not wasted, but will also provide opportunities for poverty reduction by the creation of new, formal income-generating industries and jobs with improvement in working conditions.

Barriers in Sustainable Industrial Development:

While there is a compelling case that Green Industry generates sustainable industrial development benefits in each domain — economic, environmental and social — its widespread acceptation is not necessarily a straightforward proposition. It outlines the barriers that exist to the meaningful assimilation and development of Green Industry in developing countries. There are many barriers such as:

A. Lack of Resources –It is not a point of argument over the facts that new infrastructure will need to be put in place for the full transition to a Green Economy to occur. It is seen that the developing countries will lack the resources required to support the development of Green Industry in their countries. It is due to lack of technology, knowledge and expertise, or simply a matter of insufficient capital. Without financing and the transfer of knowledge, skills and technologies to the developing world, the global transition to a Green Economy will take place at a very slow pace. The need to address environmental problems is increasing day by day, and therefore, a big push is required on the part of developed countries to facilitate and aid to developing countries in making their transition towards a Green Economy, if serious damage to ecosystems and climate is to be ignored.

B. Institutional Inertia- Industries in countries may themselves be resistant to change. Although Green Industry is in the long-term best interests of the industrial sector as a whole, there will inevitably be winners and losers. Not only is the engagement of industry important because of the valuable insight and leadership industry can provide, but it is also essential that it is not made an opponent because of its ability to slow or block the efficacy of important Green Industry initiatives.

C. Market and Policy Failures- Market failures can distort market prices and send the inadequate cost information to economic actors, serving as a barrier to the development of Green Industry. Market failures occurs due to externalities , asymmetric information, public good nature, unassigned property rights, imperfect market or they can be the result of misguided government intervention. If markets and policies are not properly adopted, they can hamper attempts to encourage and support Green Industry initiatives.

Section (V)

Recommendation for Sustainable Solutions:

It is seen that Strategic planning is necessary to address the environmental impacts of economic development to an acceptable level. In the present scenario of degrading environment and pressure for constant or rapid industrialization, eco-industry network development provides appropriate solutions to move towards sustainable industrialization. However, it will require a supportive infrastructure base to make it happen. Industry will need a perfect combination of incentives, regulations, management mechanisms, information and other infrastructure facilities to provide the conditions in which industrial symbiosis (IS) can flourish.

Regional development agencies and local Government, which have increasingly accepted responsibility for balancing economic development with other pillars of sustainability, have a welcoming approach towards this concept. Industrial diversity, continuous waste production, existing motivation in work environment, willingness of the govt., industry friendly incentives/ subsidies, huge investment on industrial sector, good transport access, close proximity of industrial participants, local academic skill/expertise provide promising opportunities for successful implementation of Industrial Ecology principles. All these create a supportive atmosphere for creation of eco-industrial Park in this region based on material and by-product exchange.

Conclusion:

Green Industry should strengthen for industrial production and development that does not come at the cost of the health of natural systems or lead to adverse human health outcomes. Green Industry is aimed at mainstreaming environmental, climate and social considerations into the operations of enterprises. It provides a platform for addressing global, interrelated challenges through a set of immediately actionable cross-cutting approaches and strategies that take advantage of emerging industry and market forces. Green Industry is therefore an important pathway to achieving sustainable industrial development. Experiences shows that environmentally sound interventions in manufacturing industries can be highly effective and significantly reduce environmental degradation .We have the technological capabilities for cleaner industrial production today. Green industry can be promoted to deliver environmental goods and services. The need for environmentally sustainable modes of production and a more efficient use of resources i.e. Green Industry, is becoming increasingly evident. This is especially so in the developing world, which has the unique opportunity of avoiding the environmental pitfalls that the developed world has fallen into in the course of its industrial development.

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Climate Change and its Impact on agriculture and Livelihood and its Solutions in Uttar Pradesh.(Keywords : Climate Change,Agriculture, Livelihood)

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ABSTRACT

Earth came into existence billions years ago and since then it is facing the cyclical fluctuations of temperature which really had an adverse impact on health, livelihood, agriculture and of all other socio-economic activities of the society. The main area of concern is that climate change is a serious issue for world and in turn for India and Uttar Pradesh also, as per FAO adversities of climate change has been seen on small and marginal farmers on food grain production, food security, and even on water resources as well. This paper aims to highlight the adverse impact of climate change leading to epidemic , pollution , floods , draughts ,depletion of ground water level thus affecting the health, lives , agriculture which is considered to be a primary activities of Uttar Pradesh and this paper even lays emphasis on the way forward to overcome these issues and how to improve the welfare of the society by ensuring sustainable development process in large populous state like Uttar Pradesh.

For this, the methods so adopted will be from secondary sources like from various research institutes, academic bodies , Intergovernmental Panel On Climate Change (IPCC).This required paper is based on several background informations for instance – "Climate Change and Uttar Pradesh" by Dr. Ashok Kumar Kaithal (Lucknow University) , which had done observations and multistage stratified random sampling of agro-climatic zones of Uttar Pradesh ; "Climate Change and challenges of water and food security for smallholder farmers of Uttar Pradesh"by Dr.R.K. Naresh based their studies on several secondary sources like data adapted from Government Of India and Uttar Pradesh and the articles so published by The Hindu for example-*"Agriculture in U.P at risk from climate change"; "Impact of climate change on agriculture* in *eastern Uttar Pradesh and Bihar states "* by A.N.Mishra (University of Agriculture and Technology , Faizabad*)* used to analyse the impact of climate change under the network project of ICAR using NYD (Normalized Yield Differences).

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Thus, the vulnerability to climate change of farmers in Uttar Pradesh has adverse impact on its agricultural productivity and its livelihood and UP due to its importance in India's food and nutrition security programme is highly sensitive to climate change. To overcome this , an easy and economically feasible options to ensure water and food security has been adopted and an effective adaptation and mitigation policies and strategies is being required to work on a large scale and for a long term solution to global warming a strategy of soil C sequestration is hence requiredsystematic literature,documents and government institutions.

INTRODUCTION

India has been an agricultural powerhouse for centuries but due to its significant portion of the population relying on agriculture for their own livelihood the sustainable management of agricultural practices becomes paramount . By agriculture we mean the science , art, or practice of cultivating the soil ,producing crops ,and raising livestock and in varying degrees the preparation and marketing of the resulting products , on the other hand livelihood means a mean of supporting one's existence especially financially or vocationally. In recent decade climate change induced natural disasters like drought,cyclone, and uneven distribution of rainfall have become a major problem in enhancing agricultural production . As per IPCC, the increase in temperature is projected to be less in kharif season than in the rabi in several parts pf Uttar Pradesh. Uttar Pradesh located in the northern part of the country is surrounded by Bihar in the east , Haryana in the west and Nepal touching its northern borders (as per National Portal Of India).As per the reports mentioned in The Hindu . it has been observed that global and severe climatic changes is degrading agriculture and livelihood of Uttar Pradesh like for instance there are dry spells for 10 days to 20 days during the monsoon,smaller rivers are causing floods and there are hot winds during summer. Sustainable farming practices are the need of the hour as they not only ensure food security but also safeguard the environment for future generations . The climate of UP is generally defined as humid with chilly winter and predominantly rain-fed and this is the reason that UP is characterised by small and marginal land holdings and frequent floods, droughts and soil salinity . Uttar Pradesh is predominantly dominated by agro-climatic zones (a land unit in terms of major climates, suitable for certain range of crops and cultivators) and this why the reason lies behind the excessive production of rice and wheat only in Uttar Pradesh . The reason of inadequate sustainability in UP is adequate and imbalanced use of fertilizers , vulnerable climatic small landholdings , poor mechanisation and problematic soils thus all these factors alarming the need to promote the use of sustainable farming and to make agriculture more resistant to climate change which will help not only the state economy but also the country as a whole

STATEMENT OF RESEARCH PROBLEM

The required study chose UP due to its importance in India's food and nutrition security programme and its high sensitivity to climate changes , Uttar Pradesh inspite of its low per capita income (as per World Bank) plays a significant role in country's agricultural productivity due to its dominance or strong agricultural base . As per All India Coordinated Research Project on Cropping System , people here are directly engaged in agriculture which is around 54% and the irrigation status of agricultural land in UP indicates 40% of net sown area is wholly rain dependent and only 18% of area is fully irrigated .As per IPCC ,the agriculture performance varies greatly across regions in the state ; the western region is agriculturally most progessive contributes around more than 50% whereas the eastern region contributes around 28% of the total value of the state's agriculture output and on the other hand Bundelkhand accounts only 4% The importance of highly intensive crop sequence is well recognised to meet out the growing demands of ever increasing population. Rice ,wheat is the most important crop sequence in India, occupying 60-70 % of the total cultivated areas whereas rest 30% is under cash crops that is mix vegetables and sugarcane in UP . Due to continuous adoption of the sequence has led to the problem of specific weeds, reduced soil fertility in specific root zone (agroclimatic zone), infestation of similar kind of pests, which led to the decline in the efficiency and productivity of the agriculture. As per the journal "Climate change and challenges of water and food security for smallholder farmers of Uttar Pradesh" by RK .Naresh ; reported that the trends as indicates that agricultural productivity of Uttar Pradesh will decline upto 25% which could be as much as 50% in rain fed agriculture ; small and marginal farmers with small land holdings will be more vulnerable to climate change and with the temperature increasing and fluctuations of precipitations , water availability and crop production are likely to decrease in the future. Uttar Pradesh is major sufferer of climatic changes due to multiple factors which are as follows:-

- **Small and fragmented holdings**
- **Fertility management**
- **Weed management**
- **Water management**
- **Lack of Crop rotation**
- **Lack of marketing facilities**
- **Lack of mechanisation**

LITERATURE REVIEW

The study includes the review of existing literature from already published studies and reports that were easily accessible through online journals , publications and library for instances-

Food and Agriculture Organization of the United Nations published *A literature Review on frameworks and Methods for measuring and monitoring Sustainable Agriculture* , in March 2017 , aimed to focus on the measurement of agricultural sustainability as a whole in order to improve the agricultural and rural statistics in the global framework.

Amarnath Tripathi , an assistant professor,Delhi University ; published his research paper "Farmers' vulnerability to climate change in Uttar Pradesh ,India" , aims to assess the vulnerability to climate change of farmers in Uttar Pradesh , and for this the method so used was multiple regression, correlation in order to measure the vulnerability index.

Jeetendra Prakash Aryal , M.L.jat, Tek B.Sapkota,Arun Khatri-Chhetri,Menale Kasssie,Dil Bahadur Rahut,Sofina Maharjan published an International Journal ***: Adoption of multiple climate-smart agricultural practices in the Gangetic plains of Bihar, India ;*** in April 2018; ISBN number- 1756-8692 ; its purpose is to adopt the climate-smart agricultural practices for sustainability of Indian agriculture ;in this study the multivariate and probit models are being utilised and the result of the study shows that farmers who face high temperature as the major climate risk factor are more likely to adopt crop diversification and minimum tillage.

Gyan Prakash Morya , Rajnish Kumar and Yogesh , *Revival of Indigenous technical knowledge for sustainable agriculture under Eastern Uttar Pradesh ;*ISBN number – 0975-1718 , published in August 2016 , it focuses on the revival of scientific traditional knowledge of agricultural practices for sustainable agricultural development, for this study survey and interviews was used and a total of 100 random samples were from 10 villages of 10 districts of 3 administrative divisions of eastern UP including Gorakhpur, Basti and Azamgarhfor recording and the findings so found was that there were 20 Indigenous technical knowledge observed for sustainable agriculture belonging to two groups that is crop and livestock production and each has only 10 indigenous technical knowledge respectively.

Netrapal Malik Scientist , Manoj Kumar Singh Associate Professor ,BANARAS Hindu University , Ashok Kumar Senior Scientist and Head Aligarh, *in 2023* published an article *: Farmers' readiness for organic farming : A study of Aligarh district in Uttar Pradesh* ; it aims to access the readiness of farmers for organic farming in terms of availability of manpower , inputs and sufficient knowledge , for this study multistage sampling method was undertaken which henceforth included 240 farmers of Aligarh and the outcome of the study so found was that landholdings of maximum number of respondents was less than 2.00 hectares and the source of irrigation for most of the respondents was electricity operated tube well and canal.

OBJECTIVES

- To Study about the impact of climate change on Uttar Pradesh,
- To develop resource efficient, economically viable and sustainable crop production technology,
- To develop the need based efficient and profitable cropping system.

RESEARCH QUESTIONS

- What is the major constraints of crop production in Uttar Pradesh ?

- What is the impact of vulnerable climatic change on the socio-economic status of f armers?
- What is the effect of marketing facilities on diversification of crops

METHODOLOGY

The study would adopt mixed methods that is both Quantitative and Qualitative Research methods. It will include the stratified random sampling method , multistage random sampling and even the use of likert scale and a field survey is also being required to study the climate-resilient practices so adopted in different parts of Uttar Pradesh . For ground level analysis an informal interview method also need to be undertaken. In order to measure the Vulnerability and Sensitivity Index on agriculture of UP correlation and multiple regression need to be undertaken .Even the use of NYD(Normalised yield difference) for prediction of crop yield on seasonal basis need to be adopted. The scientific rationale of traditional knowledge of agricultural practices should need to be verified by using secondary data which includes systematic literature , digital library , documents, and past studies .

Region-wise Annual Average Growth Rate of Gross Value Output in agriculture per hectare of Gross Cropped Area and Agriculture GDP in UP

Region wise growth rate	Annual average growth rate	Coefficient of variation of growth of GVOA/ha	Annual average growth rate	Coefficient of variation of growth of agricultural GDP
Central Region	4.5	2.4	2.6	3.6
Bundelkhand	5.2	2.7	3.7	5.0
Eastern Region	4.9	0.7	1.6	3.9
Western Region	5.4	0.9	2.7	1.0
Uttar Pradesh	4.9	0.7	2.3	1.1

Source: Economics and Statistics Divisons , Planning Department GOUP.

RESULTS AND DISCUSSION

Production of crops is greatly influenced by weather phenomena and therefore any changes in climate will have major effects on crop, life and productivity .Thus agriculture in order to cope with the adversities of climate change several measures to make crop climate resilient and to have positive impact on socio-economic status of farmers and their livelihoods several steps need to be undertaken which are like the model of sustainable agricultural practices and farming thus need to be developed especially for small and marginalised farmers for their own livelihood security and the security of future generation ; the need of resource efficient cropping system should be developed for higher profitability and sustainability. Models of integrated nutrient management for different agro-ecological zones and crooping system should be developed to provide guidance for rational and efficient use of fertilisers. Soil quality should be improved through integrated farming system approach involving microbial inoculations,crop residue incorporation and integrated nutrient management .Organic farming should be promoted . Presently 20 Indigenous technical knowledge observed for sustainable agriculture belonging to two groups- crop production and livestock production as per the jounal on Revival of ITK the Bidahani that is beushening and sanda that is double planting for rice cultivation and surka which is a cooked liquid gruel for dairy husbandry confined very local and traditional knowledge .Thereby, farmers should be educated about the need of balanced fertilization including micro or secondary nutrients deficient in their region. such studies will be adding to improve the knowledge of revival of sustainable agricultural practices which will directly or indirectly protects the crops and the livelihood indeed of Uttar Pradesh.

REFRENCES

1 Food and Agriculture Organization of the United Nations published *A literature Review on frameworks and Methods for measuring and monitoring Sustainable Agriculture ,* in March 2017 , aimed to focus on the measurement of agricultural sustainability as a whole in order to improve the agricultural and rural statistics in the global framework.

2 Amarnath Tripathi , an assistant professor,Delhi University ; published his research paper "Farmers' vulnerability to climate change in Uttar Pradesh ,India" , aims to assess the vulnerability to climate change of farmers in Uttar Pradesh , and for this the method so used was multiple regression, correlation in order to measure the vulnerability index.

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India's Climate Challenge: Rising Temperatures, Shifting Rainfall, and Sea Level Rise - Building Resilience through Adaptation and Mitigation

Prof. Archana Singh and Sonali Singh

ABSTRACT:

Climate change poses substantial threats to India, with rising temperatures, altered rainfall patterns, and rising sea levels among the key concerns. This research investigates these impacts, analysing trends and exploring potential solutions. Key findings indicate a significant increase in average temperatures, resulting in more frequent and intense heatwaves. Moreover, while overall monsoon rainfall may decrease, extreme precipitation events are projected to become more common. Sea level rise presents a severe risk to coastal communities and infrastructure.

To address these challenges, the paper explores both adaptation and mitigation strategies. Adaptation strategies include building resilient infrastructure, managing floods, developing drought-resistant crops, and promoting climate-smart agriculture. Mitigation strategies focus on advocating for sustainable energy while emphasizing energy conservation, increasing forest cover, and adopting sustainable water management practices. Additionally, the research emphasizes the importance of financing, technology transfer, and ensuring a just transition for vulnerable populations. By combining these approaches, India can build resilience, address climate change, and proceeding in the direction of a sustainable future. Further research and innovation are essential for crafting viable solutions.

Keywords: *Climate Change, Temperature, Sea-Level Rise*

INTRODUCTION:

Climate describes the typical weather patterns in a region or across the globe over extended periods. Unlike weather, which can fluctuate quickly, climate shifts gradually over decades or longer. Climate change refers to major alterations in these average conditions, such

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as a region becoming warmer, wetter, or drier. It's the enduring trend that sets climate change apart from natural weather variations.

Our planet's climate is altering with unparalleled speed, fuelled primarily by human actions. Scientists concur that rampant carbon emissions will drive global warming by a minimum of several degrees Celsius by 2100. The result will be profound risks to both human societies and ecosystems across the globe. The effects of global climate change are now apparent in every region of the Earth, influencing many economic sectors.

Understanding Climate Change:

Climate change denotes enduring alterations in temperatures and weather patterns. These variations can occur naturally, spurred by fluctuations in solar activity or significant volcanic events. However, since the 1800s, human actions have been the foremost catalyst of climate change, largely stemming resulting from the burning of fossil fuels like coal, oil, and gas. These burning produces greenhouse gas emissions that envelop the Earth like a thermal layer, ensnaring the sun's warmth and escalating temperatures. Carbon dioxide and methane are the primary greenhouse gases driving climate change. They arise from activities like fuelling vehicles with gasoline or heating structures with coal. Deforestation and agricultural practices also liberate carbon dioxide. Additionally, methane emissions are substantial in the energy and agricultural sectors.

GREENHOUSE GAS	FORMULA	ATMOSPHERIC LIFETIME (YEARS)
Carbon dioxide	CO2	100
Methane	CH4	12
Nitrous oxide	N2O	121
Chlorofluorocarbon-12 (CFC-12)	CCI2F2	100
Hydrofluorocarbon-23 (HFC-23)	CHF3	222
Sulfur Hexafluoride	SF6	3200
Nitrogen Trifluoride	NF3	500

Source: Fifth Assessment Report (Intergovernmental Panel on Climate Change, 2014).

Greenhouse gases play a major role in climate change. Some of the most significant greenhouse gases and their sources include:

❖ **Carbon Dioxide:** Fossil fuel combustion, deforestation, and cement production are major sources of carbon dioxide. Pre-industrial concentrations of carbon dioxide were approximately 278,000 ppb (parts per billion), and by 2011 concentrations had increased to 390,000 ppb.

❖ **Methane:** Methane is released from fossil fuel production, agriculture, and landfills. Pre-industrial levels of methane were around 722 ppb, rising to 1,803 ppb by 2011.

❖ **Nitrous Oxide:** The primary sources of nitrous oxide are fertilizer application, fossil fuel and biomass combustion, and industrial processes. Pre-industrial concentrations were approximately 271 ppb, increasing to 324 ppb in 2011.

❖ **Chlorofluorocarbon-12 (CFC-12):** Previously used in refrigerants, CFC-12 was phased out due to its ozone-depleting properties. It had virtually no presence in the atmosphere before industrialization (0 ppb) but reached concentrations of 0.524 ppb by 2011.

❖ **Hydrofluorocarbon-23 (HFC-23):** Also used in refrigerants, HFC-23 was introduced as a replacement for CFCs. Like CFC-12, it had no presence in the pre-industrial atmosphere but reached 0.024 ppb in 2011.

❖ **Sulfur Hexafluoride:** Used in electricity transmission, sulfur hexafluoride was not present in the atmosphere before industrialization. By 2011, concentrations reached 0.0073 ppb.

❖ **Nitrogen Trifluoride:** Nitrogen trifluoride is used in semiconductor manufacturing. It too had virtually no presence in the pre-industrial atmosphere and reached concentrations of 0.0053 ppb by 2011.

The IPCC's Sixth Assessment report, published in 2021, found that human emissions of heat-trapping gases have already warmed the climate by nearly 2 degrees Fahrenheit (1.1 degrees Celsius) since 1850-1900. The global average temperature is expected to reach or exceed 1.5 degrees C (about 3 degrees F) within the next few decades. These changes will affect all regions of Earth.

RESEARCH OBJECTIVES

1. To analyse the trends and impacts of climate change on India, focusing on temperature, rainfall patterns, and sea level rise.
2. To examine potential adaptation and mitigation strategies that can be implemented in India to address the challenges posed by climate change.

CLIMATE CHANGE WREAK ON INDIA

There's no denying it: India is heating up. Between 1901 and 2018, temperatures rose by 1.3 degrees Fahrenheit (0.7 degrees Celsius).This might seem miniscule, but slight increases in temperature can **throw our planet's natural systems out of whack**, contributing to extreme weather like heat waves, drought, and flooding. These climate impacts also disproportionately affect working families and people of colour. In India (and all over the world), you can see the effects of rising temperatures everywhere you look as the climate crisis disrupts our daily lives – and critical sectors like our energy, agriculture, and transportation systems. This spring, India sweltered through its **hottest March on record**.

India faces a dual climate change crisis: it's a significant greenhouse gas emitter while simultaneously being exceptionally susceptible to the effects of a changing climate. The nation is already grappling with altered weather patterns and the resulting impacts – water scarcity, intense heat waves, droughts, powerful storms, and flooding – all of which jeopardize livelihoods and public health. With a burgeoning population of 1.2 billion and reliance on agriculture, India is likely to face even greater adversity from ongoing climate change. Global climate models, despite their limitations, predict a number of changes for India's future climate:

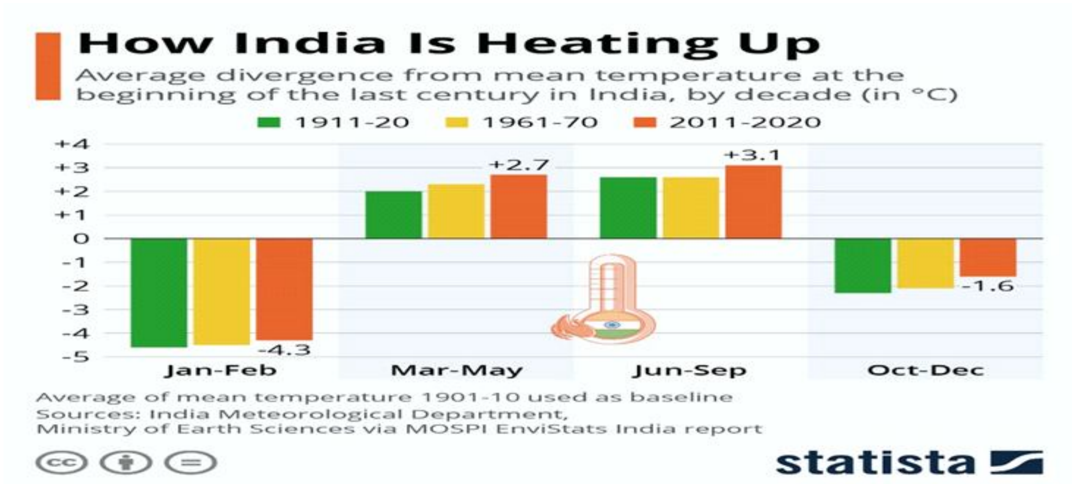
- **Temperature rise:** Projections suggest a potential average temperature increase of 2-4 degrees Celsius by the end of the 21st century.
- **Rainfall shifts:** Rainfall patterns are anticipated to become more erratic, with more intense downpours and extended dry spells.
- **Sea-level rise:** Coastal areas are vulnerable to rising sea levels, threatening displacement and damage to infrastructure.

TEMPERATURE: Between 1901 and 2018, India's average temperature increased by approximately 0.7°C. This warming trend is primarily attributed to greenhouse gas (GHG) emissions. Before the conclusion of 21st century, projections suggest India's average temperature could soar by roughly 4.4°C compared to the recent past (1976-2005). Over the last 30 years (1986-2015), the warmest day and coldest night temperatures have increased by 0.63°C and 0.4°C respectively. By the end of the century, under a high emissions scenario (RCP8.5), these temperatures could surge by an additional 4.7°C and 5.5°C compared to the 1976-2005 average.

Before the conclusion of the 21st century, under the RCP8.5 scenario, the rate of unusually warm days and nights in India is anticipated to rise by 55% and 70%, respectively, in contrast to 1976-2005 baseline. Additionally, summer heat waves (April-June) are anticipated to become 3 to 4 times more frequent before the conclusion of the century under the same scenario. The average length of these heat waves is also projected to roughly double, although individual model projections vary. Due to this rise in both temperature and humidity, India will likely experience amplified heat stress, especially in the Indo-Gangetic and Indus River basins.

Kothawale and Kumar report a 0.07°C mean yearly peak temperature increase per decade in India between 1901-2003, though minimum temperatures remained stable. Srivastava observed regional variations, with cooling trends in southern India and warming in the north. Rupa Kumar notes India's diurnal temperature asymmetry (day/night) differs significantly from global patterns. Krishnan and Ramanathan argue that, when excluding natural variability and GHG impacts, India experienced surface temperature declines of up to 0.3°C from January to May during 1968-1997. Kothawale and Rupa Kumar also found substantial increases in India's annual minimum and maximum temperatures over the 1971-2003 period.

Figure-1 Average Temperature Divergence



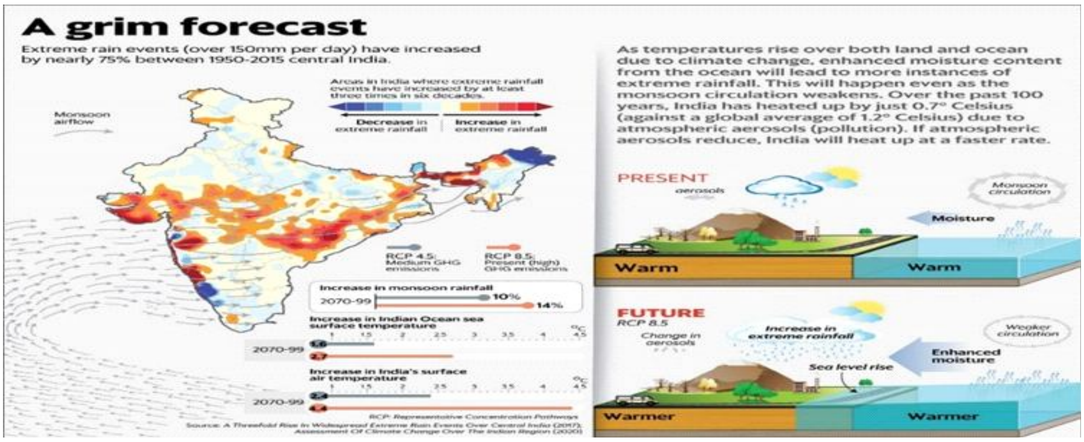
❖ **India is experiencing rising temperatures:** The graph shows that India is getting warmer compared to the average temperatures measured a century ago.**Seasonal variations:** The warming trend is most significant in the Spring (March-May) and Summer (June-September) months, while less intense variations are observed in other seasons.

Gradual increase over decades: The lines representing each decade clearly indicate that the temperature increase has been happening steadily over time. **Baseline Temperature:** The graph compares current temperatures to the average temperature between 1901 and 1910. Deviations above the zero line suggest a warmer period, while deviations below the line would indicate cooler temperatures **x-axis:** The bottom (horizontal) axis lists different seasons throughout the year. **Y-axis:** The side (vertical) axis displays temperature change in degrees Celsius (°C). The coloured lines represent average changes in temperature for each decade. For instance, the uppermost line shows that in the decade 2011-2020, summer temperatures were on average 3.1°C above the 1901-1910 baseline. The graph provides clear visual evidence of the impact of change in climate on India. The temperature increase is most pronounced during the hottest months of the year, making heatwaves more intense and longer-lasting. This trend highlights the relevance of actions to alleviate climate change and develop strategies for adapting to rising temperatures.

RAINFALL: Five Indian states: Uttar Pradesh, Bihar, West Bengal, Meghalaya, and Nagaland, faced significant decrease in southwest monsoon rainfall during the previous 30 years. Analysing **yearly rainfall patterns** in these states, along with Arunachal Pradesh and Himachal Pradesh, revealed **noticeable decreases** in annual rainfall as well.

The Ministry of Earth Sciences (MoES) published a report confirming the increasing surface air temperatures and atmospheric moisture levels across India. This report directly attributes these changes to human activities, including the emission of greenhouse gases, land-use modifications, and the effects of aerosols. These factors are believed to contribute to a rise in extreme weather events like localized heavy rainfall, droughts, floods, and intensified cyclones. Recent studies also indicate a concerning **1.3mm/year sea level rise** along the Indian coasts in recent time 40-50 years. The **IPCC report** emphasizes that rising global mean temperatures have accelerated the loss of Arctic Sea ice and contributed to a 17 cm sea level rise over the last century. Additionally, most global land areas have witnessed an increase in the frequency of intense rainfall events during the past 50 years. The report underscores the reliability of these conclusions regarding global climate change.

Figure 2 Rainfall variation in India



Source: A Threefold Rise in Widespread Extreme Rain events over central India (2017); Assessment of Climate Change Over the Indian Region (2020).

- ❖ **Extreme Rainfall on the Rise:** Between 1950 and 2015, extreme rain events (over 150mm of rain per day) have increased in central India by nearly 75%.
- ❖ **Climate Change is the Culprit:** Rising temperatures, both on land and in the ocean, are directly linked to this increase in extreme rainfall events. Warmer temperatures allow the air to hold more moisture, leading to more intense downpours.
- ❖ **Weakening Monsoon, Yet More Rain:** Paradoxically, even as the overall monsoon circulation weakens, India will experience more extreme rainfall events due to the increased moisture in the atmosphere.
- ❖ **India's Warming Trend:** In the past 100 years, India's temperature has increased by 0.7° Celsius. Atmospheric aerosols (pollution) have slowed warming somewhat; if pollution lessens, India will heat up even faster.

The Future Outlook: The graph presents projected scenarios under varying greenhouse gas (GHG) emission conditions:

- **RCP 4.5 (Medium GHG):**
- Increase in Indian Ocean temperature
- Monsoon rainfall could rise by 10%
- Extreme rain could increase by 25% by the end of the century (2070-99)
- **RCP 8.5 (High GHG):**
- Even greater increases in ocean temperatures
- Monsoon rainfall could rise by 14%

Important Considerations:

· **Regional Impact:** This data highlights the severe implications of climate change for central India. Increased flooding is highly likely, causing potential damage to infrastructure, livelihoods, and agriculture.

- **Adaptation is Key:** India, and specifically central Indian states, need to urgently prioritize strategies to adapt to these changing weather patterns. This means building more resilient infrastructure, implementing flood management systems, and developing drought-resistant crops.

- **Global Responsibility:** This graph also underscores the global nature of climate change. Decreasing greenhouse gas emissions is required to prevent even more severe climate impacts across India and the world.

SEA LEVEL:

- **Sea level rise threatens the Indian Ocean region:** Rising mean sea levels (MSL) and increasingly frequent storm surges are creating extreme sea levels (ESL) that pose a substantial danger to the 2.6 billion residents of the Indian Ocean region.

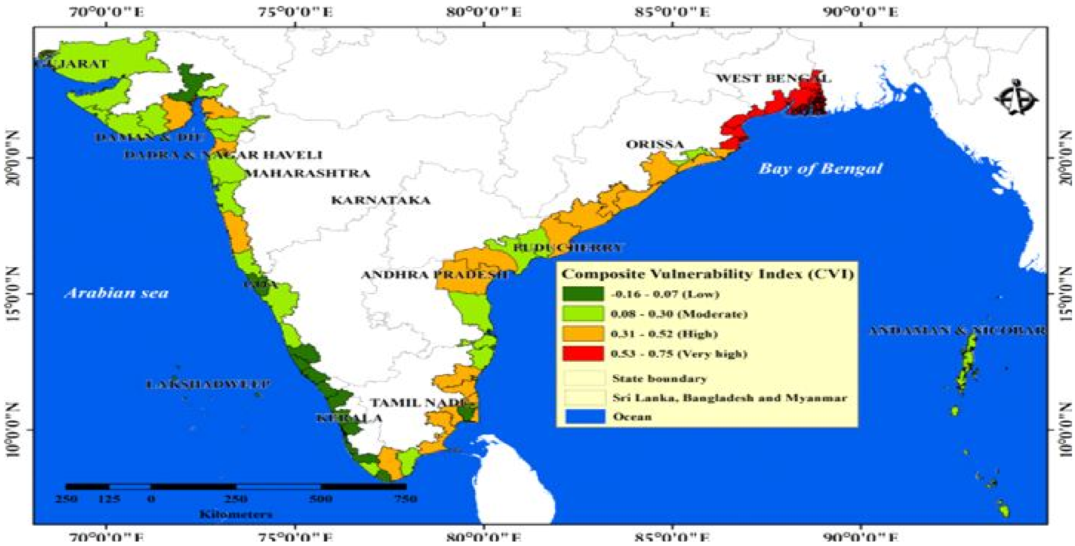
- **Extreme sea levels are intensifying:** This study combines tide gauge and satellite data to show that ESLs are becoming more frequent, longer-lasting, and more intense along the Indian Ocean coastlines. This trend is particularly threat for the Arabian Sea coastline and Indian Ocean islands.

- **Mean sea level rise is the primary driver:** The rise in MSL is responsible for in excess of the 75% of the increase in ESLs. The remaining increase is likely due to intensifying tropical cyclones, fuelled by the warming Indian Ocean.

- **Projected future impacts:** The study indicates a likely two-fold increase in ESL events along the Indian Ocean with only an additional 0.5°C of warming. Under all greenhouse gas emission scenarios, ESLs that are currently rare (100-year events) will become annual occurrences by 2100.

❖ **Urgent need for adaptation:** This research reveals that the Indian Ocean region is highly vulnerable. It underscores the urgent necessity for addressing climate change adaptation policies, particularly along densely populated coastlines.

Figure: 3 Spatial distributions of level of composite vulnerability in coastal districts of India



Source: GeoJournal; A Gateway to Spatially-Integrated Research

About the Assessment Index: Utilizing the Coastal Vulnerability Assessment Index (CVI), INCOIS has created an Atlas of 156 maps (1:100,000 scale) to calculate coastal risk from future sea-level rise. This assessment considers physical and geological factors impacting the Indian coast. The CVI evaluates the potential for physical changes due to rising sea levels based on parameters such as:

- ❖ Tidal fluctuations
- ❖ Wave intensity
- ❖ Coastal gradient
- ❖ Coastal elevation
- ❖ Shoreline erosion/accretion rates
- ❖ Coastal landforms
- ❖ Historical sea-level change trends

POTENTIAL ADAPTATION AND MITIGATION STRATEGIES FOR INDIA

- **Renewable Energy Expansion**: India has set ambitious renewable energy targets, striving to reach 175 gigawatts (GW) of capacity by 2022 and 450 GW by 2030. The International Energy Agency (IEA) projects that India's renewable energy capacity will more than double by 2040. Currently, India boasts an installed renewable energy capacity of around 149 GW, with solar and wind energy dominating the mix.
- **Afforestation and Reforestation**: India aims to increase its forest cover to 33% of its total land area. Initiatives like the Green India Mission and Compensatory Afforestation Fund Management and Planning Authority (CAMPA) aim to increase forest cover and enhance biodiversity.
- **Water Management**: India's National Water Mission aims to conserve water, minimize wastage, and ensure equitable distribution. According to the World Bank, India's groundwater extraction is the highest in the world, emphasizing the need for sustainable water management practices.
- **Climate-Resilient Agriculture**: According to the Indian Council of Agricultural Research (ICAR), climate-resilient agricultural practices like conservation agriculture, drip irrigation, and use of drought-resistant crops can increase crop yields by 20-25%.
- **Urban Planning and Infrastructure**: The Smart Cities Mission in India focuses on developing sustainable and climate-resilient urban infrastructure. According to the World Bank, investments in climate-resilient infrastructure in Indian cities can yield significant economic returns, with benefits outweighing costs by four to five times.
- **Capacity Building and Awareness**: The National Action Plan on Climate Change (NAPCC) includes programs for capacity building and awareness creation at the grassroots level. Initiatives like the Climate Change Innovation Programme by the Department of Science and Technology aim to foster innovation and entrepreneurship in climate change adaptation and mitigation.
- **Policy and Regulatory Frameworks**: India ratified the Paris Agreement in 2016 and has committed to reducing its emissions intensity by 33-35% by 2030 compared to 2005 levels. The introduction of the Goods and Services Tax (GST) in India includes provisions for incentivizing renewable energy equipment and technologies.
- **International Collaboration**: India is actively engaged in international collaborations such as the International Solar Alliance (ISA) and the Coalition for Disaster Resilient Infrastructure (CDRI) to address climate change challenges.
- **Research and Innovation**: India has a strong focus on climate change research and innovation, with institutions like the Indian Institute of Tropical Meteorology (IITM) and the Indian Institute of Science (IISc) leading research efforts. Government

funding and support for climate change-related research and innovation have been increasing steadily.

CONCLUSION:

Climate change presents a serious challenge to India, with rising temperatures, altered rainfall patterns, and rising sea levels threatening various sectors. This research examined the impacts and explored potential solutions. Key findings reveal a significant increase in India's average temperature, leading to more intense heatwaves. While overall monsoon rainfall might decrease, extreme rainfall events are expected to become more frequent. Rising sea levels pose a significant threat to coastal communities and infrastructure.

To address these challenges, adaptation strategies like building resilient infrastructure, managing floods, developing drought-resistant crops, and promoting climate-smart agriculture are crucial. Additionally, mitigation efforts including expanding renewable energy, promoting energy efficiency, increasing forest cover, and adopting sustainable water management practices are essential. Financing, technology transfer, and ensuring a just transition for vulnerable populations are additional important considerations. By combining adaptation and mitigation strategies, India can build resilience, address climate change, and work towards a sustainable future. Further research and innovation are vital in developing effective solutions.

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Human Resource Development in India with Special Reference to Education

Prof. Yamini Pandey

Development is based upon converting raw material in to consumable items, by using technology being run by commercial source of energy. This paradigm centres on materialism, consumerism, and industrialisation use of modern technology with commercial energy input. The journey of development in India starts through the five years plans .Every FYP focused on new goal according to the need of hour. Human resource development has many aspects .Education is the most topical issue in human capital formation. It is the most significant tool for four sided development of mankind. At global level all countries have to maintain their dignities. Human development index is the major issue for all over the world. Its ranking matters a lot.

This paper is the modest attempt to analysis the role of education for human resource development in India and tries to give some measures to meet out the challenges in the development process. It may be beneficial for the policy makers or planners.

Key words:-*Education, Human resource development, public investment, Human development index*

Research methodology-

The research methodology includes a conceptual discussion of the nature of the education policy framework, and the public investment focusing on human resource development. Method used for the data collection is secondary data..

Indian planners were very sensitive towards the problem of poverty and employment .Raising the level of per capita income leads to development of country. Education is one of the most important pillars of human resource development. Recently the word sustainable development is extensively used by the political persons, all over the world. This concept is consistently on the path of analysis. Every span of time and technological advancement, the components of Sustainable development are regularly revising. The main thrust of Sustainable development is Economic, social and Environmental. The social criterion is widely spread. Which includes health, education, hygiene, sanitation,. Out of these Education is the most important one. Millennium development goals 2000 and Sustainable development goals have

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education on top priority. Education has been always been considered as the key component of Human resource development and greatest liberating force in India. Education creates human capital, which is the core of economic progress and assumes that the externalities generated by human capital are the source of self sustaining economic growth as well as human resource development which improves the PHYSICAL QUALITY OF LIFE (PQLI) . The Human Development Index (HDI) is a statistic composite index of life expectancy, education (literacy rate, gross enrollment ratio at different levels and net attendance ratio), and per capita income indicators, which are used to rank countries into four tiers of human development. A country scores a higher HDI when the lifespan is higher, the education level is higher, and the gross national income GNI (PPP) per capita is higher. It was developed by Pakistani economist Mahbub ul Haq and was further used to measure a country's development by the United Nations Development Programme (UNDP)'s Human Development Report Office

In order to become prosperous global economy with in first five ranks, India has to strengthen its education system.

Education policies and investment-

In any country the quality of human resources depend upon the policies related to education, health, social security, infrastructure, hygiene and sanitation. The process of education system is highly dependent on the policies. In India after independence, first document was prepared by Radhakrishnan in 1948 and known as Radhakrishnan commission .It made the education system as a mean to establish democratic values, preservation of cultural heritage, strengthening national integration and so on. First education policy was introduced by prime minister Indira Ghandhi in 1968 and second policy by Rajiv Ghandhi in 1986.After a long gap of 34 years recent National education policy 2020 announced by prime minister Narendra modi.Kothari commission recommended the free and compulsory education for children aged 6 to 14 years .The main emphasis of NEP 1986 was the removal of disparities and equalise educational opportunities .Women, schedule cast, schedule tribes were the main focus group.NEP 2020 came with a vision of employability. It makes the education system having multidisciplinary approach. The main focus of the policy was to make student skilled and job oriented.

It also in the line of goal 4 of the united nations sustainable development goals (SDGs, 2030), which believes equal access of education to all . During the path of Economic development there may arise the gap between the demand and supply of education .In India education is provided both the sectors public as well as private. There are various sources of financing education as public expenditure by central government, state governments, union territories, local bodies, private sector, Non-government organisations, corporate investment and individual households. The efficient outcome comes in form of quality education and formation of human capitals. As far as investment is concern ,in India the share of public expenditure on education has been less than 5 percent as a proportion of GDP ,till 2014-15.It was 3.03% in 2001-02, 2.66 in 2005-06,which increases by 2.94 in 2010-11 and gradually increased by 3.32 in 2014-15. India a developing country recent changes in education expenditure have improved access. It becomes 4.39 percent in 2019-20.As per NEP 2020 public investment on education should be 6 percent of GDP. Indian government is trying to require percentage. This is a positive effort for human resource development.

Conclusion and suggestion—

Indian economy mainly as a agrarian economy .After independence with the Green revolution ,it become largely exhausted with technology and large sector of agriculture labour become jobless .These labourers posses no skills as they have spent fewer years in formal schooling and have less assets. Fifty percent population of India, women play an important role to assigning the grade in Human development index. As the development of India is not like china .We are moving towards the manufacturing sector with MAKE IN INDIA .The technology is changing day by day .so the requirement of more technical people with dynamic quality is to be meet. Our education system as well as our investment towards the sector has been changed. Some major challenges as poverty, lack of teachers, less budget for rural areas, lack of infrastructure, etc are a big hurdle towards the mission of getting good rank in Human development index. But with the proper execution of NEP 2020, will definitely resolve all the problems. Our government done tremendous efforts during the period of pandemic and make our education system digital and easily accessible.

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Impact of Climate Change on Agriculture with Special Reference to India

Dr. Janki

Abstract

One of the most significant worldwide environmental issues that humanity is currently confronting is climate change. There are connections between climate change and agriculture.The effects of climate change on soil, land, water, and the atmosphere have an impact on agriculture. Reducing greenhouse gas emissions without compromising food production and output is the difficult part. The agro ecosystem's many elements, such as crop yield, soil quality, pest and disease infestation, crop loss, irrigation water demand, etc., may be impacted by the rise in air temperature and extreme rainfall events, which are likely indications of climate change. Food security will be impacted as a result. To combat the negative effects of climate change, innovative adaptation techniques and tactics for agriculture and resource surveillance are required. The effects of climate change on several agro ecosystem components are covered in this article, along with strategies for building resilience for sustainable development. this study examines the most recent research on the detrimental effects of climate change on agricultural productivity as well as the primary problems, obstacles, and opportunities for agriculture's sustainable production. The negative effects of climate change may be mitigated by flowing opportunities like adjusting crop rotation with legumes, agroforestry, mixed livestock systems, climate resilient plants, livestock and fish breeds, monogastric livestock farming, early warning systems and decision support systems, carbon sequestration, climate, water, energy, and soil smart technologies, and biodiversity promotion.

This article discusses strategies for building resilience in support of sustainable agriculture development. In order to integrate climate information into agricultural growth by incorporating climate services into practices and policies for future food security, India has created a number of national-level projects for climate change resistance in agriculture.

KEYWORDS: *Climate change, greenhouse gas, agriculture global warming,environment,*

REVIEW OF LITERATURE

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intensification of Cuttack traffic event such as hurricane and cyclones is lacking Balmaseda, Magdalena, et. al. (2013) Water vapour level has rising by 3.5% over the past 40 years in keeping with the 0.5c warming in that time. (UN 1997)Environmental degradation is the deterioration of the natural environment through human activities and natural disasters

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Traditional economic theory posits a trade-off between economic growth and environmental quality.since the early 1990s. However the raridly expanding empirical and theoretical literature on the environment Kuznets curve has suggested that the relationship between economic growth and environment could de positive and hence growth is a prerequisite for Environmental improvement.

Jagbir Singh(2005)in last 100 years mankind has managed to destroy much of what it took nature millions of years to create.

UN Environment Programmer'(2009) India's greenhouse gas in when trees are the impact of climate change over India have realized also called global circulation models prepared by research centres based out of the UK or us this model stimulates the atmosphere at a given point and are exfropolated overtime frames to create climate scenarios.

Linghton, Loston,Warmer(N.D.) (2009)With a worldwide stagnation in serials iiled and a decline in fish catches world food prices are estimated to rise by 30-50% over the coming decade while the global population is expected to increase to more than 9 million from nearly 7 billion.

Ministry Of Environment& Forest ,Govt. Of India,Sept.1,2009, Besides 8 missions under the national action plan of climate change NAPCC there are several other initiative being undertaken and facilitated by government of India to address the issue with change

B.N. Goswami,et.al(2006), Increasing trains have been reported from the starts of West Bengal and Gujarat decline has been observed Orissa and analysis of daily rainfall data have shown arising trained in frequency of heavy rain events and a significant decrease in a frequency of moderate events over Central India from 1951 to 2000.

INTRODUCTION

Climate change refers to any notable, extended alteration in the anticipated trends of the mean weather in a particular area (or the entire planet) over a significant period of time. It deals with unusual fluctuations in the climate and how these affect other regions of the planet. It can take tens, hundreds, or even millions of years for these changes to occur. However, there has been a rise in man-made activities like industrialization, urbanisation, deforestation, agriculture, and alteration of land use patterns. Climate change scenarios include higher temperatures, changes in precipitation, and higher atmospheric CO_2 concentrations. The greenhouse effect is a natural process that plays a major part in shaping the earth's climate.

It produces the relatively warm and hospitable environment near the earth's surface where humans and other life-forms have been able to develop and prosper. Global warming, however, has resulted from an increase in greenhouse gases (GHGs) caused by human activity. These gases include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6).

Environmental, social, ecological, and economic problems are frequently brought on by global climate change and pose a threat to human life and advancement. Sea level rise, glacier melting, and an increase in natural disasters (such strong tropical storms, heat waves, and erratic precipitation) are just a few of the negative effects that climate change has had on human culture. Numerous research demonstrated the multifaceted nature of climate change's effects. . Since climate change is a global public good, individual nations lack incentive to take action to curtail their greenhouse gas emission as they enjoy only a small fraction of the benefits of their actions. This failure to take collective action has resulted in an observable increase in temperatures and rise in the frequency of extreme weather events such as droughts, floods and heat waves in the last half century.

FUNDAMENTAL PROBLEM

Agriculture faces a complex and unique challenge in the context of climate change. In light of climate change, agriculture has a difficult and distinct task. First, because agriculture depends so heavily on weather and climate, it is especially vulnerable. Higher temperatures, more erratic rainfall, invasive pests, and an increase in extreme weather events are already having a negative impact on the industry; these effects will only get worse as climate change picks up speed. Simultaneously, agriculture is a significant contributor to global greenhouse gas (GHG) emissions, both directly and indirectly (by changes in land use brought about by agricultural expansion) and through emissions associated with production on farms

INDIAN CLIMATE CHANGE SCENARIO

Between 1951 and 2015, the summer monsoon precipitation in India decreased by about 6%, with notable reductions occurring in the Western Ghats and Indo-Gangetic plains. India's weather stability is seriously threatened by the retreat of glaciers in the Himalayas, the aggravating impacts of sea level rise, and strong tropical storms that cause flooding and extreme heat stress, according to the IPCC. The scientific sciences remain at the core of the interdisciplinary issue of climate change, but the policy, social, and economic spheres must also take action. Scientific rigour over greenhouse gas accumulation and its effects on the Earth's climate has multiplied. Thanks to advances over the past fifty years, paleoclimatic records of CO2 concentration and temperature for the last half million years can now be created by scientists using data from Antarctic ice cores.

The northern regions of India might be experiencing a more noticeable warming. Under a changing climate, it is anticipated that the extremes of maximum and lowest temperatures will rise. Some locations may have more rain, while others may stay dry. Apart from Punjab and Rajasthan in the North West and Tamil Nadu in the South, where there has been an average modest decline in summer monsoon rainfall across all states in India, a 20% increase is anticipated. Rainfall may decrease in some regions of India (like MP), but most other regions—including the North East—should see an increase in intensity.. Corals in Indian Ocean will be soon exposed to summer temperatures that will exceed the thermal thresholds observed over the last 20 years. Annual bleaching of corals will become almost a certainty from 2050. Currently the districts of Jagatsinghpur and Kendrapara in Odisha; The past observations on the mean sea level along the Indian coast show a long-term (100 year) rising trend of about 1.0 mm/year. However, the recent data suggests a rising trend of 2.5 mm/year in sea level along Indian coastline. By the middle of this century and the end of the century, the sea surface temperature that borders India is expected to rise by roughly 1.5 to 2.0 degrees Celsius. More than half of India's forests are probably going to undergo a change in forest types, which would have a negative effect on the biodiversity that goes along with it, the dynamics of the local climate, and the livelihoods that depend on forest products. The majority of India's forest biomass appears to be quite vulnerable to the anticipated climatic change, even over the course of a comparatively short 50-year period.

IMPACT OF CLIMATE CHANGE ON INDIAN AGRICULTURE

Since ancient times, agriculture has been more reliant on the monsoon. Agriculture is greatly impacted by any changes in the monsoon tendency. The agriculture in India is even being impacted by the rising temperatures. These premonsoon variations would mostly impact the wheat crop in the Indo-Gangetic Plain .Rice production losses during severe droughts (which occur around once every five years) average approximately 40% of total production in the states of Jharkhand, Odisha, and Chhattisgarh alone, with an estimated worth of $800 million. Legumes, oilseeds, rice, and wheat yields increase by 10–20% as CO2 levels rise to 550 ppm. Increases in temperature of 1oC may result in 3-7% lower yields of groundnuts, potatoes, soybeans, mustard, and wheat. much greater losses when the temperature rises. With rising temperatures, more variable rainfall, and less irrigation water available, crop productivity is expected to decline by 10–40% by 2100 but only slightly by 2020 for the majority of crops. Rainfed or unirrigated crops, which are grown on around 60% of cropland, will be the main targets of climate change. According to estimates, India's rain-fed wheat output will decrease by 0.45 tonnes per hectare for every 0.5oC increase in wintertime temperatures (Lal et al., 1998). There could be a slight increase in the yields of coconut, rabi, chickpeas, sorghum, and millets along the western coast.

Reduced frost damage in northwest India has resulted in less loss of vegetables, potatoes, and mustard. Production variability is probably going to rise as droughts and floods become more frequent. Every degree Celsius that the temperature rises throughout the growing season could result in a loss of 4–5 million tonnes of wheat production in the future, according to recent studies conducted at the Indian Agricultural Research Institute. If the temperature rises by 2 o C, rice production is expected to drop by nearly a tonne/hectare. It was estimated that a 2oC increase in temperature in Rajasthan would result in a 10-15% decrease in pearl millet yield. Soybean yields in M.P. will decrease by 5% from 1998 levels if the maximum and minimum temperatures climb by 3oC and 3.5oC, respectively. Because productive areas are susceptible to salinization and flooding, agriculture would be most negatively impacted in Gujarat and Maharashtra's coastal regions. Medium-term climate change projections have estimated the potential decline in agricultural yields owing to climate change at between 4.5 and 9 per cent by 2039, according to A K Singh, deputy director-general (natural resource management) of the Indian Council of Agricultural Research (ICAR). Long-term projections show an even more dire picture, with crop yields predicted to decline by 25 percent or more by 2099. It is critical to lessen vulnerability to the effects of climate change because 27.5% of the population still lives in poverty. The food output in India needs to rise by 5 million metric tonnes annually in order to meet the country's growing population and guarantee food security. Careful management of resources including soil, water, and biodiversity will be necessary to combat the effects of climate change on agriculture. India will have to take action at the international, regional, national, and local levels to address how climate change is affecting food production and agricultur

SUGGESTIONS.

1. Offer farmers incentives for efficient use of resources and resource conservation by giving them credit for switching to adaptable technologies.
2. It is necessary to implement an early warning system to track shifts in disease and pest epidemics. Since integrated pest management addresses various pests in a specific climatic situation, it ought to form the foundation of any comprehensive pest control plan.
3. Eliminate obstacles to the adaptive transformation of production systems, such as insurance programmes with subsidies that sway farmers' decisions and types of assistance that may be detrimental to the environment and raise greenhouse gas emissions.
4. Participatory and formal plant breeding to develop climate-resilient crop varieties that can tolerate higher temperatures, drought and salinity.
5. Realign budgetary support for innovation to ensure the introduction of new technologies for mitigating emissions and sustainable productivity growth, as well as new breeds and varieties that are more resilient to harsh weather events. In order to maximise research and development synergies, such investments would benefit from better partnerships between the public and commercial sectors.
6. Water use efficiency, including frequent yet shallow watering, high-value crop drip and spray irrigation, and irrigation at key periods.

7. Take a food systems perspective when approaching adaptation and mitigation changes. This includes moving consumption to more suited and low-emission production systems and reducing resource demands by minimising food loss and waste.
8. Effective use of fertilisers, including liming acid soils, applying micronutrients like zinc and boron, using sulphur in oilseed crops, applying split applications of nitrogenous and potassium fertilisers, deep placement, using neem, karanja products, and other similar nitrification inhibitors, and integrated nutrient management.
9. To maximise planting and watering schedules, seasonal weather forecasts could be employed as a helpful tool.
10. Strengthen the system for producing food by enhancing input delivery and technology.
11. Reorient budgetary support towards innovation to foster emission-saving and sustainable productivity growth and ensure emergence of new mitigation technologies, as well as new varieties and breeds more resistant to extreme events. Such investments would benefit from stronger partnerships between the public and private sectors to enhance synergies in research and development.
12. Ensure that agricultural policy is completely in line and consistent with long-term strategies and policies to satisfy international climate obligations, especially those that come out of the 27th Conference of the Parties of the UNFCCC Conference (COP27), by means of coordination amongst pertinent ministries. .
13. Offer farmers incentives for efficient use of resources and resource conservation by giving them credit for switching to adaptable technologies.

CONCLUSION

The result of “global warming,” or climate change, is now becoming more noticeable everywhere. The main factor influencing agricultural productivity, which in turn affects global food production, is climate. Since the climate of a region or nation affects the type and qualities of vegetation and crops, the agriculture sector is the most vulnerable to changes in the climate. A rise in the average seasonal temperature can shorten the growing season for many crops, which will lower their yield in the end. The nation’s food security may be negatively impacted by pest and disease outbreaks that lower harvests due to the heightened sensitivity of food production systems to climatic variations in temperature and precipitation.The net impact of food security will depend on the exposure to global environmental change and the capacity to cope with and recover from global environmental change. Careful management of resources including soil, water, and biodiversity will be necessary to combat the effects of climate change on agriculture. India must take action at the international, regional, national, and local levels to address how climate change is affecting agricultural and food production.. More precisely, governments should make sure that agricultural policy is fully in line with long-term strategies and policies to fulfil international climate commitments, including those that come out of the 27th Conference of the Parties of the UNFCCC Conference (COP27). This can be done by coordinating with relevant ministries. There may be trade-offs between consumer food security and nutrition and producer livelihoods when implementing certain policies aimed at reducing emissions and changing agricultural systems..

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The Impact of Sustainable Development Goals on National Policies in India

Dr. Poonam Tomar

Abstract

The nations of the world have joined forces in their pursuit of sustainable development's objectives. This stands in stark contrast to prior strategies where governments sought to advance the expansion and development of their respective economies. The competition for expansion and excellence has led to an imbalance in the economic development of various nations, the depletion of some natural resources, and a consequent change in the ecological balance. Global warming and climate change are the effects of this that are currently being felt. Given that this imperils human life itself on Earth, it is urgent that we take steps to guarantee future generations will live in a safe environment. The phrase "sustainable development" was created to describe development that preserves natural resources and ensures they are preserved for use by future generations. This paper attempts to comprehend the advancement and difficulties India has faced in achieving the Sustainable Development Goals, and it provides solutions to these issues. As environmentally responsible economic growth necessitates a total transformation of the present economic production systems, sustainable development has emerged as a major challenge for the contemporary society in which we live. India has adopted the Sustainable Development Goals, which act as a guide for sustainable development, as a member of the UN.

Key Words: *Millennium Development Goals (MDG), Sustainable Development Goals (SDG), Economic Growth*

Introduction

An improved and more sustainable future for everyone can be attained by achieving the Sustainable Development Goals (SDGs). The 2030 Agenda for Sustainable Development, which consists of 17 Sustainable Development Goals and associated 169 targets, was adopted by the United Nations (UN) General Assembly at its 70th session on September 25, 2015, in an effort to build on the success of the Millennium Development Goals. Beginning on January 1, 2016, the SDGs became operative. The SDGs are a comprehensive list of global goals

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integrating social, economic and environmental dimensions of development. Moreover, the SDGs are universal (for all nations – developed, developing and least developed), interconnected and indivisible and hence necessitate comprehensive and participatory approaches in bringing everybody together so that no one is left behind. Countries are primarily responsible for following up and reviewing the progress made in implementing the goals and targets at the national level till 2030.

India is committed to implement the SDGs based on the nationally defined indicators responding to national priorities and needs. The Government is committed to ensuring "*Sabka Saath, Sabka Vikas, Sabka Vishwas*" in the spirit of the Sustainable Development Goals' motto of "Leaving No One Behind".

The Sustainable Development Goals (SDGs) which came into effect on 1 January, 2016 is an improvement on the Millennium Development Goals (MDGs). These 17 goals cover a wide variety of socio-economic and political aspects which are seen as critical towards achieving a sustainable and equitable growth trajectory which aims to minimise the adverse impact of climate change. The 17 SDGs are as follows – 1) No Poverty, 2) Zero Hunger, 3) Good Health and Well-being, 4) Quality Education, 5) Gender Equality, 6) Clean Water and Sanitation, 7) Affordable and Clean Energy 8) Decent Work and Economic Growth, 9) Industry, Innovation, and Infrastructure, 10) Reducing Inequality, 11) Sustainable Cities and Communities, 12) Responsible Consumption and Production, 13) Climate Action, 14) Life Below Water 15) Life On Land 16) Peace, Justice, and Strong Institutions, 17) Partnerships for the Goals.

Performance of Uttar Pradesh:

Uttar Pradesh has improved on its score in Niti Aayog's Sustainable Development Goal (SDG) index for the second straight year, getting an average score of 60 out of 100 in 16 goals defined by the think-tank. When the first study was conducted in 2018, UP scored 42 which went up to 55 in 2019-20. In 2020-21, it improved its aggregate to 60 against the national average of 66. Based on the score, UP has been ranked as a 'performer' state, ahead of Bihar, Jharkhand and Assam. The state's best performance comes in the seventh sustainable goal of affordable and clean energy. UP, along with 14 other states, has scored a perfect 100 for this goal. Niti Aayog looked at the coverage under household electrification, for which UP scored 100% and the percentage of LPG and PNG connections against the number of households for which the state recorded 106.83%. In 2019-20 index, UP scored 63 under this SDG.

The state has also registered improvement in five other SDGs where its ranking has changed. This includes SDG 3, 'Good Health and Well Being', in which the state's score of 60 against last year's 34 took it from 'aspirant' category to 'performer'.

Similarly, from 48 in SDG 4 of 'Quality Education' last year, it went up to 51 moving the state to 'performer' category. UP also jumped to 'performer' category in SGD 5, 'Gender Equality', where it recorded a score of 50.

In SDG 11 of ‘Sustainable Cities and Communities’ and SDG 12, ‘Responsible Consumption and Production’, the state jumped from ‘performer’ category to ‘frontrunner’ with scores of 77 and 79, respectively.

However, the state saw its score drop in SDG 1 of ‘Reduced Inequality’ in which it came last. The score also dipped in SDG 1 ‘No Poverty’, SDG 2 ‘Zero Hunger’, SDG 9 ‘Industry, Innovation and Infrastructure’ and SDG 13 ‘Climate Action’.

Review of Literature

Choudhuri (2019) found lacunae in linking of government’s plans for clean energy and sanitation.

Dhar (2018) focussed on economic empowerment of women and ending violence against women under the SDG framework**.**7 There have been very few researches on SDGs and almost negligible which have focussed on the need, current status and progress of SDGs in India. This paper aims to bridge that gap.

M. Prabhakar (2018) identified challenges in India’s implementation of SDGs such as defining indicators, monitoring and ownership, measuring progress, financing SDGs**.**

Pradhan et al. (2017) found that the indicators are not independent from each other and show positive and negative correlations which they termed as trade-offs and synergies respectively**.**

Griggs et al. (2013) mentions how in the anthropogenic epoch a focus only on poverty alleviation without regards for environmental considerations is unsustainable**.**

Need for Sustainable Development Goals

The Sustainable Development Goals replaced the Millenium Development Goals (MDGs), which were focussed on eradication of poverty and hunger, combating HIV/AIDs, malaria and other diseases while also improving access to primary education, improving maternal health, gender equality and ensuring environmental sustainability. The MDGs were highly effective in universalising primary education and improving access to clean water and sanitation while also tackling HIV/AIDS, malaria and tuberculosis. However, the 8 MDGs were found to be insufficient to deal with the challenges posed by climate change and hence the goals were expanded with emphasis laid on sustainable development. Unlike the MDGs which were formulated with a top-down approach, SDGs were formulated through a collaborative process wherein citizens and civil society members participated in framing the goals. Additionally, the reliance on Official Development Assistance (ODA) in the case of MDGs, wherein poor countries received aid from rich donor countries, has been done away with and SDGs focus on countries’ improving their own revenue generating capabilities, since fund flows under MDGs did not materialise as expected. SDGs have also separated hunger and poverty as separate goals since nutritional challenges are not linked to poverty alone.8 For a country like India which faces several developmental challenges in the form of its large population, rampant poverty, poor infrastructure and weak socio-economic indicators, achievement of the

SDGs can go a long way in ensuring sustainable and inclusive economic growth. Having 1/6th of the world's population residing in India, India also has an important stake and responsibility in ensuring prosperity of the planet and its people.

Impact of Sustainable Development Goals

For SDGs to be successfully achieved, the government policies, schemes and programs have to be aligned with goals. The effort cannot be driven by government alone but requires support of the private sector as well. While the SDGs have to be achieved by 2030, the indicators under each target and goal are being actively monitored by the Indian government. NITI Aayog is the institution involved in overseeing the implementation of SDGs by sensitising stakeholders, building capacity, ensuring and monitoring of SDGs and targets through programmes and schemes in collaboration with States/UTs, academia, civil society, multi-lateral agencies. Government of India has created the Sustainable Development Goals India Index 2.0 (SDGII 2.0) which is constructed using 100 indicators, covers 54 targets across 16 goals, barring Goal 17, which is qualitative in nature. This index ranks states and UTs in their achievements of goals and targets. The composite score ranges from 0 to 100 which denotes achievement of the State/ UT in achieving the targets under the goals. A score of 100 shows that the State/ UT has already achieved the targets set for 2030. According to NITI Aayog's SDG India Index & Dashboard 2019-20 report based on SDGII 2.0, India's composite score improved, from 57 in 2018 to 60 in 2019 showing improvement in its progress towards achieving SDGs. This improvement in score was driven by five specific SDGs namely, SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 9 (industry, innovation, and infrastructure), SDG 15 (life on land), and SDG 16 (peace, justice, and strong institutions), where India has scored between 65 and 99. The improvement in SDG 6 is attributed to the success of the Swachh Bharat Abhiyaan which aims at eliminating open defecation. SDG 7 improved due to the extensive coverage of LPG for households and electricity connections. Improved rural road network and higher ICT penetration. The two goals where India scored the poorest were SDG 2 (zero hunger) and SDG 5 (gender equality) having overall country score below 50.9

Kerala and Chandigarh maintained their top ranks for states and UTs respectively, both with an overall score of 70. From just 3 states in 2018 (Himachal Pradesh, Kerala, and Tamil Nadu) having a score between 65-99, five more states (Andhra Pradesh, Telangana, Karnataka, Sikkim and Goa) joined this group of high scorers. The states which showed the greatest progress from 2018 to 2019 in their overall score were Uttar Pradesh, Odisha and Sikkim. Uttar Pradesh saw its overall score improve from 42 in 2018 to 55 in 2019 due to improvement in goal 7 – affordable and clean energy, where the jump has been by 40 points. It also scored well in goal 6 – clean water and sanitation and goal 9 – industry, innovation, and infrastructure.

Odisha saw its overall score rise by 7 points driven by a massive improvement in achieving in goal 9. While Sikkim performed well in goal 7, goal 9, goal 11 – sustainable cities and communities.9

Challenges in achieving Sustainable Development Goals by India

India faces several challenges in meeting the SDGs. One of the key challenges is poor infrastructure which affects development. The financial markets while vibrant are still not well developed especially with regards to debt market which makes borrowing for infrastructure difficult and solely reliant on the banking sector. The Indian banking sector itself plagued by NPA crisis has resulted in credit crunch for private sector. Poor levels of research and development and lack of sufficient innovation has resulted in India lagging behind and being unable to adopt and adapt climate change resilient agricultural practices or eco-friendly manufacturing. The high level of poverty in India coupled with poor access to sanitation, primary healthcare and education also results in the progress in the SDGs indicators being slow.

Conclusion

Research and discussions on the Sustainable Development Goals (SDGs) have been prevalent within recent years due to the benefits these goals aim achieving so as to impact human livelihood and promoting social equity for the better. In this wise, this paper investigated the concept of data-driven e-government and the potential role it can play in expediting the attainment of the SDGs. The benefits of data-driven e-government are immense and relevant for decision and policy makers in supporting the governmental processes as well as impacting the development and livelihood of citizens who are the main beneficiaries of such public sector innovations.

While several Indian states have shown progress across indicators in 2019, there are still 5 states which were unable to improve their score. There is also alarming lack of progress in certain goals like SDG 5 – Gender equality, where all states barring Kerala, Himachal Pradesh and Jammu & Kashmir, all states score below 50. India also has the poorest overall score in SDG 2 – Zero hunger, at just 35 out of 100. India has not yet achieved its targeted 100 score in any of the goals and with majority of the overall SDG scores hovering in the range of 50 to 75, it is apparent that India needs to significantly improve its progress in achieving SDGs in this decade. With the incoming global recession driven by the Covid 19 pandemic, attainment of SDGs becomes even more difficult as revenue generation is being hampered and government resources are getting constrained. Yet, there is sufficient time for the 2030 deadline and innovative approaches driven by participation of all stakeholders including the private sector can help India achieve its goals.

One of the highlights of the statement of our Prime Minister is that - much of India's development agenda is mirrored in the SDGs. This is reflective of the fact that even before the SDGs were formulated and adopted, India had initiated numerous developmental programmes.

The NITI Aayog has been overseeing the implementation of SDGs at the national level. As part of this implementation process, the NITI Aayog has carried out a mapping of all

SDGs, Central Ministries and the Centrally-sponsored Schemes. It is also undertaking national and regional level consultations with other stakeholders including States and Union Territories.

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Problem of Plastic Waste, Plastic Waste Management Rules and its Implementation in District of Amethi

Dr. Sandeepa Biswas and Dr. Maneesh Kumar

Abstract

About 90% of the plastic waste is discarded in the environment as solid waste resulting in global environmental and social damage of more than $2.2 trillion every year. According to a 2018 United Nations Report, Africa stands out as the continent where the largest number of countries has instituted a total ban on the production and use of plastic bags. Polystyrene and polyethylene articles exhibit up-to 50% degradation after 20 years of disposing. According to the U.S. National Oceanic and Atmospheric Administration (NOAA) and the European Chemicals Agency, Microplastics are fragments of any type of plastic less than 5 mm (0.20 in) in length. They cause pollution by entering natural ecosystem from a variety of sources, including cosmetics, clothing, food packaging, and industrial processes. Amethi is a city situated in the Indian state of Uttar Pradesh. Gauriganj is the administrative headquarter of the Amethi District. This district is a part of Ayodhya Division in the Awadh region of the state. The Project Amethi of RGIPT also seeks to bring an all-round development of the Amethi district, covering the living standards, modernity and social harmony. It includes plastic waste management as its one goal. Amethi got a major boost during Rajeev's 1984-89 prime ministership, in the form of agro based industries, cement factories, petrochemicals etc. But with all these developmental and economic activities, the level of pollution was bound to increase. The increased per capita income, modernization and urbanization also have increased the level of pollution in the district. Here comes the role of waste management policies to mitigate this problem. The present paper tries to evaluate government's policies in this direction and its results.

Keywords: *Amethi, Pollution, Plastic Pollution, Environment, Government policy*

JEL Classification: Q50, Q53, H4, K2

1.Introduction

Our mother earth can't digest plastic. It remains on the surface for 500 to 1000 years.

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India generates 9.4 million tons of plastic annually at current time. This demands 66,000 hectare of landfill of 10 meter high. Our Prime minister is also determined to reduce the single use plastic consumption like poly bags, cups, spoons etc. and eliminate it immediately. The scrap metals are almost totally recycled but this is not the case with plastic waste.

India has a low per capita consumption of plastic of 11 kilograms a year, if compared to 109 kilograms by U.S citizens but people are reluctant to abandon the use of plastic as it is cheaper than other alternatives. Plastic is a world- wide problem but it is severely felt in India where towns and villages do not have adequate waste disposal systems and eventually making way to food chain system.

According to the U.S. National Oceanic and Atmospheric Administration (NOAA) and the European Chemicals Agency, Microplastics are fragments of any type of plastic less than 5 mm (0.20 in) in length. The term Macroplastic is used to differentiate microplastics from larger plastic waste, such as plastic bottles. There are two classifications of microplastics. Primary microplastics include any plastic fragments or particles that are already 5.0 mm in size or less before entering the environment. These include microfibers from clothing, microbeads and plastic pallets. Secondary, microplastics arise from the degradation of larger plastic products through natural weathering process after entering the environment. These include water and soda bottles, fishing nets, plastic bags, microwave containers tea bags etc. Both types are found in high level particularly in aquatic and marine ecosystem. There they cause water pollution.

In case of environmental issues, normal mechanism of market doesn’t work which results in pollution. Plastic waste is also an example of a market failure in the form of negative externality generation. In this situation government’s role become very crucial to tackle this problem.

2.Review of Literature

Hopewell, Dvorak and Kosiar said in their paper “Plastics recycling: challenges and opportunities” that plastics are inexpensive, lightweight and durable materials. Consequently the production of plastics has increased markedly over last 70 years. But, the current level of their use and disposal generates several environmental problems.

Preston and Frank in their paper “Plastic Waste: A Key Issue to a Processor” said processors are attempting to develop new approaches to the key issue of plastic waste disposal. In 1987 more than 55 billion pounds resins were sold to U.S. They said that the question is not of “where is the next market for plastic?”, but more “what is the next disposal option for plastic waste.”

Michael R. Kozak said in his paper “Environmental Impacts: The role of Plastics” that the readiness of many leaders to address environmental concerns through plastics regulation is a reflection of the prejudice many people have for synthetic materials. Biodegradability and photodegradability are not synonymous. Nearly all commercial thermoplastics are sensitive to photooxidation and will degrade naturally. Polystyrene and polyethylene articles exhibit upto 50% degradation after 20 years of disposing. However, when placed in sanitary landfill, like paper, wood and food scraps, plastics do not degrade because there is no light.

Jeffrey L. Meikie said in material Doubts: The Consequences of Plastic" that while most people could expect to avoid being in a fire, no one could avoid daily exposure to a plastic as a common as polyvinyl chloride (PVC).

A paper by **Yvonne A. Braun and Assitan Sylla Traore** says the ease and convenience of plastic bags is a critical contemporary environmental issue, and perhaps particularly so in developing societies, which may lack systematic waste management and recycling efforts.

Gregory E. Lang says in Plastics, The Marine Menace: Causes and Cures" that in one respect plastics are positive development. They are very beneficial to modern society.

A paper "**Accumulation and fragmentation of plastic debris in global environments"** says mega and macro plastics have accumulated in the highest densities in the Northern Hemisphere adjacent to urban centers, in enclosed sea and at water convergences.

Susan E. Selke says in "Plastics Disposal- what are the options" that there is a general consensus that in terms of dealing with solid waste, the first preference should go to source reduction, limiting the amount of waste requiring disposal.

"Plastic recycling" by **Vannessa Goodship** says the amount of plastics ending up in the waste stream seems to be ever increasing. This is due to the fact that plastics are an extremely useful and versatile set of materials.

Dewess and Hare says in Economic analysis of Packaging Waste Reduction that since British Columbia introduced a deposit refund program for soft drink containers in 1971, every province in Canada has adopted one or more packaging waste reduction program.

Anthony L. Andrady and Mike A. Neal say in "Application and Societal benefits of plastic" that humans have benefitted from the use of polymers since approximately 1600 BC.

Ronald Paul Hill and Kanwalroop Kathy Dhanda says that the benefits of plastics are wide spread and have contributed significantly to productivity advancement throughout the developed world.

3. Objective: The objective of the present paper is to describe the different laws available for plastic waste management in India and the paper also shows how district Amethi is coping with this problem.

4. Methodology: The methodology of present paper is descriptive in nature. It analyses the present situation of plastic waste generation and management in Amethi.

5. Provisions for Plastic Waste Management in India

5.1. Environment (Protection) Act, 1986

It made several rules like (i) planning and execution of a nation-wide programme for the prevention, control and abatement of environmental pollution; (ii) laying down standards for the quality of environment in its various aspects; (iii) laying down standards for emission or discharge of environmental pollutants from various sources etc.

5.2. Recycled Plastic Usage Rules, 1998

Reprocessing or recycling of plastics is undertaken strictly in accordance with the Indian Standards, IS 14534; 1998 entitled "Guidelines for Recycling of Plastics", published by the Bureau of Indian Standards and the end product made out of recycled plastics is marked as "recycled" alongwith the indication of the percentage of use of recycled material.

5.3. The Plastics Manufacture, Sales and Usage Rules, 1999

This made rules like (1) No person shall manufacture, stock, distribute or sell carry bags made of virgin or recycled plastic bags which are less than 8 x 12 inches in size and which do not conform to the minimum thickness specified in rule 8. (2) No vendor shall use carry bags made of recycled plastic for storing, carrying, dispensing or packaging of foodstuffs. (3) No vendor shall use containers made of recycled plastics for storing, carrying, dispensing or packaging of foodstuffs.

Recycled Plastics and Manufacture and Usage Rules (Amendments) Rules, 2003

5.4. Draft Plastic (Manufacture, Usage and Management) Rules, 2009

The Ministry of Environment and Forests notified the draft "Plastics (Manufacture, Usage and Waste Management) Rules, 2009" to replace the Recycled Plastic Manufacture and Usage Rules, 1999 (as amended in 2003). The 1999 rules stipulated both size and thickness restrictions on plastic bags, requiring them to be at least 8x12 inches in size and 20 microns in thickness. 5 Report of the Expert Committee to examine the comments and suggestions including economic instruments in the Draft Plastics (Manufacture, Usage and Waste Management) Rules, 2009. The 2009 draft rules also required manufacturers to print their name and address on each carry bag and container and to mark it in a manner that would make it possible to ascertain whether it was "virgin plastic", "recycled plastic" or "bio-degradable plastic" as per BIS specification.

5.5. Plastic Waste (Management and Handling) Rules, 2011

The Government of India in the erstwhile Ministry of Environment and Forests, as amended from time to time, provided a regulatory frame work for management of plastic waste generated in the country, dated 4th February, 2011, Plastic Waste (Management and Handling) Rules, 2011.

5.6.Plastic Waste Management Rule, 2016

In exercise of the powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 , the draft rules, namely, the Plastic Waste Management, Rules, 2015 were published by the Government of India in the Ministry of Environment, Forest and Climate Change, dated the 25th May, 2015 in the Gazette of India.

The PWM Rules, 2016 cast Extended Producer Responsibility (EPR) on Producer, Importer, and Brand Owner and EPR shall be applicable to both pre-consumer and post-consumer plastic packaging waste.

Plastic Waste Management (Amendment) **Rules, 2018 was also introduced.**

5.7.Plastic Waste Management (Amendment) Rules, 2021

Plastic Waste Management (Amendment) Rules, 2021 defined Non-woven plastic bag" as Non-woven plastic bag made up of plastic sheet or web structured fabric of entangled plastic fibers or filaments (and by perforating films) bonded together by mechanical or thermal or chemical means, and the "non-woven fabric" means a flat or tufted porous sheet that is made directly from plastic fibres, molten plastic or plastic films. It defined "Plastic waste processing" as any process by which plastic waste is handled for the purpose of reuse, recycling, co-processing or transformation into new products, According to this rule, "Single-use plastic commodity" mean a plastic item intended to be used once for the same purpose before being disposed of or recycled and "Thermoset plastic" means a plastic which becomes irreversibly rigid when heated and hence cannot be remoulded into desired shape.

Any notification prohibiting the manufacture, import, stocking, distribution, sale and use of carry bags, plastic sheets or like, or cover made of plastic sheets and multilayered packaging and single-use plastic, including polystyrene and expanded polystyrene, commodities, issued after this notification, shall come into force after the expiry of ten years, from the date of its publication".

5.8. Plastic Waste Management (Amendment) Rules, 2022

And whereas, to implement these rules more effectively and to give thrust on plastic waste minimization, source segregation, recycling, involving waste pickers, recyclers and waste processors in collection of plastic waste fraction either from households or any other source of its generation or intermediate material recovery facility and adopt polluter's pay principle for the sustainability of the waste management system, the Central Government reviewed the existing rules;

6.Rules in Uttar Pradesh for Plastic Waste Management

There are state specific provisions for Uttar Pradesh also for mitigating the plastic waste pollution.

Plastic Waste Management Provisions, August 2022

1. Plastic sheets for use of packaging shall not be made less than 50 microns in thickness except where the thickness hampers the quality of packaged material like medicine etc.
2. Gutkha, Pan Masaala, tobacco shall not be packaged in in plastic packaging.
3. All kinds of plastic carry bags (irrespective of thickness, woven/non woven) are ban in Uttar Pradesh.
4. Compostable and bio-degradable carry bags are allowed only after Authorisation/ Registration of Central Pollution Control Board.
5. Apart from carry bags following identified Single Use Plastic are ban:
6· Ear buds with plastic sticks, plastic sticks for ballons, plstic flags, candy sticks, ice-cream sticks, polystyrene (Thermocol) for decoration.
7· Plastic cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping or packaging films around sweet boxes, invitation cards, and cigarette packets, plastic or PVC banners less than 100 microns, stirrers.
8. Plastic used in multilayer packaging (as an integral part) is exempted from thickness criteria.
9. All the producers, Importers, Brand Owners (except micro and small units mentioned under MSME) and Pastic Waste Processors have to register themselves under EPR portal of CPCB.
10. All the producers, Importers, Brand Owners (except micro and small units mentioned under MSME) have to submit their EPR plan to UPPCB for disposal of plastic waste generated in Uttar Pradesh from their packaging material.

7. Points of Plastic Waste Generation in Amethi-

There are several sources of plastic waste generation like local dhabas, houses, various shops, clinics/hospitals and agricultural areas in the district. In rural Amethi, the fragments of large plastic waste debris are accumulated in mainly around the markets and human settlements. It creates negative externality as well as causes many diseases. Around 95 percent people in Amethi lives in rural area and in lack of proper waste management system the local people are bound to suffer this problem. In urban areas municipal services are available so all kinds of waste is taken and deposited outside of the city centre. But mechanism for their proper treatment is inadequate.

7.1. Hospitals- There are 41 PHCs and CHCs in district Amethi. Apart from this there are some other important hospitals like Indira Gandhi Eye Hospital, Govt. District Hospital, Hindustan Aeronautics Limited Hospital and Ayushmann Hospital in the district. These hospitals generate bio waste as well as plastic waste in the nearby areas.

7.2. Restaurants and Dhabas- Restaurants and local dhabas are also becoming a major source of plastic waste generation points. Especially the local and small dhabas use single-use plastic or foam cutleries which are thrown near the shops usually. It remains there for a very long time because in rural areas waste pickups are not active.

7.3. Houses- Households are also major contributors to plastic waste generation in the district. The increasing use of packaged food items are the most important concern in this respect. Apart from it a number of plastic materials are ejected every day from houses.

7.4. Producers- Production units generate plastic wastes at a huge level. In 2010-11, there were148 registered industrial units.

List of the units in Amethi & nearby Area:

1. M/S Indogulf Fertilizers, Industrial Area, Jagdishpur
2. M/S Bharat Heavy Electronic Limited (BHEL), Industrial Area, Jagdishpur
3. M/S A.C.C. Ltd., Industrial Area, Tikaria-Gauriganj
4. M/S H.A.L.Korwa, Munsiganj
5. M/S Bharat Heavy Electronic Limited (BHEL), Industrial Area, Jagdishpur

Amethi Industrial township is located at Kauhar village in Amethi, providing a wider scope of employment to the people of Amethi. A mixed model of development has been adopted where the attempt has been to accommodate industrialization while promoting agriculture.

8. Agricultural plastic waste --

The 29th edition of UNEP's Foresight Brief explores the use of plastic in agriculture and the significant waste problem this entails which impacts on soil health, biodiversity, productivity and food security.

Plastics are used extensively in farming, from plastic coated seeds to mulch film. They also make their way into bio solid fertilizer which is spread on fields. All these products have helped increase crop yields, but there is increasing evidence that degraded plastics are contaminating the soil and impacting biodiversity and soil health. This can lead to reduced productivity and could threaten long-term food security. As a finite resource which is under pressure, agricultural soil needs to be safeguarded from further degradation. Steps are being taken to improve the production and management of agricultural products containing plastics but there is also a need to look at a more holistic approach to food production, including nature-based solutions.

Sorting operations are generally complex due to the different nature of plastics used in agriculture, to their inert and organic matter contamination, to the presence of hazardous agrochemicals, of heavy metals and so on.

According to Hurley, plastics generate micro- and nano-fragments during their use and at the end of their lifetime; these fragments can be accumulated in soil and in water on a transitory or permanent basis. The impacts of this pollution are unknown.

Waste reduction provides the greatest overall benefits with a reduction of financial, social, and environmental costs. This should therefore be at the heart of any strategy for agricultural waste management.

Agricultural plastics are, in very limited examples, reused. Film plastics are replaced seasonally because they are degraded from exposure to the elements during the growing season, damaged and contaminated from field operations, and destroyed during their collection. Their reuse options are limited if not non-existent.

Rigid plastics in agriculture have been widely adopted, in part, because they are durable, ostensibly resulting in their effective and common reuse. Yet, reuse is still rare by primary, high-volume users. Nursery pots, for example, lack standardization in size. This seemingly innocuous issue prevents automation for cleaning equipment in an industry very contentious of disease prevention and pest control. Reuse is generally only considered by the end user.

9.Implementation of the Rules and Provision for Plastic Waste Management in Amethi

There are several rules at hand introduced by the central govt. as well as the govt. of Uttar Pradesh. But there are few Impediments in the implementation of these rules and laws-

9.1. Lack of cleanliness preference- The preference of peoples for a clean environment is very low.

9.2.Lack of political will- Political parties is afraid of introducing rigid implementation measures for pollution control in fear of losing government. No fine is charged on scattering plastic waste here and there.

9.3.Lack of education- The education level for good environmental quality is inadequate.

9.4.Lack of producer responsibility- producers are not responsible for the pollution they create. They always try to escape the obligations on them and manipulate the law according to them.

9.5.Marketization of consumption pattern- In this modern era, consumption pattern is totally becoming market based. Regular consumption items are packaged and bought from MNCs. In this scenario, plastic wrappers of the items are a huge matter of concern.

9.6.Lack of technology and innovation-

10.Suggested solutions

Waste from plastic films for greenhouse covering can be reduced extending their service life by using most effective additives. Plastic packaging waste can be reduced improving packaging design and product delivery systems. APW reduction can be achieved with an increase in the size of: bags used for the supply of fertilizers and seeds; containers used for agrochemicals; feed bags; containers used for animal health products. The development of highly active agrochemicals that are applied at g/ha rather than kg/ha will result in less packaging. Farmers could buy concentrate feed in bulk to minimize the use of feed bags. The purchase of seeds and of granular and powdered fertilizers in cardboard box is recommended because cardboard is more easily recyclable than plastic. The use of reusable and returnable bags and containers can be another solution.

A sustainable solution for waste reduction is based on the use of bio-based and biodegradable materials made of renewable raw materials. Mulching films, pots, trays, and seedling containers can be made with biodegradable materials.

11. Conclusion

Plastic is not a problem in itself but it is a boon for human civilization in fact. What became problematic is relentless and thoughtless usage of plastic. More than 90 percent of this district comes under rural areas. 95 percent people are living in rural areas. So the plastic waste generation is mainly from agricultural sector and households. In this current time when marketization of products has been prominent, household waste generation has become a big problem. People prefer packaged food items even in rural areas. They like MNC produced products like chips, biscuits, soft drinks and a countless items. The awareness level for cleanliness is comparatively very low in city as well as rural areas of Amethi. There are several policies and rules at hand both at center and state level. But their implementation is not so satisfactory. The government should be more active in implementation of available rules.

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Assessing Environmental Responsibility among Urban Households in India: Case of Lucknow city in Uttar Pradesh

Ekta Srivastava and Sanatan Nayak

Abstract

Households, due to their energy consumption behavior, are responsible for over 72% of the total greenhouse gas emissions globally. Their energy consumption behavior is influenced by a number of other factors apart from their economic interests, including the socio-economic conditions, environmental awareness, cultural variables, etc. Present study attempts to assess the extent and dimensions of people's awareness on climate change, more specifically on emission of domestic induced CO2, social and personal norms, environmental action and willingness to sacrifice on controlling CO2 emissions by developing an environmental responsibility index across households in the old and new region of Lucknow city, considering a sample of 270 households. In order to serve the objectives, United Nations Development Programme (1990) methodology to develop an environmental responsibility index (ERI) using field survey data, has been utilized. The ERI is composed of five major components, viz., weather change awareness, personal environmental norms, social environmental norms, environmental action and willingness to sacrifice. Each of these components comprise of several sub-components.

The findings suggest that in both the regions HHs are equally aware and concerned about environmental issues. However, in terms of community participation, environmental action and willingness to sacrifice, the HHs in the new Lucknow region excel.

1.0 Introduction

There is an extensive literature on economic and technological solutions to climate change, but the role of shifting to climate-friendly behavior in climate change mitigation is usually undervalued (van de Ven et al 2018; Stankuniene et al 2020; Safarzyñska 2017). The existing macro-economic models are increasingly found to be inefficient in aiding to climate change mitigation policy due to the large amount of uncertainty and sensitivity involved in fixing discount rates (Stern 2016; Farmer 2015). Thus, a need for alternative modelling approaches

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is increasingly being felt (Stiglitz & Gallegati 2011). Behavioural economics models recognize the fact that humans have cognitive limitations and human decisions are not always rational (Stankuniene 2020; Brekke & Stenman 2008). Given the complexity of climate change mitigation policy, interventions are needed at every level, beginning with the households (HHs), because they are responsible for over 72% of the total greenhouse gas emissions globally (Hertwich 2009).

Behavioural economics offers a realistic view of human decisions and thus, is more accurate in assessing energy consumption behavior of the households. Faber et al (2012) studied the GHG emission reduction potential of behavioural changes in European Union for the year 2020, 2030 and 2050. The study considered three aspects of behavioral change i.e., mobility (using fuel efficient vehicles in a fuel efficient way, switch to public transport, walking, cycling, etc., reduce travel distance by living near work place or work from home etc.), housing (optimized use of space heating, air-conditioning and water heating; turning off lights and fans when not needed, use of windows and doors for light and ventilation, etc.) and food and drink habits (vegetarian, local and seasonal food with minimum food wastage). Changes in mobility behavior, housing and eating habits were found to be able to reduce CO2 emissions by 6% to 34%, 50% and 20% respectively in 2020. Dietz et al (2009) in their study on HHs in United States of America found that with little or no reduction in household well-being and without introducing any new regulatory measures, only five kinds on behavioural interventions (Weatherization and Upgrades of Home Heating and Cooling Systems, Equipment Upgrades, Maintenance of Equipment, Adjustments of Equipment and Daily Use Behaviors) could save approximately 123 million tons of carbon per year in 10 years, which is 20% of household direct emissions or 7.4% of USA's national emissions.

The present study identified five behavioural attributes to assess the sense of environment responsibility among the households of Lucknow. People's behavior is influenced by a number of other factors apart from their economic interests, including environmental awareness (Li et al 2021, Mei et al 2016, Brounen et al 2013), personal and social environmental norms (Poortinga et al 2004, Farmer & Foley 2009; Brekke & Stenman 2008, Niamir et al 2020, Chen and Zheng 2016, Han et al 2018), environmental action and willingness to sacrifice (Chen and Zheng 2016). The classical rational individual model assumes that each individual working for his self-interest will ultimately lead to the promotion of social interest. In case of externality ridden environmental problems, however, the self-interest theory leads to the 'tragedy of the commons'. The free-rider dilemma and the collective action problem are one the important reason behind environmental degradation, as the rational individual model motivates action leading to self-interest irrespective of the social-interest. The concept of Willingness to Sacrifice (WTS) suggests the contrary, wherein the individual altruistic behavior leads to the collective good, even at the expense of self-interest. The WTS behavior is explained by Norm-Activation theory proposed by Schwartz (1970; 1977). The norm-activation theory suggests that the helping behavior arises when the individual is aware of the impact of his/her actions/behavior on others, as well as when they ascribe the responsibility of helping others on themselves (Chen and Zheng 2016). The WTS indicator was developed initially by Dietz, Stern, & Guagnano (1998). Unlike the more popular concept of Willingness to Pay (WTP), which focuses mainly on the willingness of the people to contribute in the form of money, WTS covers people's willingness to sacrifice in terms of everyday behavior and lifestyle changes along with monetary sacrifice (Chen and Zheng 2016). Individuals who demonstrate greater WTS are also observed to demonstrate more environmentally responsible behavior (Rahman & Reynolds 2016; Han & Hyun 2017). This study takes the study by Dietz, Stern, & Guagnano (1998) and Chen and Zheng (2016) as the reference to measure WTS in Lucknow city. Sacrifice in terms of money and daily life behavioural changes are covered in the schedule.

The present study is designed to assess the sense of environmental responsibility (ERI) among the residents of old and new region of Lucknow, the capital city of Uttar Pradesh in India. A comprehensive field survey was conducted in the city to elicit information on socio-economic and perceptional factors to understand their interrelationships. Present study attempts to assess the extent and dimensions of people's awareness on climate change, more specifically on emission of domestic induced CO2, social and personal norms, environmental action and willingness to sacrifice on controlling CO2 emissions by developing an environmental responsibility index across households in the study area. This paper is organized into five sections. Section one describes the behavioural attributes playing an important role is deciding people's environmental concern. Section two provides details about the study area, the data collection methods, and the methods of estimation. Section three analyses the results. Section four deals with the discussion. Finally, section five contains the conclusion and makes a few recommendations.

2.0 Research Methods

2.1 Study Area

Lucknow city located between 260 30'N and 270 10'N latitude and 80030' E and 81031'E longitude, is the capital of the state of Uttar Pradesh (UP), developed on the banks of Gomti river with flat alluvial terrain. It has a warm humid sub-tropical climate with cool, dry winters. It is one of the most developed cities of Uttar Pradesh and has good connectivity (rail, road and air) to other major cities. Lucknow is the second most populated city of UP1. Lucknow has been divided into two parts based on growing urbanisation i.e. Old Lucknow and New Lucknow. The old residential area where commercial activities coexists along with other activities, are extremely crowded, as roughly 30% population resides in only 5% area2. New Lucknow, on the other hand, is structurally planned with wide roads, shopping malls and parks. As of May 2021, Lucknow has been divided into eight administrative zones, wherein zone 1,2,5 and 6 belong to old Lucknow and zone 3,4,7 and 8 belong to new Lucknow (Fig.1).

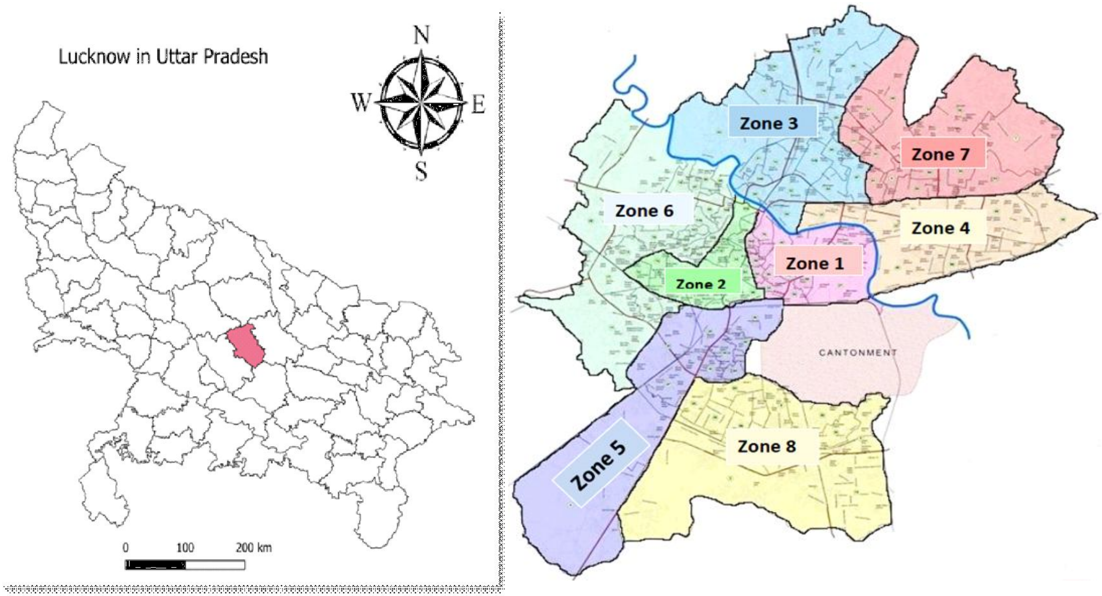

Fig. 1: Zone-wise Map of Lucknow City

2.2 Sampling Design and Size

In order to select a representative sample for the study, Multi-Stage Sampling Method is used for selecting area and households for data collection. In the first stage, Lucknow city is selected. In the second stage, all administrative zones in the city are covered based on proportionate sampling method, i.e., sample size in each zone is proportion to the total population of respective zone. In the last stage, systematic sampling method is adopted to capture the household in the specific ward/locality (which is selected randomly) as mentioned in Table 1.

According to UN World Population Prospects, the estimated population of Lucknow in 2020 is approximately 3.6 million. Taking the average household size to be 5 persons per household (from census 2011), the number of households in Lucknow in 2020 is estimated to be 6.6 lakhs. Employing Cochran's formula (1977)3 and Yamane method (1973)4 for sample size calculation, a sample size of 270 households is found to be appropriate for the study. For sample selection, one ward has been selected randomly from each zone (covering population in both old (less developed) and new (developed) Lucknow), so as to ensure fair representation of households from whole of Lucknow (Table 1). The primary survey has been carried out from January 2021 to April 2021. Within each household one adult (earning member/oldest member/one who has knowledge about household's details) is interviewed.

Table 1: Sample Distribution

	Zones in Lucknow	Zone-wise Population share (census 2011)	Wards selected for study	Number of Households selected
Less developed	Zone 1	10.4	Basheeratganj-Ganeshganj	28
	Zone 2	9.3	Aishbagh	25
	Zone 5	8.5	Ramlila-Sardar Patelnagar	23
	Zone 6	18.5	Balaganj	50
Developed	Zone 3	18.5	Jankipuram I	50
	Zone 4	9.3	Gomtinagar	25
	Zone 7	14.1	Indiranagar	38
	Zone 8	11.5	Ibrahimpur II	31
	Total	100	Lucknow City	270

2.3 Construction of Environmental Responsibility Index (ERI)

The development of an index is accomplished to reflect on the extent and dimensions of environmental responsibility among the residents of old and new Lucknow. The study used different kinds of primary data to develop an ERI for new and old Lucknow region with different scales. Based on the methods adopted by Nayak and Singh (2020) and Nayak and Jatav (2023) to, estimate the index, the process of normalization was undertaken to reduce the variability that could arise due to the presence of extreme values and enhance the comparability of the variables. The ERI is composed of five major components, viz., weather change awareness index (WCAI), personal environmental norms index (PENI), social environmental norms index (SENI) and willingness to sacrifice (WTS) and Environmental Action Index (EAI). Each of these components comprise of several sub-components as shown in Table 2.

2.3.1 Normalization of indicators

As the sub-components are measured on different scales, it is necessary to standardize each of them as an index first. Based upon the nature of the data, the min-max method was adopted to standardize all indicators into a common range (0, 1) depending on their functional relationship with the sub-components. The min-max method can help to simplify a complex array of information on environmental awareness, personal and social concern, and willingness to sacrifice at household level. Equations (1) and (2) were used for larger-the-better and smaller-the-better type indicators, respectively, to normalize the data.

$$X_{ij} = (X_a - X_{min})/(X_{max} - X_{min}) \quad \text{—— (Eq.1)}$$

$$X_{ij} = (X_{max} - X_a)/(X_{min} - X_{max}) \quad \text{——— (Eq.2)}$$

Where X_a is the actual value of the sub-component, X_{max} and X_{min} are the maximum and minimum values of each of the sub-components respectively.

2.3.2 Assigning Weights to Indicators

After standardization, weights are generated through Principal Component based weighted approach, for each of the five major components of the ERI is estimated separately, by using Eq. (3) and (4):

$$W_i = 1/\sqrt{Var(X_i)} \text{ ——— (Eq. 3)}$$

$$K = 1/\left(\frac{1}{\Sigma_i^m \sqrt{Var(X_{ij})}}\right) \text{ ——— (Eq. 4)}$$

Where W_i is weight, m is the sample size, and $Var(X_i)$ is the variance of X_i. Weights thus generated, are then multiplied by corresponding sub-components and then the sub-components are summed up using Eq. (5) to calculate the value of each of the five major components, which is as follows.

$$Y_i = \Sigma_{i=1}^{n} W_i X_i \text{ ——— (Eq. 5)}$$

Where Y_i stands for each of the three major components and n stands for each of the sub-components in each major component.

2.3.3 Estimating Environmental Responsibility Index

Firstly, the index values of all the indicators under each sub-component were estimated for both old and new Lucknow households. In case of WCAI, there are six sub-components, while PENI have eight sub-components, SENI have four sub-components, WTS have three sub-components and EAI has three sub-components. To estimate ERI, all the twenty five sub-components were taken together, standardized using Eq. (1) and (2) and weights were estimated using Eq. (3) and (4) and finally summed up using Eq. (5) and shown below:

$$\textbf{WCAI} = W_{1x} * X_{1j} + W_{2x} * X_{2j} + W_{3x} * X_{3j} + \ldots + W_{6x} * X_{6j} \text{ ———— } \textbf{(6)}$$

$$\textbf{PENI} = W_{1x} * X_{1j} + W_{2x} * X_{2j} + W_{3x} * X_{3j} + \ldots + W_{8x} * X_{8j} \text{ ———— (7)}$$

$$\textbf{SENI} = W_{1x} * X_{1j} + W_{2x} * X_{2j} + W_{3x} * X_{3j} + W_{4x} * X_{4j} \text{ ———— (8)}$$

$$\textbf{WTSI} = W_{1x} * X_{1j} + W_{2x} * X_{2j} + W_{3x} * X_{3j} \text{ ———— (9)}$$

$$\textbf{EAI} = W_{1x} * X_{1j} + W_{2x} * X_{2j} + W_{3x} * X_{3j} \text{ ———— (10)}$$

Finally the value of the ERI was calculated by taking the average values of all the sub-components through the following formula:

$$ERI = \sum(WCAI + \text{PEN}I + SENI + WTSI + \text{EA}I)/5 \text{ ——— } \textbf{(11)}$$

Where, SLSI is the final index value of all the sub-components. An index value close to zero (0) shows a lower environmental responsibility status, whereas an index value close to one (1) shows a higher environmental responsibility. Based on the above, a total of 25 indicators were selected and then segregated into five dimensions under the 'environmental responsibility' framework of households. The origin and description of each variable is analyzed in detail in Table 2.

Table 2: Details of Rational Indicators for Environmental Responsibility Index

	Components	Functional relationship with Index	Source	Mean	
				Old Lucknow	New Lucknow
Weather Change Awareness Index	Is climate change really happening?	+	Whitmarsh (2005)	46	54
	Human activity is responsible for climate change.	+	Whitmarsh (2005)	47	53
	Natural variability is responsible for climate change.	-	Whitmarsh (2005)	54	46
	Is climate change harmful?	+	Whitmarsh (2005)	47	53
	Recent floods and cyclones in this country are due to climate change	+	Whitmarsh (2005)	49	51
	Is climate change responsible for loss in work efficiency	+	Whitmarsh (2005)	51	49
Personal Environmental Norms Index	People should reduce their energy consumption if it reduces climate change	+	Han et al 2018	46	54
	I would only do my bit to reduce climate change if everyone else did as well	-	Whitmarsh (2005)	53	47
	Climate change is something that frightens me	+	Whitmarsh (2005)	53	47
	Radical changes to society are needed to tackle climate change	+	Whitmarsh (2005)	47	53
	If I come across any information about climate change I look at it carefully	+	Whitmarsh (2005)	48	52
	I feel a moral duty to do something about climate change	+	Lillemo 2014	47	53
	Humans are severely abusing the planet	+	Whitmarsh (2005)	47	53
	Plants and animals have the same rights as human beings to exist	+	Whitmarsh (2005)	47	53
Social Environmental Norms	People who are important to me motivate me to buy climate friendly products.	+	Jansson and Dorrepaal 2015	45	55
	People around me think that I should do as much as possible to protect the environment.	+	Jansson and Dorrepaal 2015	41	59
	I see many people around me who actively act in a climate friendly way.	+	Jansson and Dorrepaal 2015	51	49

Personal Environmental Norms Index	People should reduce their energy consumption if it reduces climate change	+	Han et al 2018	46	54
	I would only do my bit to reduce climate change if everyone else did as well	-	Whitmarsh (2005)	53	47
	Climate change is something that frightens me	+	Whitmarsh (2005)	53	47
	Radical changes to society are needed to tackle climate change	+	Whitmarsh (2005)	47	53
	If I come across any information about climate change I look at it carefully	+	Whitmarsh (2005)	48	52
	I feel a moral duty to do something about climate change	+	Lillemo 2014	47	53
	Humans are severely abusing the planet	+	Whitmarsh (2005)	47	53
	Plants and animals have the same rights as human beings to exist	+	Whitmarsh (2005)	47	53
Social Environmental Norms	People who are important to me motivate me to buy climate friendly products.	+	Jansson and Dorrepaal 2015	45	55
	People around me think that I should do as much as possible to protect the environment.	+	Jansson and Dorrepaal 2015	41	59
	I see many people around me who actively act in a climate friendly way.	+	Jansson and Dorrepaal 2015	51	49
	I think that many people who mean a lot to me expect me to reduce my climate impact.	+	Jansson and Dorrepaal 2015	40	60
Environmental Action Index	Do you look for good fuel efficiency while purchasing a vehicle?	+		49	51
	Do you look for good energy efficiency while purchasing an electronic equipment?	+		50	50
	Did you plant any tree over past 5 years?	+		39	61
Willingness to sacrifice	How willing would you be to pay much higher prices in order to protect the environment? (buying electronic vehicles, energy efficient appliances, etc.)	+	Chen and Zheng 2016	45	55

Willingness to sacrifice	How willing would you be to pay much higher prices in order to protect the environment? (buying electronic vehicles, energy efficient appliances, etc.)	+	Chen and Zheng 2016	45	55	
	How willing would you be to accept cuts in your standard of living in order to protect the environment? (using public vehicles, using less AC, fewer air travels)	+	Chen and Zheng 2016	46	54	
	How willing would you be to pay much higher taxes in order to protect the environment?” (increased electricity rates, petrol and diesel rates, etc.)	+	Chen and Zheng 2016	46	54	

Source: Field Survey, 2021. Note: Values are in Percent.

3.0 Results

3.1 Socio-economic characteristics

Table 3 shows the socio-economic characteristics of households in old and new Lucknow. The households in new region have 1.6 times higher per capita income as compared to old region. New Lucknow households are better educated as compared to old region households. House ownership in both the regions does not vary much, but occupational status suggests that while half of the households in new Lucknow region are regular salaried, over 60% HHs in old Lucknow are non-regular salaried.

Table 3: Socio-economic Characteristics

	Per capita income (Rs.)	HH Size	Education (%)			House Ownership (%)		Occupatio	
			Below graduate	Graduate	Post graduate and above	Own House	Rented House	Regular salaried	r s
Old Lucknow	151305.8	4.9	32	44	24	78	22	38	
New Lucknow	244416.3	4.5	20	33	47	81	19	49	
Overall	200964.7	4.7	25	38	37	80	20	44	

Source: Field Survey, 2021

3.2 Weather Change Awareness Index

Table 4 reveals that households in both new and old Lucknow region are found to be nearly equally aware regarding the causes, effects and existence of the climate change phenomenon. Majority of the households experienced irregular rainfall patterns, decreasing winters and increasing summer temperatures. Over 85% of the HHs in both the regions believed that anthropogenic factors are main contributors to changing climate and that climate change is changing rainfall pattern, which ultimately decreases the working efficiency of sample households.

3.3 Personal Environmental Norms Index

Similar to WCAI, households in both the regions are found to be equally sensitive in case of environmental issues (old Lucknow 0.89 and new Lucknow 0.88). The findings of the primary survey suggest that most of the households felt concerned about the increasing temperatures, natural calamities, etc., but were not sure about how they can help to overcome the situation.

3.4 Social Environmental Norms Index

A much lower value observed in case of SENI (0.63) as compared to WCAI (0.87) and PENI (0.88) suggests that despite being aware and sensitive towards environmental issues, community and peer group participation in climate change adaptation and mitigation activities remains low and that climate change has yet not become a serious issue of concern in general public. Although, new Lucknow region shows a better picture (0.66) compared to old Lucknow region (0.60) in terms of social environmental norms.

3.5 Environmental Action Index

In terms of environmental action, new Lucknow region seems to be better (0.69) compared to old Lucknow region (0.65). However, while delving into the sub-components, old Lucknow households performed little better in terms of their vehicle and electronic equipments purchase behavior. The reason behind this is observed to be the income difference in the two regions. Old region households give priority to vehicle mileage in order to save upon the fuel cost, while the households in the new region, being in a better economic situation, gave priority to the design and other specifications. The households of new Lucknow region fared much well in case of tree plantation, due to the space availability and access to various community led plantation drives and awareness programs.

3.6 Willingness to sacrifice Index

The new Lucknow region households are found to be more willing to sacrifice in terms of paying more for environment friendly products, changing their lifestyle and tax payments for environmental wellbeing. As in case of EAI, WTS is found to be higher among the residents of new region due to their greater ability to pay.

Table 4: Index values of various sub-components for old and new Lucknow

Components	Weight	Mean	
		Old Lucknow	New Lucknow
Weather change Awareness Index			
Is climate change really happening?	29	0.280	0.284
Human activity is responsible for climate change.	19	0.184	0.183
Natural variability is responsible for climate change.	9	0.038	0.051
Is climate change harmful?	19	0.180	0.175
Recent floods and cyclones in this country are due to climate change	13	0.114	0.104
Is climate change responsible for loss in work efficiency	11	0.088	0.072
Weather change Awareness Index	100	0.884	0.869
Personal Environmental Norms Index			
People should reduce their energy consumption if it reduces climate change	19	0.1828	0.1895
I would only do my bit to reduce climate change if everyone else did as well	7	0.0374	0.045
Climate change is something that frightens me	9	0.0808	0.0632
Radical changes to society are needed to tackle climate change	14	0.1267	0.1251
If I come across any information about climate change I look at it carefully	11	0.0967	0.0929
I feel a moral duty to do something about climate change	13	0.1172	0.1168
Humans are severely abusing the planet	13	0.1161	0.113
Plants and animals have the same rights as human beings to exist	14	0.1327	0.133
Personal Environmental Norms Index	100	0.8904	0.8785
Social Environmental Norms Index			
People who are important to me motivate me to buy climate friendly products.	27	0.1968	0.2101
People around me think that I should do as much as possible to protect the environment.	25	0.1446	0.182
I see many people around me who actively act in a climate friendly way.	24	0.1315	0.1101

I think that many people who mean a lot to me expect me to reduce my climate impact.	24	0.1244	0.1608
Social Environmental Norms	100	0.5973	0.663
Environmental Action Index			
Do you look for good fuel efficiency while purchasing a vehicle?	33	0.2388	0.2158
Do you look for good energy efficiency while purchasing an electronic equipment?	31	0.1786	0.1584
Did you plant any tree over past 5 years?	36	0.2292	0.3159
Environmental Action Index	100	0.6466	0.6902
Willingness to sacrifice Index			
Would you be to pay much higher prices in order to protect the environment? (electronic vehicles, energy efficient appliances, etc.)	32	0.2458	0.2617
Would you be to accept cuts in your standard of living in order to protect the environment? (using public transport, using less AC etc.)	40	0.3442	0.3565
Would you be to pay much higher taxes in order to protect the environment? (increased electricity rates, petrol and diesel rates, etc.)	28	0.1974	0.2022
Willingness to sacrifice Index	100	0.7875	0.8204

Source: Field Survey, 2021.

3.7 Environmental Responsibility Index

Using equation (11), we found that the dwellers in the old region of Lucknow have a low level of environmental responsibility index (0.76) compared to the new Lucknow (0.78). This presents a positive picture because for all the components of ERI, the mean values in both the regions is greater than 0.50, thus suggesting that despite all socio-economic differences, people in general are sensitive and willing to act for saving the environment. The spider diagram shown in Fig. 2, clearly brings out that in both the regions are environmentally responsible.

Table 5: Environmental Responsibility Index for old and new Lucknow

Components	Mean	
	Old Lucknow	New Lucknow
Weather change Awareness Index	0.8842	0.8685
Personal Environmental Norms Index	0.8904	0.8785
Social Environmental Norms	0.5973	0.663
Environmental Action Index	0.6466	0.6902
Willingness to sacrifice Index	0.7875	0.8204
Environmental Responsibility Index	0.7612	0.78412

Source: Field Survey, 2021

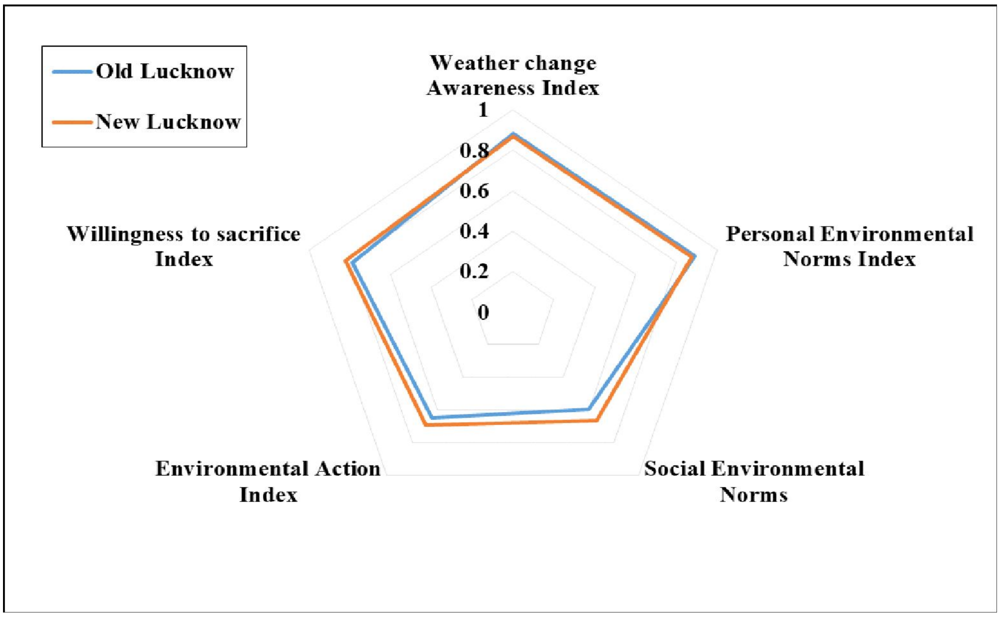

Fig. 2: Environmental responsibility spider diagram for new and old Lucknow households.

4.0 Conclusion

Lucknow city aptly represents average urban areas in India which are largely categorized into old compactly developed regions and newly developed planned regions. A comparative assessment of household's climate change awareness, personal concern, social environmental concern, pro-environment action and willingness to sacrifice between old and new Lucknow region shows that majority of the households are aware of the climate change phenomenon and its harmful consequences and felt a personal concern towards environmental issues. However, community and peer group participation in climate change adaptation and mitigation activities, in both the regions, is observed to be low. In terms of environmental action and willingness to sacrifice also majority of the households responded positively in both the regions, although the newly developed region with economically better off households excel. The study thus concludes that households with better education and living standard are more environmentally responsible.

Based upon the findings, following policy suggestions are made in context of urban areas in developing countries:

Firstly, along with awareness campaigns community engaging activities should be promoted in schools, colleges as well as offices. Secondly providing financial incentives, tax breaks, or subsidies for implementing energy-efficient solutions, renewable energy systems, or sustainable agricultural practices, can motivate people to act in an environment friendly manner. Thirdly, development of green infrastructure such as vertical gardens, green roofs, permeable pavements etc. in old compact settlements. Fourthly, establish local climate action committees in urban colonies to develop targeted solutions. Fifthly, make environment friendly products also budget friendly.

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when population size is finite:

$\boldsymbol{n} = \frac{n_0}{1+\frac{(n_0-1)}{N}}$ Where, n is the required sample size,

$\boldsymbol{n_0}$ is the sample size derived from Cochran's formula of sample size for unknown population and N is the total population.

4 $\boldsymbol{n = N/(1 + N(e^2))}$ **Where e is the margin of error and N is the population size.**

Sustainable Development and Global Warming: A Comprehensive Review

Prof. V.D. Sharma and Nidhi Sonkar

ABSTRACT

Sustainable development and global warming are two interconnected and pressing issues facing humanity in the 21st century (Cramer et al., 2018). This review paper aims to provide a comprehensive overview of the relationship between sustainable development and global warming, exploring their definitions, impacts, challenges, and potential solutions. Through an interdisciplinary approach, this paper synthesizes existing literature to offer insights into the complex dynamics between these phenomena, highlighting the need for integrated strategies to address both environmental and socio-economic dimensions.(Kriegler et al., 2012)

1. INTRODUCTION

Global warming refers to the long-term increase in Earth's average surface temperature due to human activities, primarily the release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide into the atmosphere.(Mehmood et al., 2020) These gases trap heat, leading to the warming of the planet and disrupting the Earth's climate system. Global warming is causing various environmental impacts, including rising sea levels, extreme weather events, loss of biodiversity, and disruptions to ecosystems.(Upadhyay, 2020) It poses significant threats to human health, food security, water resources, and socio-economic stability worldwide. Addressing global warming requires mitigating greenhouse gas emissions, transitioning to renewable energy sources, promoting sustainable land use and agriculture, and adapting to the changing climate.(Suman, 2021)

Understanding the interconnectedness of sustainable development and global warming is crucial for several reasons:

- **Integrated Solutions:** Recognizing the interconnections between sustainable development and global warming allows for the development of integrated solutions that address both environmental and socio-economic challenges simultaneously. By considering the

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complex interactions between environmental, social, and economic factors, policymakers and stakeholders can devise more effective strategies to achieve sustainable outcomes while mitigating global warming.(Scharlemann et al., 2020)

- **Avoiding Trade-offs:** Without understanding their interconnectedness, there's a risk of making decisions that prioritize one aspect over the other, leading to unintended consequences or trade-offs.(Cohen et al., 2021; Scharlemann et al., 2020) For example, focusing solely on economic growth without considering its environmental impact can exacerbate global warming and undermine long-term sustainability. Understanding the interconnectedness helps identify synergies and minimize trade-offs between sustainable development goals and climate action.(Cohen et al., 2021)
- **Holistic Approach:** Sustainable development and global warming are inherently interconnected, with actions in one domain often influencing outcomes in the other. Taking a holistic approach that considers the broader context and interdependencies between environmental, social, and economic systems is essential for achieving lasting and meaningful progress. This approach ensures that efforts to address global warming contribute to sustainable development goals and vice versa, leading to more comprehensive and sustainable outcomes.(Umar et al., 2020)
- **Long-Term Planning:** Understanding the interconnectedness of sustainable development and global warming enables long-term planning and decision-making. By considering the potential impacts of climate change on various aspects of society, such as food security, water availability, infrastructure, and public health, decision-makers can anticipate future challenges and implement proactive measures to build resilience and adaptability.
- **Global Collaboration:** Addressing sustainable development and global warming requires coordinated efforts at local, national, and global levels. Understanding their interconnectedness fosters collaboration and cooperation among diverse stakeholders, including governments, businesses, civil society organizations, and communities. By working together towards common goals, such as reducing greenhouse gas emissions, promoting renewable energy, and advancing social equity, the collective impact can be maximized, leading to more effective and sustainable outcomes.

The purpose of the review is to provide a comprehensive examination of the relationship between sustainable development and global warming. It aims to synthesize existing literature and research findings to elucidate the interconnectedness, impacts, challenges, and potential solutions related to these two critical issues. By exploring their interplay and understanding the complexities involved, the review seeks to inform policymakers, researchers, and stakeholders about the importance of addressing both sustainable development and global warming in an integrated manner.

2. SUSTAINABLE DEVELOPMENT

Sustainable development is a concept that encapsulates the pursuit of societal progress while ensuring the preservation of natural resources and the environment for current and future generations. At its core, sustainable development seeks to harmonize economic growth, social equity, and environmental conservation, recognizing the interconnectedness of these dimensions.(Ruggerio, 2021) The principles guiding sustainable development include intergenerational equity, emphasizing the responsibility to meet the needs of present generations without compromising the ability of future generations to meet their own needs. Additionally, intra-generational equity stresses the importance of addressing disparities within societies and ensuring that all individuals have access to basic necessities and opportunities for well-being. (*Sustainable Development Report 2022 - Jeffrey D. Sachs, Christian Kroll, Guillame Lafortune, Grayson Fuller, Finn Woelm - Google Books*, n.d.)Environmental stewardship is another fundamental principle, emphasizing the responsible management and conservation of natural resources, biodiversity, and ecosystems to maintain ecological balance and resilience. Social inclusivity is also paramount, advocating for participatory decision-making processes, equal access to resources and opportunities, and the protection of human rights. Finally, economic viability underscores the necessity of fostering economic growth and development that is ecologically sustainable, socially equitable, and promotes long-term prosperity for all.(Østergaard et al., 2020) These principles collectively guide the pursuit of sustainable development, serving as a framework for integrating environmental, social, and economic considerations into policies, practices, and decision-making processes at local, national, and global levels.

2.1 PILLARS OF SUSTAINABILITY: ENVIRONMENTAL, SOCIAL, AND ECONOMIC DIMENSIONS.

The pillars of sustainability encompass three interconnected dimensions: environmental, social, and economic. These pillars serve as foundational principles guiding efforts towards achieving sustainable development.

i. Environmental Dimension: This pillar focuses on the conservation and protection of natural resources, ecosystems, and biodiversity. It emphasizes the importance of minimizing environmental degradation, reducing pollution, and promoting sustainable resource management practices. Key elements of the environmental dimension include biodiversity conservation, water and air quality preservation, waste reduction and recycling, climate change mitigation, and the protection of ecosystems and habitats.(Kriegler et al., 2012)

ii. Social Dimension: The social pillar of sustainability emphasizes social equity, justice, inclusivity, and the protection of human rights. It focuses on ensuring that all individuals have access to basic necessities such as food, water, shelter, healthcare, education, and employment opportunities. This dimension also encompasses issues related to social cohesion, community well-being, cultural diversity, and the promotion of social justice and equity across various segments of society, including marginalized and vulnerable populations.

iii. Economic Dimension: The economic pillar of sustainability aims to promote economic growth and development that is ecologically sustainable, socially equitable, and contributes to the overall well-being of society. It involves fostering economic systems and practices that prioritize long-term prosperity and minimize negative impacts on the environment and society. (Scharlemann et al., 2020) Key elements of the economic dimension include promoting sustainable consumption and production patterns, investing in renewable energy and green technologies, supporting small and medium-sized enterprises (SMEs), fostering innovation and entrepreneurship, and promoting fair trade and responsible investment practices.

3. GLOBAL WARMING

Global warming refers to the long-term increase in Earth's average surface temperature, primarily caused by human activities that release greenhouse gases into the atmosphere. These greenhouse gases, including carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and fluorinated gases, act like a blanket, trapping heat from the sun and preventing it from escaping back into space.(*Exceeding 1.5°C Global Warming Could Trigger Multiple Climate Tipping Points | Science*, n.d.) The primary cause of global warming is the burning of fossil fuels such as coal, oil, and natural gas for energy production, transportation, and industrial processes. This combustion releases large amounts of CO2 into the atmosphere, contributing to the enhanced greenhouse effect. Deforestation and land-use changes also play a significant role in global warming by reducing the Earth's capacity to absorb CO2 from the atmosphere through photosynthesis. Additionally, other human activities, such as industrial agriculture, livestock farming, and waste management, release methane and nitrous oxide, potent greenhouse gases that further exacerbate global warming. (Kriegler et al., 2012)While natural factors such as volcanic eruptions and variations in solar radiation can influence the Earth's climate, the overwhelming consensus among climate scientists is that human activities are the primary drivers of the unprecedented warming observed in recent decades. Addressing global warming requires concerted efforts to reduce greenhouse gas emissions, transition to renewable energy sources, protect and restore ecosystems, and adapt to the changing climate.

3.1 MITIGATION AND ADAPTATION STRATEGIES

Mitigation and adaptation strategies are essential components of addressing global warming and its impacts. Mitigation strategies aim to reduce greenhouse gas emissions and limit the extent of future climate change, while adaptation strategies focus on building resilience and adapting to the unavoidable impacts of climate change.

3.1.1. MITIGATION STRATEGIES:

i. Transition to Renewable Energy: Accelerating the transition from fossil fuels to renewable energy sources such as solar, wind, hydroelectric, and geothermal power reduces greenhouse gas emissions from energy production.

ii. **Energy Efficiency:** Improving energy efficiency in buildings, transportation, and industrial processes reduces energy consumption and associated emissions.

iii. **Afforestation and Reforestation:** Planting trees and restoring degraded forests increase carbon sequestration, helping to offset greenhouse gas emissions.

iv. **Carbon Capture and Storage (CCS):** Implementing technologies that capture CO2 emissions from industrial sources and storing them underground prevents their release into the atmosphere.

v. **Sustainable Land Use:** Implementing sustainable land management practices, such as conservation agriculture and agroforestry, helps sequester carbon in soils and vegetation.

vi. **Regulatory Policies:** Implementing policies such as carbon pricing, emissions trading systems, and regulations on emissions from industries and vehicles incentivize emission reductions.

3.1.2. ADAPTATION STRATEGIES:

i. **Climate-Resilient Infrastructure:** Designing and upgrading infrastructure to withstand extreme weather events, sea-level rise, and other climate-related risks.

ii. **Water Management**: Implementing water conservation measures, improving water storage and distribution systems, and developing drought-resistant crops to adapt to changing precipitation patterns.

iii. **Ecosystem Restoration:** Restoring and protecting natural ecosystems such as wetlands, mangroves, and coral reefs enhances their resilience to climate change and provides valuable ecosystem services.

iv. **Early Warning Systems**: Developing and implementing early warning systems for extreme weather events such as hurricanes, floods, and heat waves helps communities prepare and respond effectively.

v. **Community Engagement:** Engaging local communities in adaptation planning and decision-making processes, and incorporating traditional knowledge and practices, strengthens resilience and promotes adaptive capacity.

vi. **Climate-Smart Agriculture:** Adopting climate-smart agricultural practices such as crop diversification, conservation tillage, and improved irrigation techniques helps farmers adapt to changing climate conditions while reducing emissions.

4. INTERCONNECTION BETWEEN SUSTAINABLE DEVELOPMENT AND GLOBAL WARMING

4.1 FEEDBACK LOOPS AND MUTUAL IMPACTS BETWEEN THE TWO PHENOMENA

The interconnection between sustainable development and global warming involves feedback loops and mutual impacts between the two phenomena, highlighting the complexity of their relationship. Feedback loops occur when actions taken to address one issue inadvertently influence the other, leading to interconnected outcomes. For example, unsustainable development practices such as deforestation and intensive agriculture contribute to global warming by releasing greenhouse gases and reducing carbon sinks, exacerbating climate change. In turn, global warming impacts sustainable development by increasing the frequency and intensity of extreme weather events, disrupting ecosystems, and threatening food security and livelihoods. These impacts, in turn, can further exacerbate poverty, inequality, and social vulnerability, hindering progress towards sustainable development goals. Conversely, efforts to mitigate global warming, such as transitioning to renewable energy and promoting sustainable land use, can also support sustainable development objectives by improving environmental quality, enhancing resilience, and fostering economic opportunities. Similarly, sustainable development initiatives aimed at poverty alleviation, education, and healthcare can contribute to climate resilience and mitigation by building adaptive capacity and reducing vulnerability to climate impacts. Recognizing and understanding these feedback loops and mutual impacts are essential for developing integrated strategies that address both global warming and sustainable development goals effectively. By adopting holistic and coordinated approaches, policymakers, practitioners, and stakeholders can maximize synergies, minimize trade-offs, and advance progress towards a more sustainable and resilient future for all.

4.2 IMPLICATIONS OF GLOBAL WARMING ON ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

Global warming poses significant challenges to achieving sustainable development goals across multiple dimensions. Firstly, it exacerbates existing vulnerabilities and inequalities, particularly in developing countries and marginalized communities, making it harder to eradicate poverty (SDG 1) and achieve food security (SDG 2). Rising temperatures and changing precipitation patterns impact agricultural productivity, exacerbating food insecurity and malnutrition.

Secondly, global warming threatens efforts to ensure clean water and sanitation (SDG 6). Changes in precipitation patterns and increased water scarcity due to climate change can affect water availability and quality, impacting access to safe drinking water and sanitation services.

Thirdly, global warming undermines efforts to promote health and well-being (SDG 3). It contributes to the spread of vector-borne diseases, heat-related illnesses, and respiratory problems, placing additional burdens on healthcare systems and hindering progress towards universal health coverage.

Moreover, global warming affects efforts to build sustainable cities and communities (SDG 11). Rising sea levels and extreme weather events increase the vulnerability of urban areas to flooding, heat waves, and other climate-related hazards, threatening infrastructure, housing, and livelihoods.

Additionally, global warming hampers efforts to protect life on land and below water (SDGs 14 and 15). Climate change disrupts ecosystems, reduces biodiversity, and threatens habitats, undermining conservation efforts and sustainable management of terrestrial and marine resources.

Furthermore, global warming complicates efforts to combat climate change (SDG 13) itself. As temperatures continue to rise, the urgency of mitigating greenhouse gas emissions and adapting to climate impacts intensifies, requiring more ambitious and immediate action.

Overall, the implications of global warming on achieving sustainable development goals underscore the interconnectedness of environmental, social, and economic challenges. Addressing global warming effectively requires integrated approaches that consider climate change impacts across all SDGs, prioritizing resilience, adaptation, and sustainable development pathways that leave no one behind.

5. CHALLENGES AND BARRIERS

5.1 POLITICAL, ECONOMIC, AND SOCIAL BARRIERS TO SUSTAINABLE DEVELOPMENT AND CLIMATE ACTION

Political, economic, and social barriers pose significant challenges to sustainable development and climate action. Politically, there may be a lack of political will or commitment to enact and enforce policies that prioritize sustainability and address climate change. This can be due to competing interests, short-term political cycles, and reluctance to implement unpopular measures that may affect certain industries or constituencies. Economic barriers include the high upfront costs of transitioning to sustainable technologies and practices, as well as the entrenched interests of fossil fuel industries that resist change. Limited access to financial resources, particularly in developing countries, also hinders efforts to invest in climate-resilient infrastructure and clean energy solutions. Social barriers encompass a range of factors, including lack of public awareness and understanding of climate change, as well as cultural attitudes and behaviors that may perpetuate unsustainable consumption patterns. In addition, social inequalities and inequities can exacerbate vulnerability to climate impacts, with marginalized communities often bearing the brunt of climate-related disasters and lacking resources to adapt. Overcoming these political, economic, and social barriers requires concerted efforts from governments, businesses, civil society organizations, and individuals to promote policy coherence, mobilize financial resources, raise awareness, and address underlying structural inequalities. Collaboration and partnerships across sectors and stakeholders are essential to navigate these challenges and accelerate progress towards sustainable development and climate resilience.

5.2 EQUITY AND JUSTICE ISSUES IN ADDRESSING GLOBAL WARMING

Equity and justice issues are central to addressing global warming, as climate change disproportionately affects vulnerable and marginalized communities, exacerbating existing social inequalities. Firstly, there is a fundamental issue of historical responsibility, where developed countries, historically the largest emitters of greenhouse gases, have contributed the most to global warming, while developing countries, with lower emissions historically, bear a disproportionate burden of its impacts. This raises questions of fairness and equity in international climate negotiations and agreements. Additionally, within countries, disadvantaged communities, including low-income populations, indigenous peoples, and racial minorities, often face the most severe consequences of climate change, such as extreme weather events, sea-level rise, and food insecurity. These communities often have limited access to resources and social protections, making them more vulnerable to climate-related risks and less able to adapt. Furthermore, there are concerns about the distribution of benefits and costs associated with climate mitigation and adaptation efforts. For example, policies promoting renewable energy and carbon pricing may inadvertently increase energy costs for low-income households, exacerbating energy poverty and widening socio-economic disparities. Similarly, adaptation measures such as infrastructure improvements and coastal defenses may disproportionately benefit affluent communities, further widening the gap between the rich and the poor. Addressing equity and justice issues in addressing global warming requires recognizing and addressing the underlying structural inequalities that contribute to vulnerability and ensuring that climate policies and actions prioritize the needs and rights of the most vulnerable populations. This includes promoting participatory decision-making processes, incorporating social equity considerations into climate policies and programs, and providing adequate support and resources for adaptation and resilience-building efforts in marginalized communities. Additionally, international cooperation and solidarity are essential to ensure that climate action is fair, inclusive, and equitable, reflecting the principle of “common but differentiated responsibilities” and taking into account the diverse needs and circumstances of all countries and communities.

5.3 TECHNOLOGICAL LIMITATIONS AND INFRASTRUCTURE CHALLENGES

Technological limitations and infrastructure challenges present significant barriers to addressing global warming and transitioning to sustainable development pathways. One major technological limitation is the lack of scalable and cost-effective clean energy technologies. While renewable energy sources such as solar and wind power have made significant advancements, challenges remain in terms of energy storage, grid integration, and intermittency, limiting their widespread adoption as reliable alternatives to fossil fuels. Additionally, the development and deployment of breakthrough technologies such as carbon capture and storage (CCS) and advanced nuclear reactors face technical and economic hurdles, hindering their potential to mitigate greenhouse gas emissions.

Infrastructure challenges further compound these technological limitations. Existing infrastructure, particularly in developing countries, may be outdated, inefficient, and ill-equipped to support the transition to low-carbon and climate-resilient infrastructure. For example, inadequate transportation networks, water and sanitation systems, and energy grids may limit the deployment of clean technologies and impede efforts to reduce emissions and enhance resilience. Furthermore, the upfront costs of retrofitting or replacing existing infrastructure with climate-friendly alternatives pose financial challenges, particularly in contexts where resources are limited.

Moreover, technological limitations and infrastructure challenges intersect with social and political factors, further complicating efforts to address global warming. For instance, entrenched interests in fossil fuel industries may resist the adoption of clean energy technologies, while regulatory barriers and bureaucratic processes may slow down infrastructure development and innovation. Additionally, disparities in access to technology and infrastructure between urban and rural areas, as well as among different socio-economic groups, exacerbate inequalities and hinder inclusive sustainable development.

Addressing technological limitations and infrastructure challenges requires a multifaceted approach that encompasses research and development, policy incentives, financial investments, and capacity-building efforts. This includes promoting innovation and collaboration among public and private sectors, providing targeted support for technology transfer and diffusion in developing countries, improving regulatory frameworks to incentivize sustainable infrastructure investment, and enhancing public-private partnerships for infrastructure development and implementation. Furthermore, efforts to address technological limitations and infrastructure challenges must be integrated with broader strategies for promoting sustainable development and climate resilience, ensuring that solutions are context-specific, inclusive, and equitable.

5.4 CONFLICTING INTERESTS AND TRADE-OFFS IN POLICY IMPLEMENTATION

Conflicting interests and trade-offs in policy implementation present complex challenges when addressing global warming and sustainable development. Various stakeholders, including governments, businesses, civil society organizations, and individuals, often have divergent priorities, values, and objectives, leading to competing interests that can hinder effective policy implementation.

One significant area of conflicting interests is economic development versus environmental conservation. Policies aimed at promoting economic growth, job creation, and industrial development may conflict with environmental protection measures that seek to mitigate global warming and preserve natural resources. For example, expanding infrastructure projects or incentivizing certain industries may lead to increased greenhouse gas emissions and environmental degradation, undermining sustainability goals.

Similarly, conflicting interests may arise between short-term economic gains and long-term environmental sustainability. Decision-makers may face pressure to prioritize immediate economic benefits, such as maximizing profits or stimulating economic growth, even if it comes at the expense of long-term environmental health and climate resilience. This tension between short-term economic interests and long-term sustainability objectives can create trade-offs in policy implementation.

Furthermore, conflicting interests may emerge between different sectors and stakeholders, particularly in the context of resource allocation and regulatory decisions. For example, conflicts may arise between agricultural interests seeking access to land and water resources for food production and conservation efforts aiming to protect biodiversity and ecosystem services. Similarly, conflicts may arise between energy producers advocating for fossil fuel extraction and energy consumers pushing for renewable energy transition to mitigate global warming.

Addressing conflicting interests and trade-offs in policy implementation requires navigating complex political, economic, and social dynamics while striving to achieve balanced and inclusive outcomes. This involves engaging stakeholders in participatory decision-making processes, fostering dialogue and collaboration among diverse actors, and seeking win-win solutions that reconcile competing interests. Additionally, transparent and accountable governance mechanisms, backed by robust regulatory frameworks and effective enforcement mechanisms, can help mitigate conflicts and ensure that policies align with sustainable development and climate objectives. Ultimately, addressing conflicting interests and trade-offs requires a holistic and integrated approach that considers the interdependencies between environmental, social, and economic dimensions, while promoting equity, justice, and shared responsibility in policy implementation.

6. FUTURE DIRECTIONS AND RECOMMENDATIONS

- Enhanced Interdisciplinary Research: Future research should continue to explore the interconnectedness between sustainable development and global warming through interdisciplinary approaches. Collaborative efforts among scientists, policymakers, economists, social scientists, and other stakeholders can deepen our understanding of complex dynamics and identify innovative solutions.
- Integrated Policy Frameworks: Policymakers should prioritize the development and implementation of integrated policy frameworks that address both sustainable development goals and climate action. This entails mainstreaming climate considerations into development policies and vice versa, ensuring coherence and synergy across various policy domains.

- Empowerment of Vulnerable Communities: Efforts should be made to empower vulnerable and marginalized communities, ensuring their meaningful participation in decision-making processes and climate adaptation/mitigation efforts. Building local capacity, promoting social inclusion, and addressing underlying inequalities are essential for enhancing resilience and promoting sustainable development.
- Investment in Green Technologies: Increased investment in research, development, and deployment of green technologies is crucial for accelerating the transition to a low-carbon economy. Governments, businesses, and international organizations should prioritize funding for renewable energy, energy efficiency, sustainable agriculture, and other clean technologies.
- · Climate Education and Awareness: Climate education and public awareness campaigns should be expanded to promote understanding of the interconnectedness between sustainable development and global warming. Empowering individuals and communities with knowledge and skills can drive behavioral change and foster a culture of sustainability.
- International Cooperation and Solidarity: Enhanced international cooperation and solidarity are essential for addressing global warming and achieving sustainable development goals on a global scale. Countries should commit to ambitious climate targets, fulfill their climate finance obligations, and support vulnerable nations in climate adaptation and resilience-building efforts.
- Inclusive Green Recovery: Post-pandemic recovery efforts provide an opportunity to build back better and greener. Governments and international institutions should prioritize green stimulus packages that promote sustainable development, create green jobs, and foster economic resilience while advancing climate goals.
- Continuous Monitoring and Evaluation: Regular monitoring and evaluation of progress towards sustainable development goals and climate targets are essential for tracking achievements, identifying challenges, and adjusting strategies as needed. Robust monitoring frameworks and data collection systems should be established to ensure accountability and transparency.

7.CONCLUSION

In conclusion, the interconnection between sustainable development and global warming is undeniable, as both phenomena are intricately linked and mutually influential. Throughout this review, we have explored the complex dynamics and interdependencies between these issues, highlighting the challenges, opportunities, and potential pathways forward. Sustainable development goals cannot be achieved without addressing global warming, and effective climate action requires integrated approaches that consider environmental, social, and economic dimensions. From the historical context and evolution of these concepts to the implications on achieving sustainable development goals, we have seen the importance of understanding and addressing these interconnected challenges holistically.

As we look to the future, it is clear that bold and coordinated action is needed to tackle the intertwined challenges of sustainable development and global warming. This will require enhanced interdisciplinary research, integrated policy frameworks, empowerment of vulnerable communities, investment in green technologies, climate education, international cooperation, and continuous monitoring and evaluation. By embracing these recommendations and working together across sectors and borders, we can pave the way towards a more sustainable, resilient, and equitable future for all. It is imperative that we act decisively and collectively to address these urgent challenges and build a better world for current and future generations.

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A Study on Household Waste Management by Rural Women Leading to Environmental Conservation: A Case Study of Bumuar Village in Gaya District, Bihar

Shalini Jai Shree and Prof. Mrutyunjaya Mishra

ABSTRACT

Waste need to be considered as potential resource rather than undesirable and unwanted, in order to avoid its contamination with air, water, land and other resources, domestic waste should be properly handled. For handling household waste in an efficient manner, women play a vital role. Women are the primary handlers of domestic waste if they are aware of the potential of waste generated from kitchen, they can utilize it in various ways, such as making compost for kitchen garden, use for feeding cattle and many more. Thus this study was conducted in Bumuar village of Gaya district, Bihar to assess the domestic waste management practices followed by rural women which leads to environmental conservation. Data was collected through focus group study and interview schedule based on semi structured questionnaire covering 50 rural women, where each women representing each household. The result of the study revealed that irrespective of educational qualification, women are aware of the importance of kitchen waste. The result also revealed that due to lack of knowledge and unavailability of proper washroom facility, women fail to maintain proper sanitation and hygiene practices, which is dangerous to their health. Furthermore through this paper, the researcher tried to explore the relationship of socio - cultural attributes such as educational level, occupational level, role of gender, role of festive seasons. Additionally, it will play a crucial role in educating and training sanitation workers, educational institutions, and the general public about solid waste and its effective management.

Keywords: *Bumuar, domestic waste management, rural women, Socio-cultural attribute*

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INTRODUCTION

Effective domestic waste management is crucial for improving public health and environmental quality. The responsibility for managing household waste often falls on women, who play a significant role as the primary caregivers and environmental stewards in many societies. In rural areas, women are particularly instrumental in the collection, sorting, and disposal of household waste, despite facing challenges such as low literacy rates.

Rural women, despite lower literacy rates, actively participate in waste management practices, demonstrating a commendable commitment to environmental sustainability. They engage in daily activities like gathering, segregating, and disposing of waste, showcasing an understanding of the importance of waste segregation. Unlike urban areas, where waste often ends up in dustbins, rural women employ innovative methods such as feeding kitchen waste to cattle or using residuals for composting.

In Bihar, a state in India, domestic waste management practices reflect a conscious effort towards sustainability. Segregation of waste into categories like organic and inorganic is a common practice, with rural households utilizing kitchen waste for cattle feed or composting. Recycling efforts extend to selling biodegradable waste, while composting pits in backyards are prevalent for managing organic waste. Unfortunately, burning waste remains a less ideal, yet practiced method in some households, leading to air pollution and health hazards.

Literature on waste management practices emphasizes the impact of women's occupations and literacy levels on waste management. Studies in places like Damataru in Nigeria (Tiwary, 2015) highlight the relationship between demographic characteristics, such as occupation and literacy levels, and waste management practices. Similarly, research in Pondicherry (Anupriya et al., 2020) reveals insufficient knowledge among rural women about hazardous waste disposal.

Other studies delve into specific aspects of waste management, such as the nutritional value of fruit and vegetable peels for composting (Patel et al., 2015). Efforts to improve knowledge through brochures demonstrate a proactive approach to address gaps in understanding. In Cheruthazam *Panchayat* in Northern Kerala (Kaithery et al., 2019), attitudes towards waste management are explored, emphasizing the need for ongoing awareness campaigns.

Studies in various locations, including those in Kenya (Kinyua et al., 2016), emphasize the importance of knowledge and attitude in household waste management. The correlation between solid waste management knowledge and practices is evident, with suggestions for innovative interventions. Additionally, socio-cultural factors, as highlighted in a study by Sinha and Prabhudev (2016), play a pivotal role in solid waste generation, emphasizing the need for tailored policies and educational initiatives.

OBECTIVES OF THE STUDY

- Assessing the extent to which women contribute to environmental conservation through the management of daily household chores.
- Evaluating the enduring effects of sanitation practices on both women's health and the environment.
- Examining the influence of socio-cultural challenges on the management of solid waste.
- Analyzing women's viewpoints on their involvement and contributions to waste management.

STUDY AREA

Present study is related to a small village called Bumuar located in Gaya district, Bihar. Bumuar is a Village in Mohanpur Block in Gaya District of Bihar State, India.

SAMPLING FRAME & DATA COLLECTION

The study employed simple random sampling, selecting every fourth household from a pool of 405 households in Bumuar village. Interviews with 50 women, chosen through focused group study, explored their roles in domestic waste management. The primary data collection utilized semi-structured questionnaires, supplemented by focus group discussions to understand motivations. Examining socio-cultural factors like education, occupation, gender, and festivals, the study employed descriptive research. Variables such as knowledge of waste management and attitudes were measured using statements and a 3-point Likert scale, respectively. Data analysis involved coding responses in numerical form using MS Excel, calculating percentages, and drawing relationships among variables.

DATA ANALYSIS

TABLE 1. Demographic background of the respondents

S.NO.	PARTICULARS	FREQUENCY (N0.)	PERCENTAGE
1	AGE		
	18-25	6	12%
	26-30	9	18%
	31-40	14	28%
	41 and above	21	42%
	TOTAL	50	100%
2	OCCUPATION		
	Housewife	10	20%
	Agricultural labor	18	36%
	Farmer	8	16%
	Others (Potter, government teacher, milkmen, NGO workers etc.)	14	28%
	TOTAL	50	100%
3	EDUCATION QUALIFICATION		
	Illiterate	20	40%
	Primary	13	26%
	High school	5	10%
	Intermediate	4	8%
	Graduate and above	8	16%
	TOTAL	50	100%

Source: Field survey

This study shows that among 50 respondents , 12% belongs to age bracket of 18-25 who were married, 18% belongs to age group of 26-30, majority of the respondents belongs to the age group of 41 and above. From each house, data is collected from single women representing the whole house. If occupation is to be discussed then majority of women belongs to labor class , these women who are engaged in labor activities , not only works on others field but also engage in various activities where daily wages are paid. 28% of the women, who comes under others category, generally are government teachers, or some social workers. If education level is to seen then 40% of women were illiterate or mere knows to do their signature.16% of women who were graduates and above were generally employed women. Furthermore the study shows that 68% of the samples were staying in a Pucca house.

Attitude of rural women in managing domestic waste

This section analyzes how women just by managing daily household chores play a vital role in environmental conservation

Table 2A: Frequency and percentage of women dealing with biodegradable waste according to the particulars.

PARTICULARS	FREQUENCY(n)	PERCENTAGE%
Feed the cattle	30	60
Throw in barren land	2	4
Use as compost	13	26
Feed the cattle as well as use as compost	5	10
TOTAL	50	100

Source: Field survey

FIGURE 1: Ways to treat the biodegradable waste.

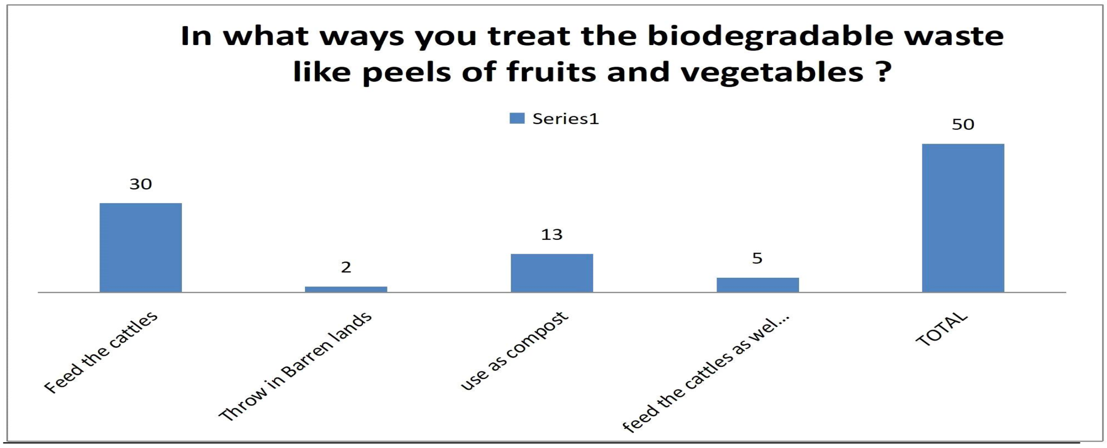


Figure 1 shows that 60% of the respondents do not throw biodegradable waste from the kitchen into the garbage rather they prefer to feed the cattle's. Among these, those who don't have cattle in their house they give their kitchen waste to their neighbors who have cattle in their house. 26% of the respondents use this kitchen waste for making compost that can be utilized for making soil fertile. They do this because they are aware of the nutrients that are present in the peels of the fruits and vegetables that can be beneficial for the increasing the fertility of the soil. Only 2% of the population do not utilize these kitchen waste rather throw them away.

TABLE 2B: Frequency and percentage of cattle owners dealing with waste generated from the cattle, according to the particulars.

Particulars	Frequency(n)	Percentage
Use as fuel	8	23
Use for making compost	3	8
Use for polishing their house	1	3
Throw away in open ground	1	3
Use for making compost during rainy season and rest of the time use for fuel	22	63
TOTAL	35	100

Source: Field Survey

FIGURE 2: Ways to utilize waste generated from cattle

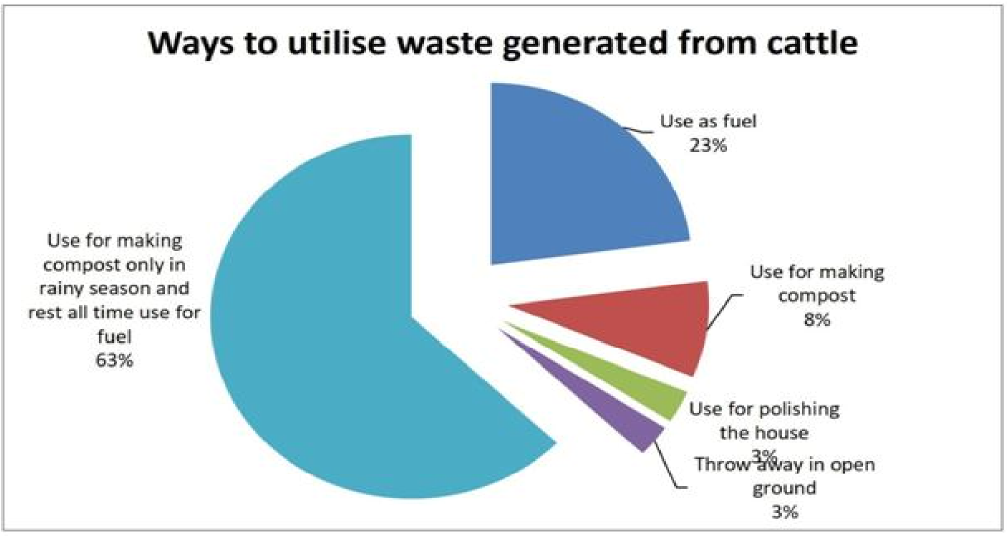


Figure 2 shows how rural women manage waste generated from cattle. Out of the 50 respondents 35 were the one who were having cattle in their house, out of this 35 ,8 were utilizing the waste generated from the cattle in making cow dung cake which were later be utilized as a fuel that can be used for cooking purpose. 8% of women use waste generated from cow only for making compost because they were aware that cow dung can be composted as a nutrient rich fertilizer which can be used for gardening purpose. Rest 63% of the women were those who utilizes cow dung in a multiple activities, like during rainy season they cannot make cow dung cake, so during that time they utilizes waste for making compost which could later be utilizes as a organic fertilizer for farming.

Impact of socio-cultural challenges on solid waste management

This section finds the impact of socio-cultural challenges on solid waste management In order to show the impact of socio-cultural challenges following attributes are used:

1. Education level
2. Occupation
3. Gender role
4. Festival seasons

Table 3A: Impact of the education level of rural women in managing domestic waste

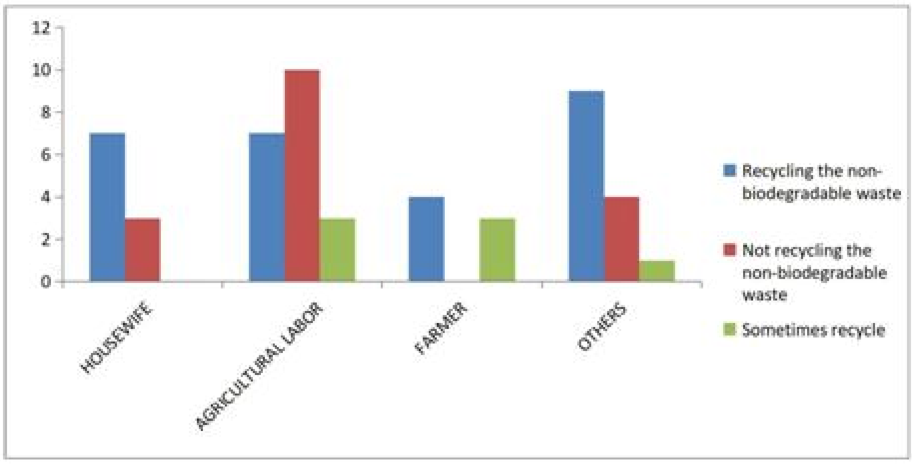
Education level	Segregation of waste	No segregation Waste	TOTAL
lliterate	18	2	20
Primary	10	3	13
High school	5	0	5
Intermediate	4	0	4
Graduate and above	7	1	8

Source: Field survey

Occupation	Recycling theNon Biodegradable Waste	Not Recycling The Non Biodegradable Waste	Sometimes Recycling	Total
Housewife	7	3	0	10
Agricultural labor	7	10	1	18
Farmer	4	1	3	8
Others	9	4	1	14

Source: Field Survey

FIGURE 3: Impact of the occupation of women in managing domestic waste



Occupation of the respondents was the identified as another key attribute for seeing the impact of socio-culture in managing domestic waste. Recycling of non-biodegradable waste such plastic bottles and jars, glass bottles and jars, metal containers, is an crucial step in controlling environment pollution . In order to recycle such kinds of waste , the villagers sell these items to *kabadiwala* in return of which they either get money as per the weight of items or gets *soanpapdi* (Indian desert) in return.

FIGURE 3 through our research shows that agricultural labor, which are recycling the non-biodegradable waste are very less in number as compared to others. In order to increase the no. government should organize various awareness programmers to teach the rural women the importance of recycling waste.

TABLE 4: Role of gender in managing domestic waste.

Who goes for fetching water	Frequency(n)	Percentage
Mostly male members of house	7	14%
Mostly female members of the house	32	64%
Anyone who so ever is available	11	22%
TOTAL	50	100%

Source: Field Survey

FIGURE 4 : Role of gender in managing domestic waste

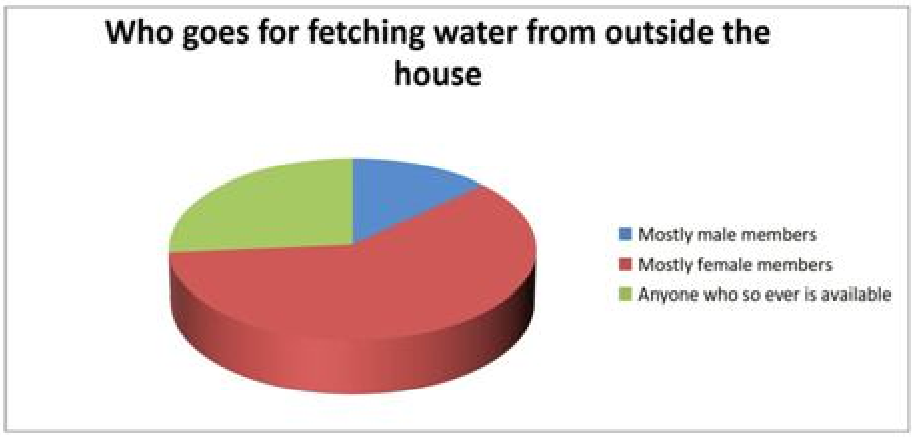


TABLE 4 and FIGURE 4 shows that in rural areas contribution of women in managing household activities as well as fetching water from common tube wells is comparatively at a higher rate. As 64% of the respondents claims that men has no contribution in household activities or sometime shows a minimum contribution, whereas 14% of the respondent strongly claims that in our house in case motor pump is not working then it is the responsibility of the male members of the house to go out and fetch water from common tube wells ,this happens mostly during the summer season, when water level goes down, not only that in those whose houses where drinking water comes from outside, far from the house (water gallon) it is the

Responsibility of men to fetch those water gallons. 22% of the respondent claims that anyone from the family who so ever is available at that time goes for fetching water.

Perception of rural women related to solid waste management.

Utilizing a 3-point Likert scale, reflects women's perspectives on domestic waste management. 47 respondents agree that females efficiently handle domestic waste, emphasizing male indifference. 29 believe improper sanitation disproportionately affects women, while 7 assert men suffer more due to environmental degradation. Regarding rural vs. urban waste management, 40 agree rural women excel due to resourceful practices, contrasting with 9 supporting urban women's efficiency. When asked about recognition for household contributions, 41 feel overlooked, while 7 working women claim acknowledgment and appreciation. This survey provides insights into gender roles, waste management practices, and societal recognition in domestic responsibilities.

4.4. Discussion and Conclusion

The study reveals that rural women play a significant role in domestic waste management and environmental conservation, particularly in handling biodegradable kitchen waste. A majority of respondents separate dry and wet waste, using kitchen waste for cattle feed or compost due to their awareness of its soil-nourishing properties. Among those with cattle, 63% utilize cow dung for cooking fuel or compost during bad weather. However, 13 respondents lack proper sanitation facilities, attributing it to husbands misusing government subsidies for alcohol.

The study highlights the government's inadequate provision of basic amenities for rural households, impacting impoverished women. Despite their pivotal role, rural women face challenges such as insufficient infrastructure, lack of knowledge, and funding constraints in waste management.

To address these issues, the study emphasizes empowering rural women with tools, information, and resources for effective waste management. This involves educating them on waste management procedures, improving access to waste facilities, and supporting the development of eco-friendly waste management systems.

SUGGESTIONS

The recommendations include distributing dustbins or establishing common dumping zones for daily waste disposal. The government should raise awareness on sanitation, hygiene, and menstrual health through programs by *aganwadis* or NGOs. Strict actions are needed to discourage open defecation, with public toilets in common areas. Promoting biogas from cow dung as a cooking fuel is suggested, along with forming volunteer communities for waste management. Incentives for residents participating in waste reduction and recycling initiatives should be provided.

LIMITATIONS OF THE STUDY

The study's limitations include a small random sample size of 50, hindering generalization to the entire village. Time and budget constraints prevented detailed data analysis. Household reluctance to disclose annual income impeded examining its correlation with waste management practices. Inexperience with primary data may have overlooked crucial aspects of rural women's waste management practices.

FUTURE SCOPE OF THE STUDY

- Comparative study of waste management practice between rural and urban women could be done.
- Variation in waste management practice on the basis of income level and education level could be explored.
- Type of campaigns working on creating awareness among rural women in Bumuar village, regarding sanitation and hygiene practice could be explored.

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India's Stand on Global Climate Policy Negotiations: Kyoto to Post Paris Era

Sandeep Kumar and Nikhil Kumar Gautam

Introduction: -

The world has turned the page on 2024 with the worrying revelation that it would be the warmest year since 19th century. A warming globe with changes to the climate in the form of altered rainfall, droughts, floods, biodiversity loss, and reduced crop yield have been seen currently, affecting commons across the globe and would affect further in future. At current time, the **Intergovernmental Panel on Climate Change (IPCC)**, and the **United Nations Framework Convention on Climate Change (UNFCCC)** with the collaboration of developed and developing countries across the globe have trying to slow down this warming as fast as they can. In the way to achieve this global aim, several global agreements have been committed during yearly conferences named as – **'Conference of Parties – COPs'** of which **Kyoto Protocol** and **Paris Agreement** are emphasis to be more effective agreements that are accepted by the global community. Countries agreed at United Nation climate talk in Paris in 2015 (latter called **Paris Agreement**) to keep global warming well below 2! and aim to limit it to 1.5!, a level regarded as crucial to preventing the most severe consequences. However, the scientists at the **European Union's Copernicus Climate Change Service (C3S)** have said that the world has experienced the warmest January on records. Same agency also said that global mean temperature for the past 12 month (Feb 2023- Jan 2024) was the highest on record and 1.52! above the 1850-1900 pre-industrial average. Exceeding 1.5! does not yet mean the Paris goal has been missed, as the UN agreement refers to an average global temperature over decades, however, some scientists have said the 1.5! aim can no longer realistically be met, and they have urged governments to act faster to cut CO2 emissions to limit the amount of overshoot of the target. ***"Rapid reductions in GHG emissions are the only way to stop global temperature increasing"*** - C3S deputy director Samantha Burgess said in *'The times of India' Feb, 2024.*

India was among the pioneers of various crucial formulations that went on to define **UNFCCC** and **Kyoto Protocol**, including the ethical background that all nation and people

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were responsible for anthropogenic climate change, with the consideration that developed countries are more responsible than developing countries, and that per capita national emissions constituted the best metric to represent the respective contribution of different nations as well as to determine their share of the burden toward its solution. The principle of **'common but differentiated responsibility (CBDR)'** embodied in the **UNFCCC** and has underpinned the **Kyoto Protocol** and all climate negotiations, until very recently, however, the idea of **CBDR** now constitutes a firewall between developed and developing countries has been sharply contested.

This paper presents the background of global climate change policy along with the opening debate between developed and developing countries. Paper also presents the Indian stand on climate change policy from **Kyoto Protocol** to currently happened COP 27 in **Sharm-El Sheikh, Egypt.** At last, paper also upbrings the major challenges of Indian climate change policy.

Background of Global Climate Change Policy

The issue of climate change is viewed as a public good issue, requiring collaborative action to develop adequate policies. Negotiations for this global issue has begun in 1991 and led to the signing of the United Nations Framework Convention on Climate Change (UNFCCC) at the **Earth Summit** in **Rio De Janeiro** the next year. At this convention no schedule for mandatory limits on **Greenhouse Gas (GHG)** emissions was formally established. However, the convention was able to establish an ambitious framework for stabilizing concentrations of GHGs in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The convention entered into the force on March 21, 1994 and enjoys near universal membership, with 192 countries having already ratified.

The nations that have ratified the UNFCCC meet each year as the **Conference of the Parties (COP),** the governing body of the convention, to the treaty. The nations have attending COP 1, which was held in Berlin in1995, and agreed that the original treaty did not go far enough and committed themselves to negotiate a schedule for binding reductions that would be ready for adoption when they gathered for COP 3 in Kyoto in 1997. Surprisingly, the landmark international treaty materialized as scheduled, and COP 3 adopted a protocol (latter known as **Kyoto Protocol**) committing the developed countries to achieving an average 5.2 percent reduction in their GHG emissions from 1990 levels in the commitment period, 2008 to 2012. However, developing countries are not required to restrict their emission because of their very little per capita GHG emissions. The detailed rules of Kyoto Protocol were adopted at COP 7 in Marrakesh (Morocco) in 2001 – The **Marrakesh Accord**. Under President George W. Bush, the U.S. refused to ratify the Kyoto Protocol. Despite U.S. withdrawal, treaty officially entered into force on February 16, 2005, and 184 Parties of the UNFCCC have ratified its Protocol to date. Few further COP meetings have been devoted to refining and clarifying the rules for compliance, the use of sink and the implementation of flexible mechanisms that are consistent with the Marrakesh Accords.

After successful enforcement of Kyoto Protocol, discussions immediately turned to what would happen to the climate regime, post-2012, once the **'first commitment period'** of Kyoto Protocol ended. On the other side, developed countries, however, forcefully raised the issue of developing country participation again. They argued that no long-term solution could be found without the active engagement of the fast growing developing economies (e.g., China & India).

In order to resolve this stand-off, COP 11 launched a dual-track process to not only discuss the post-2012 **'second commitment period'** mitigation targets of **Annex I Parties** that had ratified the Kyoto Protocol, but also a separate parallel 'dialogue' on **'long-term cooperative action'** to discuss the future commitments of those countries that had either refused to ratify the treaty or had no binding emissions reduction obligations under it, that is, developing nations. However, with low targets, weaker rules and covering fever countries than earlier, the Kyoto Protocol has been extended till 2020. COP 15 produced the **Copenhagen Accord** were developed countries have pledged up to $30 billion to fund developing nations' need for mitigation and adaptation actions. This financial support is expected to increase to **$100 billion** a year by 2020. However, the binding global agreement on emission reductions have failed at Copenhagen at COP 15 in 2009, and the negotiation starts for another approach. The Copenhagen conference parties agreed only that the goal for future rounds of negotiations would be to keep the global temperature warming below the threshold of 2! above pre-industrial levels. The most contentious point of disagreement was the question of whether developing countries should be bound by mandatory cuts in GHG emissions. However, developing countries contended that mandatory cuts would limit their economic development and reinforce existing global inequalities.

After the failure of Copenhagen, the idea of a binding agreement was rejected as unfeasible. In its place, negotiators came up with the idea that countries would instead propose their own voluntary goals – the hope being that countries would eventually feel 'peer-pressure' to set the most ambitious possible goals within their reach. And this new negotiation strategy laid the foundation for the global agreement reached at the 21st Conference of Parties (COP 21) in Paris.

The **Paris Agreement**, negotiated by 195 national delegations formally expresses the global aim of holding temperatures to no more than 2! above pre-industrial levels, with a more ambitious target of 1.5!. Since the current total of country pledges **(Nationally Determined Contributions – NDC)3** is not sufficient to secure the global, goal of keeping warming under 2!, the agreement includes 5 year cycles for countries to review their goals and ratchet up their targets, to reach more ambitious goals – analyzed by **Climate Action Tracker (CAT)**. Despite subsequent rejection of the agreement by the United States Trump Administration, the agreement remains in force – though compliance with the targets is voluntary.

India's Climate Policy in Pre-Kyoto Era

It is the fact that India has intentionally played an active role in the international debate on climate change from very early on. At the **'Conference of Select Developing Countries on Global Environmental Issues'** convened in New Delhi in April 1990 – the first of its kind for developing countries – India succeeded in securing the general support of the developing world for its basic international positions on climate change. These were:

- ❖ The primary responsibility for reducing GHG emissions causing the problem of climate change rested with the developed world since they were the one responsible for producing the bulk of these emissions.
- ❖ The emissions of developing countries were still very low and needed to grow to meet their future development and poverty reduction needs, and hence no GHG reduction targets could be prescribed for them.
- ❖ Any formal agreement on climate change needed to provide for technology transfer and funds for developing countries to help them address this challenge **(Ministry of Environment and Forests, 1990).**
- ❖ India also played a vital role in shaping the background conditions against which the convention negotiations were held, and worked closely with other developing nations to ensure that this was amended to become the **'common but differentiated responsibilities' (CBDR)** of industrialized and developing countries. India also played a key role in ensuring that the convention negotiations were undertaken through an **'Intergovernmental Negotiating Committee'** operating under the direct authority of the **United Nation General Assembly (UNGA) -** to allow for 'openness, transparency, universality and legitimacy' and the 'full participation' of all states rather than through other specialized forums, such as United Nations Environmental Program (UNEP) or IPCC, which were being advocated by developed countries at that time. During the entire convention negotiation, India has always emphasized that it had no legal responsibility for addressing climate change and if it took any voluntary mitigation measures that will be consistent with its national development plans and priorities.
- ❖ India was largely successful in securing its core positions in the convention negotiations; however, it was nevertheless able to get its preferences (concrete emission reduction commitments from developed countries; and technology transfer on 'preferential' terms) on specific principles and provisions successfully embedded within the core text of UNFCCC. The final text of the UNFCCC adopted at Rio De Janeiro in 1992 clearly acknowledged that –
- ❖ '*The largest share of historical and current global emissions' originated in developed countries; that per capita emissions in developing countries were 'still relatively low' and their future share of global emissions would need to 'grow to meet their social and development needs'; that 'Parties should protect the climate system … on the*

basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities' (CBDR & RC); and that 'accordingly, the developed country Parties should take the lead in combating climate change' (UNFCCC 1992: Preamble, Article 3.1).

India played an important role not only in insisting on developed nations shouldering the emissions reduction burden but also in undertaking independent scientific studies and analyses to counter attempts, notably by the US, to shift blame for anthropogenic GHGs away from the fossil-fuel based power generation, transportation, industries and lifestyles of the global north to activities in the developing countries, such as paddy cultivation and animal husbandry accused of producing competing quantities of methane. There can be little doubt that it was the vigorous pursuit by developing countries including India of this position, with its strong ethical grounding and backed by the widely accepted numbers of per capita energy consumption and emissions in developed and developing countries respectively, which ultimately led to the signing of the Kyoto Protocol and its ratification even in the face of US opposition to it.

Kyoto Protocol & India

At the third annual negotiation of UNFCCC which was held in Kyoto, a city in Japan, 37 developed countries along with European Union were agreed to adopt binding commitments to reduce GHG emissions up to an average 5% compare to their 1990 level of emission over the five-year period 2008 to 2012, either individually or jointly. However, Kyoto Protocol was entered into force from 16th Feb, 2005. The detailed rule for the implementation of the Kyoto Protocol were adopted at COP 7 in Marrakesh, Morocco, in 2001, and referred as the **'Marrakesh Accord'**. There set two commitment periods to the Kyoto Protocol, the first of which lasted from 2008-2012, and second one decided to run from 2013-2020. The Protocol committed the industrialized nations to specify, legally binding reductions in emissions of six GHGs namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

India strongly favored the Kyoto Protocol because it ensures that India would not be responsible for lowering its own GHG emissions, and that Annex I countries would invest resources in India for development of cleaner technologies. Any future agreement that held India to particular GHG emissions reductions would therefore be a significantly greater imposition on India. Kyoto Protocol brought benefit by transfer of technology and additional foreign investments after came into force. Additional investments would come into renewable energy, energy generation and efficiency promotion and afforestation projects. India has all along maintained the developed and developing countries have differentiated responsibility towards stablishing emissions of GHG. Beside upholding this position, the Kyoto Protocol enables India to take up clean tech projects with external assistance in accordance with national sustainable development priorities.

Out of the three mechanisms of Kyoto Protocol, the **Clean Development Mechanism (CDM)** is the only mechanism where developing countries can participate and join in mitigation of climate change. The CDM allow emission reduction projects in the developing countries to earn **Certified Emission Reductions (CERs)** which can be purchased or used by industrialized countries to meet a part of their emission reduction targets under Kyoto Protocol. India has been one of the major beneficiaries of the CDM, a flexible mechanism under the Kyoto Protocol and would like that the mechanism to continue and be further strengthened.

In December 2012, after the first commitment period of the protocol ended, parties to the Kyoto Protocol met in Doha, Qatar, to adopt an amendment to the original Kyoto Agreement. This so-called Doha Amendment added new emission-reduction targets for the second commitment period, 2012-2020, for participating countries. In view of the critical role played by India in securing international consensus on climate change issues, India has ratified the second commitment period of the Kyoto Protocol **(Doha Amendment)** that commits countries to contain the emission of GHGs. Under the second commitment period, implementation of CDM projects have helped Indian to attract some investments.

The United States did not join Kyoto Protocol, and Canada withdrew before the end of the first commitment period. While negotiating the second Kyoto commitment period, Australia, Japan, and other Parties also decide to seek an agreement that included commitments on the same term from all parties. From COP 15 in Copenhagen in 2009 to COP 20 in Lima in 2014, the conferences of UNFCCC seek for an agreement on a "protocol, another legal instrument, or an agreed outcome with legal force" which could take over from the Kyoto Protocol. With this goal in mind, the Parties affirmed their desire to limit global warming to below 2!, made progress on finance for the necessary actions and thus prepared the conditions for COP 21 (later called Paris Agreement).

Paris Agreement & India

At COP21 in Paris, on 12 December 2015, Parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. Paris Agreement is the second major subsidiary agreement under the UNFCCC which eventually replace the Kyoto Protocol as the primary subsidiary vehicle for process and actions under the UNFCCC. The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2! above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5!. To reach these ambitious goals, appropriate mobilization and provision of financial resources, a new technology framework and enhanced capacity building is to be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with own national objectives. The Agreement requires all Parties to put forward their best efforts through **'nationally determined contributions" (NDCs)** and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts. Parties also decided to update or submit new NDCs by 2020 and every five years thereafter.

India has ratified the Paris Climate Agreement on October 2, 2016, the birth anniversary of Mahatma Gandhi, exactly a year after the government announced its NDC to combat climate change. India despite having no binding mitigation obligations as per the Convention, however, India has declared a voluntary goal of reducing the emission intensity of its GDP by 20-25% over 2005 levels, by 2020. However, India has updated its first NDC in August 2022 in which it has enhanced its target to reduce emissions intensity of its GDP by 45% by 2030 from 2005 level and achieve about 50% cumulative electric power installed capacity from the non-fossil fuel based energy resources by 2030. The other targets are to create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030; and propagate sustainable lifestyles through a mass movement of **'LIFE' (Lifestyle for Environment)** as a key to combating climate change; to better adapt to climate change; adopt climate friendly and cleaner development path; mobilize domestic, new, and additional funds and capacity building.

India's Climate Policy in Post-Paris Era

India has overachieved its commitments made in its NDC (2015) on electric power installed capacity from non-fossil fuel-based energy resources. As per the report of Central Electricity Authority, electric power installed capacity from non-fossil fuel-based energy resources is about 43.60% (183 giga watt out of total 421 giga watt) as on 30th June 2023. India has progressively continued decoupling of economic growth from GHG emissions. India's emission intensity of GDP has reduced by 24% between 2005 and 2016. As per the estimate published by the Forest Survey of India, India is on the track to achieve additional carbon sink of 2.5 billion to 3.0 billion tonnes of CO2 by 2019 as compared to base year 2005.

Further, in November 2022, India has submitted its long-term Low-carbon Development Strategy rests on seven key transitions to low-carbon development pathways. One of these transitions will focus on promoting Adaptation in Urban Design, Energy and Material-Efficiency in Buildings, and Sustainable Urbanization. Other than that, Government of India has also implemented several programmes and schemes including the **National Action Plan on Climate Change (NAPCC)** which comprises missions in specific areas of solar energy, energy efficiency, water, sustainable agriculture, Himalayan ecosystem, sustainable habitat, green India, and strategic knowledge for climate change.

Apart from resolutely addressing climate change domestically, India has launched international coalitions such as **International Solar Alliance (ISA)** and **Coalition for disaster Resilient Infrastructure (CDRI)**. At COP 26 in Glasgow in November 2021, new initiatives under CDRI and ISA, viz, **Infrastructure for Resilient Island States (IRIS)** and Green Grids Initiative – One Sun, One World, One Grid (GGI-OSOWOG) were also launched. Along with Sweden, India co-leads the Leadership Group for Industry Transition (LeadIT) for voluntary for low carbon Transition of hard to abate sectors. At COP 26 India has also announced it aim of achieving Net-Zero emission by 2070 at Glasgow. At COP 27 held in Sharm-El Sheikh, Egypt, India has welcomed the headline outcome – reaching agreement to compensate nations for loss and damage caused by climate change through the establishment of the fund which is lauded as an historic decision. However, the goal of developed countries to mobilize jointly USD 100 billion per year by 2020 has not yet been met. Other than there are national schemes such as ROSHANEE, which is the energy efficiency roadmap; UJJWALA – a cooking gas mission; UJALA which is the LED lighting; PM KUSUM, which is the solar energy for agriculture; Jal Jeevan mission is the drinking water supply mission. A comprehensive National Hydrogen Energy Mission with its emphasis on generating and utilizing green hydrogen will be a quantum leap in tackling climate change.

Major Issues & Challenges of Climate Change Policy in India

Climate change is the issue of global concern, which only can tackle by the global collaboration. However, each country has its own priorities and problems, which shapes their domestic climate policy differentiated from others. India is one of the most significant countries in the world in both its GHG emissions and its vulnerability by climate change. At national level, India's climate policies are subsumed in its economic-industrial and human development policies which come first. **Climate Change Performance Index (CCPI) 2023** has put India at the best among G-20 countries and considered as on track to meet its 2030 emission targets (compatible with a well-below 2! scenarios. However, along these cheers, India has also faced several challenges regarding its climate change policies. Here are the few considerations:

❖ Climate Change and Social Justice

Climate change is an issue of social justice, particularly in developing countries. Rationally, India faces enormous and more immediate, challenges to eradicate poverty, and build up the life standard of their people by providing them the access to health, literacy, clean energy & water, and sanitation. If the world is to avoid disastrous climate change while at same time reduce poverty, then developing countries will need access to low-carbon fuels which is not possible theoretically. The transition to a low-carbon economy can be made, but it will be at cost of social injustice because most of the climate finance are from domestic sources which can be used for development purposes within country.

❖ Carbon Trading Paradox

Carbon credit trading has its own problems for the developing countries. When the main element (Carbon) associated with climate change is available for trading then it may not deliver the desired results. It could result in the exploitation of developing countries who fail to get the deserved price for projects taken with the intention carbon emission reduction while the emitters of carbon (developed countries) may get away with increased emission levels. Instead of viewing climate change as simply the biggest challenge that has ever confronted humanity, trading in carbon credits may amount to business as usual.

❖ Climate Change and Intellectual Property Rights

Another challenge is to ensure that low-carbon technology is transferred from industrial countries to India and other developing countries. Restrictive **intellectual property rights (IPR)** arrangements can prevent the transfer of low-carbon technologies. So, there is a need to seek a regime that permits access to available low-carbon technologies and IPRs on concessional terms. Collaborative research could also help in this respect.

- **Managing the Politics of Global Climate Change Policy**

India is the world's third-largest emitter of GHG, but in terms of cumulative emissions, it has imparted marginal harm. According to data compiled by the Global Carbon project, a research organization, around half of CO2 emissions since 1750 have come from Europe and the US. At the UNFCCC, developing countries have pressed developed ones to pay for their past excesses. At Paris Agreement 197 signatories have promised to limit lobal temperature increase to just 1.5! over pre-industrialization levels, but each country has set its own targets. India, for instance, has promised to cut its emissions intensity (emission per unit of GDP) by 33-35% by 2030 compared to 2005 levels.

- However, analysis by **Climate Action Tracker**, a research unit tracking climate change policy, reveals that few countries have committed enough to meet the Paris target. India's policies are on track to help limit global average temperature rise to 2! but most countries are failing to meet even this target. And, at the other extreme, the second largest contributor to worldwide emission, the US, has pulled out of the agreement itself.

- **Problem of Climate Finance**

Adaptation and mitigation activities requires fund (Climate Fund). The UNEP estimates that developing countries currently require $70 billion annually as adaptation cost and are set to vary between $140 billion to $300 billion per year by 2030. However, at COP 27 at Sharm-El Sheikh in Egypt, the Parties have adopted 'Loss & Damage' fund for supporting the countries who are at climate risk.

- **Reducing Coal Dependency**

While India will need to address these challenges of global coordination, one obvious area for domestic attention is coal. According to one estimate, 68% of India's GHG emissions come from the energy production, which remains largely reliant on coal power plants. The government is trying to wean off coal by investing significantly in renewable energy, expanding-capacity and incentivizing private sector investment. The government projects that by 2030, 40% of electricity generation can come from non-coal sources. Estimates from the **International Energy Agency (IEA)** suggest that this target could be met. India's electricity demand is expected to triple by 2030, with coal sources projected to account for around 57% of electricity generation -within India's Paris Agreement target, but still a significant figure.

- **Balancing Growth and Environment**

Rationally, tackling climate change is a balancing act between the present and the future. Like government everywhere, the India government will have to strike a balance on inter-generational equity. One way to do this would be to frame more holistic goalposts.

❖ Other than these challenges, several other challenges are also existing e.g., achieving renewables energy potential, production enhancement of bio-fuels like ethanol, utilization of nuclear energy, prevent overlapping of Union and State's climate policies, expansion of electric vehicles in public transport, expansion of proper finance availability and their sources, geo-political conditions, etc.

❖ Conclusion & Way Forward

Being global environmental problem, climate change and its early proven impacts are posing an extremely serious challenge for both developed and developing countries. However, being a developing country, India has its own priorities other than tackling climate change – eradicating poverty, inequality, unemployment and upbring the life-standard of their citizens. But interestingly, India has intentionally played an active role in the international debates on climate change from the establishment of **UNFCCC** to the subsequent **'Conference of Parties' – (COPs)**, and highlighted the several points of the climate change policy at nearly all climate negotiations. The principle of **"common but differentiated responsibility'** embodied in the UNFCCC has put the base of **Kyoto Protocol** and all climate negotiation. India has enthusiastically welcomed Kyoto Protocol's first and second commitment period which also benefited India by **CDM** projects. However, non-participation decision of U.S. had weakened the outcomes of the Protocol. **Paris Agreement** at COP 21 has been ratified by 196 countries along with India. India has put very enthusiastic targets within its updated **NDCs** – to reduce emissions intensity of its GDP by 45% by 2030 from 2005 levels and aim to achieve about 50% cumulative electric power from non-fossil fuel based energy resources by 2030. India also set target to create additional carbon sink of 2.5 to 3 billion tonnes CO2 equivalent through additional forest cover by 2030. At COP 26 India has also announced it aim of achieving **Net-Zero emission** by 2070 at Glasgow.

Along these enthusiastic targets, India has also faced some challenges e.g., balancing between climate action & development, problem of climate finance, managing the politics of international negotiations, problem of climate finance, rigidity of intellectual property rights, etc. As a voice for the developing world, India should push the developed, wealthy nations to set up their efforts on climate action. In this endeavor, it must lead the **COP 28** to become an opportunity for the developing nations to reaffirm their collective beliefs in the principle of equity and inclusivity in charting a collective path for climate goals. At upcoming COPs, India should ramp up pressure on the developed countries for intensifying commitment to finance and extend technology transfer.

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Biodiversity Conservation and Ecosystem Services: Threats, Valuation and Restoration

Prof. Sandeep Kumar Rajni Nigam

(I) Introduction

We are increasingly concerned about the impacts of human economy on biodiversity and ecosystem functioning, and their ability to continue to deliver the ecosystem services that are essential for human life. To meet humanity's rapidly increasing demand for fuel, water and food, human impacts on ecosystem have also been increasing, accumulating and interacting, leading to irreversible changes in the way ecosystems' function. Anthropogenic climate change caused by an increase in the atmospheric concentration of greenhouse gases, large additions of nitrogen and phosphorus activated by humans to soil, water and atmosphere resulting from modern agriculture, and rates of biodiversity loss have all crossed boundaries for sustainable functioning of the Earth system (Rockstrom et al., 2009). Species are lost today at rates 10–100 times higher than those found in the fossil record. Predictions for extinction rates in the twenty-first century are up to 100 times higher than those found today (Millennium Ecosystem Assessment, 2005; Rockstrom et al., 2009). Given that ecosystem processes depend on living organisms, and that ecosystem functioning is given by the combination of such ecosystem processes, a key question to be answered is how will biodiversity loss impact the ability of ecosystems to continue meeting human needs. The concept of ecosystem services was developed to show explicitly the tight connections between human well-being and the adequate provision of ecosystem services. The drive to satisfy human needs is threatening the maintenance of ecosystem functioning, while at the same time human impacts on ecosystems threaten their continued ability to satisfy human needs.

In this light, the present study is classified into seven parts. Part I of this paper, which consists conceptual introduction of biodiversity and links with ecosystem services including impacts of human economy on it. Part II elaborates the impacts of human activities on biodiversity losses. In Part III, illustrates the threatening factors to biodiversity conservation and ecosystem services. Part IV elaborates the concept, approaches and strategies to conserve

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biodiversity. In part V of this paper, valuation, methods and some related studies of biodiversity conservation and ecosystem services have been taken. Part VI is related to the restoration process of ecosystem services and biodiversity conservation. And finally, part VII is concluding paragraph and future way of conserving methods and approaches of biodiversity conservation and ecosystem services have been suggested.

New concepts have been coined in the past few years to advance key frontiers of knowledge, and old ones have been used in different contexts to address the multifaceted nature of the relationship between biodiversity and ecosystem services. A rich literature has developed exploring the links between biodiversity and ecosystem services in many ways. Such a wealth of data and theory has led to syntheses on the role of species richness in ecosystem functioning and provision of ecosystem services that will be discussed below. A large fraction of the explorations of the links between biodiversity and ecosystem services focus on species richness (Figure 1). Yet, the roles of species composition or identity, functional diversity, species' relative abundance, species' spatial distribution patterns, and trophic diversity are increasingly being recognized and investigated (Table 1); the same is true for the roles of genetic diversity in ecosystem functioning and ecosystem services. To date there is a very large amount of evidence available that indicates that increased producer species richness increases the efficiency by which plants and algae convert these into standing biomass; this is true for temperate grasslands, agricultural systems, marine coastal systems and lakes (Cardinale et al., 2011).

In brief, Biodiversity is the variety of different forms of life on earth, including the different plants, animals, micro-organisms, the genes they contain and the ecosystem they form. It refers to genetic variation, ecosystem variation, species variation (number of species) within an area, biome or planet. Relative to the range of habitats, biotic communities and ecological processes in the biosphere, biodiversity is vital in a number of ways including promoting the aesthetic value of the natural environment, contribution to our material well-being through utilitarian values by providing food, fodder, fuel, timber and medicine. Biodiversity is the life support system. Organisms depend on it for the air to breathe, the food to eat, and the water to drink. Wetlands filter pollutants from water, trees and plants reduce global warming by absorbing carbon, and bacteria and fungi break down organic material and fertilize the soil. It has been empirically shown that native species richness is linked to the health of ecosystems, as is the quality of life for humans. The ecosystem services of biodiversity is maintained through formation and protection of soil, conservation and purification of water, maintaining hydrological cycles, regulation of biochemical cycles, absorption and breakdown of pollutants and waste materials through decomposition, determination and regulation of the natural world climate. Despite the benefits from biodiversity, today's threats to species and ecosystems are increasing day by day with alarming rate and virtually all of them are caused by human mismanagement of biological resources often stimulated by imprudent economic policies, pollution and faulty institutions in-addition to climate change. To ensure intra and intergenerational equity, it is important to conserve biodiversity. Some of the existing measures of biodiversity conservation include; reforestation, zoological gardens, botanical gardens, national parks, biosphere reserves, germplasm banks and adoption of breeding techniques, tissue culture techniques, social forestry to minimize stress on the exploitation of forest resources.

The biodiversity we see today is the result of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans. It forms the web of life of which we are an integral part and upon which we so fully depend. So far, about 2.1 million species have been identified, mostly small creatures such as insects. Scientists believe that there are actually about 13 million species, though as per UNEP estimates there are 9.0 to 52 million species exist on earth (Mora *et al.*, 2011). Biodiversity also includes genetic differences within each species - for example, between varieties of crops and breeds of livestock. Chromosomes, genes, and DNA-the building blocks of life-determine the uniqueness of each individual and each species. Yet another feature of biodiversity is the variety of ecosystems such as those that occur in deserts, forests, wetlands, mountains, lakes, rivers, and agricultural landscapes. In each ecosystem, living creatures including human form a community, interacting with one another and with the air, water, and soil around them. Biodiversity is thus considered at three basis level: **Genetic diversity**, **Species diversity** and **Ecosystem diversity**

Biodiversity is not distributed evenly on Earth. It is the richest in the tropics. Terrestrial biodiversity tends to be highest near the equator (Gaston, 2000), which seems to be the result of the warm climate and high primary productivity (Field et al., 2009). Marine biodiversity tends to be highest along coasts in the Western Pacific, where sea surface temperature is highest and in the mid-latitudinal band in all oceans. There are latitudinal gradient in species diversity (Tittensor et al., 2010). Biodiversity generally tends to cluster in hotspots (Myers et al., 2000), and has been increasing through time (McPeeket al., 2007) but will be likely to slow in the future (Robosky, 2009).

(II) LOSS OF BIODIVERSITY

The loss of biodiversity and the related changes in the environment are now faster than ever before in human history and there is no sign of this process slowing down. Virtually all of Earth's ecosystems have been dramatically distorted and altered by human activities and continuously be converted for agricultural and other uses. Many animal and plant populations have declined in numbers and geographical spread. However, species extinction is a natural part of Earth's history but human activity has increased the extinction rate by at least 100 times compared to the natural rate. Loss of biodiversity is caused by a range of drivers**.** A driver is any natural or human-induced factor that directly or indirectly causes a change in an ecosystem**.** A direct driver unequivocally influences ecosystem processes. An indirect driver operates more diffusely by altering one or more direct drivers. Important direct drivers affecting biodiversity are habitat alteration, climate change, invasive species overexploitation and pollution.

(III) Threats to biodiversity conservation and ecosystem services:

Threats to biodiversity are mounting. There is need to understand the dangers and opportunities for action. The vital component of the economy is biodiversity. As we have seen above, biodiversity is the variety of living things. It means the many forms of life that exist in a given area and on the planet overall, and the ways in which that life is supported. An area with good biodiversity will have many different forms of life in it: animals, plants, fungi and others these diverse species are all linked to each other in a network called an ecosystem. Different types of ecosystems support business sectors ranging from food and clothing to insurance and tourism. Economists call the economically valuable goods and services that ecosystems supply "ecosystem services" These services include crop pollination, flood protection and water purification. When there is enough biodiversity to keep these ecosystems working well they can provide trillions of dollars' worth of services every year. Biodiversity and ecosystem services are threatened but ecosystem services are shutting down as species go extinct and the ecosystems grow weakened or unbalanced. The costs to businesses are massive. For example in every year from 1997 to 2011, declines in biodiversity from just two causes– changes in land use and damage to the land from those changes– led to ecosystem services loses valued at USD $10 to $31 trillion. Economy and biodiversity depend on each other economy need functioning diverse ecosystems for their operations and supply chains at the same time the way what economy operate and obtain those supplies affects whether the ecosystems will stay healthy or not. Here we can named mainly five threats to biodiversity. These are:

1.Changes to how we use the land and water or alternation of habitat: Both our lands and seas contain many different ecosystem, and these are affected by actions of the economy. For example: when developers drain and fill in marshes or wetlands in order to build housing, they take away the land that captures excess water during storms. The consequences can be drastic.

2.Overexploitation or overuse and unsustainable use of natural resources: Activities such as logging, farming and fishing can be done sustainably, but they are often done in ways that overexploit a resource. When too many species or even just a few important species are taken out of the ecosystem, the whole network of life in that area can collapse (think of a rock wall with too many rocks taken out, or a spider web with too many stands cut.) overall people have been taking far more from nature than It can afford. For example, 70% of fish stocks in the ocean are currently being overfished. A 2016 study suggested that the oceans could be empty of fish by 2050.

3.Climate changes and increased pollution: We are already seeing hotter temperatures warmer oceans and more severe weather events many species can't adjust to these conditions and their numbers crash the species endangered include many pollination insects which contribute $235 to $577 billion in ecosystem services value to the global economy every year. At the same, Pollution of air, soil and water poses a serious problem to many ecosystems tiny bits of plastic suspended in ocean water buildup inside fish, birds and other marine species. Industrial toxins kill many species in rivers and lakes. Air pollution makes its way into soil, leaves and water. It all adds up to fewer species, less diversity and weakened ecosystems.

4.Invasive species: Global trade brings species from their home ecosystems to other parts of the world, where there are often no predators to eat them and keep their numbers in cheque the warming climate allows dangerous species such as disease carrying mosquitoes to drive in new latitudes. Alien species often throw their new habitats severely out of balance. For instance, the brown rat which originated in central Asia and has invaded almost every part of the world has driven hundreds of species instant and causes an estimated $19 billion in damage each year in the United States alone.

5.Increased human population: From 1950 to 2011, World population increased from 2.5 billion to 7 billion and is forecast to reach a plateau of more than $9 billion during this 21st century (Population reference bureau). As the human population is increasing, there exists insatiable demand for raw materials which is bound to cause changes in biodiversity. The human population has more impact on biodiversity than any other single factor. According to Dumont (2012) until the middle of the 21st century, worldwide losses the Pristine biodiversity will largely depend on the worldwide human birth rate. It is therefor vital to control human population which will result in biodiversity conservation.

To conclude how does biodiversity loss threaten economy? all economies, as we know, depend on the ecosystem services that biodiversity provides whether directly or indirectly. So, as a report for the World Economic Forum notes, the steep decline in biodiversity will inevitably impact bottom lines– for example through reduced fish stocks disrupting commodity supply chains, economic losses from disasters such as flooding and the loss of potential sources of Medicine. Some of the risks posed to economy by diversity loss are: a. Operational risk under which many raw materials are becoming scarce or unavailable because of more exploited or disturbed ecosystems. b. In regulatory risks, countries are limiting and regulating the use of certain raw materials and business activities. c. Market and reputational costs may cover customers increasingly demand that businesses operate in environmentally sustainable and ethical ways one is study shows that 87% of consumers worldwide want companies to protect biodiversity with their sourcing practices. d. Reduced excess to capital and loss of investment opportunities. e. Increasing insurance cost.

(IV) Biodiversity conservation

Biodiversity conservation is about saving life on Earth in all its forms and keeping natural ecosystems functioning and healthy. This incorporates the preservation maintenance sustainable use recovery and enhancement of the components of biological diversity. A balance between the environment development and society results to sustainable development which ensures biodiversity conservation. This is only possible in the presence of proper enforcement and implementation policies conventions and environmental institutions.

Now, the question arises why conserve biodiversity? it is the life support system of our planet we depend on it for the air we breathe, the food we eat and the water we drink, medicines originating from wild spaces including penicillin aspirin, taxol and quinine have saved millions of lives and elevated tremendous sufferings wetlands filter pollutants from water, trees and plants reduce global warming by absorbing carbon bacteria and fungi breakdown organic material and fertilise this soil. It has been observed that native species richness is linked to the health of ecosystems as is the quality of life for humans. The connections between biodiversity and our sustainable future appear closer and closer the more we look. We literally need to conserve biodiversity as our lives depend on it.

Approaches to conserve biodiversity

In-situ conservation: It refers to conservation of ecosystems and natural habitats including maintenance and recovery of viable populations of species in their natural habitats. The In-situ Conservation has several advantages. Following are the important advantages of in-situ conservation:

i. It is a cost effective and convenient method of conserving biodiversity.

ii. A large number of living organisms can be conserved simultaneously.

iii. Since the organisms are in a natural ecosystem they can evolve better and can easily adjust to different environmental conditions.

Certain protected areas where in situ conservation takes place includes national parks wildlife Sanctuaries and biosphere reserves.

Ex-situ conservation: It refers to conservation of components of biodiversity outside their natural habitats e.g. Zoos, Museums, gene banks, Botanical gardens, used for threatened and endangered species to avoid their extinctions also known as captive conservation. Ex-situ has following advantages:

i. The animals are provided with a longer time and breeding activities

ii. The species bred in captivity can be reintroduced in the wild.

iii. Genetic techniques can be used for the preservation of intensive species.

Strategies for biodiversity conservation

i. All the varieties of food timber plants livestock microbes and agricultural animals should be conserved.

ii. All the economically important organisms should be identified and conserved.

iii. Unique ecosystems should be preserved first.

iv. The resources should be utilised efficiently.

v. Peaching and haunting of wild animals should be prevented.

vi. The reserves and protected areas should be developed carefully.

vii. The levels of pollutants should be reduced in the environment.

viii. Deforestation should be strictly prohibited.

ix. Environmental laws should be followed strictly.

x. The useful and intensive species of plants and animals should be conserved in their nature as well as artificial habitats.

xi. Public awareness should be created regarding powered biodiversity conservation and its importance

(V) Valuation of biodiversity conservation and ecosystem services-

The valuation of ecosystems and biodiversity has become an important field of Investigation. Evaluation of biodiversity typically have focused on ecosystem aspects not variety related ecosystems framing value biodiversity with a focus on those critical elements relating to functioning of ecosystems. An important pathway for better appreciation of insurance and investment benefits of variety is to understand and communicate the reasons why we value these benefits from variety biodiversity as variety is valued because we care about every fear of future generations. Although the interest has been largely motivated by the search for arguments in favour of broader conservation policies both the methods and the meaning of the results remain controversial.

The valuation lies in the ecosystem services that provides. These services are essential for the survival of the planet, including for the food production secure living conditions and human health. Biodiversity has environmental social cultural economic and intrinsic values biodiversity values have often not been accounted for in decision making because of externalities and the lack of understanding regarding their nature and the costs of losing them. One of the telling examples of the cost of losing biodiversity was demonstrated by lower agricultural yields erosions depleted water resources and increased flooding in the areas surrounding the forest area which had been disrupted denuded by industrial logging in Uttarakhand in the early 1970s industrial logging was also seen to be one of the main causes of the sewer monsoon flood that killed 200 people in 1970 the government eventually banned logging in this area after protests from local people through Chipko Andolan. similar example exists in the other parts of the country also. Basically, we can see manifold values of biodiversity. these are as follows: environmental values, refers to ecosystem processes which result in ecosystem services.; social values, refers to aesthetic, recreational, cultural and health benefits.; ecosystem services value, various types of ecosystem services e.g., purification of water by wetlands through the process of soil organisms breaking down the water borne nutrients and pollutants brought into wetlands and captured by its vegetation.; consumption value offers natural products for food, shelter etc. ; productive use value ; ethical and moral value ; Aesthetic values.

The concept and methods to value ecosystems and biodiversity have progressively emerged with roots in the core of economic theory of value. The recent enthusiasm for such analysis appears to have been mostly initiated by the needs of conservationist of a strong reason for policies aiming at protecting biodiversity broader and more rooted than the current ones. The current situation can then be characterised by a worrying gap between the perceived importance of improving our understanding of the dependence of our economy and societies upon the maintenance of well-functioning ecosystems and the theoretical and practical and resolved difficulties to build consistent and reliable analysis of this dependency.

Material and approaches

Although facing severe conceptual issues the valuation of biodiversity has become widely developed area of research and we have to come back to the methods and techniques that economists have built in attempts to circumvent these obstacles.

1.On the valuation techniques: During the last decades, a large scientific and administrative literature has repeatedly reviewed the available methods to produce practical measurements of ecosystem services values. First, the total economic value approach does not pretend at estimating an absolute value of ecosystems but rather to allow adding the multiple economic reasons that underlie the social values associated with ecosystem. The evaluation and the comparison inherent in it must be built from observations. What is observable? Ultimately, it is an individual preferences that must be made observable which may involve helping individuals to build them.

Valuation techniques are ranked by rows according to the type of observation and by columns according to the methods for expressing preferences.

Table 1.Valuation methods for non-market goods and services

	Revealed preferences	stated preferences
Direct methods	Monetary valuation at market prices, Avoided costs, productivity effects, Costs of restoration, replacement	Contingent valuations
Indirect methods	Prevention or protection expenditures, Trevel costs Hedonic prices	Contingent ranking comparison by pairs Joint analysis: choice Experiment, Choice modelling

Some valuation studies:

Over 150 valuation studies have been undertaken starting from 1980s to 2017 of these 30 four cover wetlands 68 forecast forests 19 coastal marine and mangroves ecosystems and 25 other ecosystems.

A large number of these studies have been promoted by the government or by bilateral or multilateral institutions.

Assigning monetary value to the services serves an important purpose because in the absence of such an assessment the cost of losing biodiversity is neither understood nor properly factored into decision making.

They scope of these studies varies while some studies have restricted themselves to a chosen category of services or values such as intrinsic value cultural value and spiritual value or regulating services a large number of them have valued all the four categories of ecosystem services that biodiversity offers.

One of these studies namely,"The economics of ecosystems and biodiversity India initiative (TEEB)-TII" implemented by MoEFCC with supported from gig aimed at making values of biodiversity and ecosystem services explicit for integrating them into developmental planning 14 studies under this covered: forests, inland wetlands and coastal and marine ecosystems. these were carried out by(i) Universities, (ii) Research institutions and (iii) NGOs. Local people participated in these by providing their knowledge and services.

(VI) Restoration of biodiversity and ecosystem services

Restoration is becoming regarded as a major strategy for increasing the provision of ecosystem services as well as reversing biodiversity losses. Here we show that restoration projects can be effective in enhancing both, but that conflicts can arise, especially if single services are targeted in isolation. Numerous restoration programmes have been launched worldwide in recent years but the effectiveness of such programmes for biodiversity conservation remains unclear. Additionally, priority areas of restoration need to be identified in a region where resources are limited habitat availability combines habitat amounts with interpatch connectivity governing whether a landscape can shelter biological populations. In the long term consequently restoration efforts should focus on enhancing habitat availability to promote biological flows.

1.The evidence for biodiversity effects on ecosystem services

The Millennium Ecosystem assessment and many subsequent publications suggest that biodiversity and the provision of ecosystem services are positively related with implementation that management to enhance one should increase the other. However, analysis of empirical evidence shows that this relationship is complex and not always positive. Species richness has been linked positively to several ecosystem processes, leading to enhanced provision of ecosystem services. On this basis, actions that increase species is richness should also benefit services. However, this cannot be considered to be a general rule. Most studies of the relationship between biodiversity and ecosystem function consider a limited number of ecological processes that relate almost exclusively to resource utilisation. Furthermore, the increase in ecosystem processes often reaches operative at moderate species numbers. Species identity affects add an extra level of complexity, especially as the rare species are frequently targeted by conservation efforts often have minor effects on ecosystem processes, whereas more common species can have a dominant role. Variation among ecosystems in processes and service provision is not necessarily coincident with the differences in either species richness or measures of conservation value. Indeed, mapping of ecosystem services and biodiversity measures at a variety of scales have repeatedly indicated a lack of special concordance.

2. Impacts of restoration on biodiversity and ecosystem services:

The findings summarised above suggested that restoration projects focusing on the enhancement of biodiversity will not necessarily increase the provision of ecosystem services. A meta-analysis of 89 restoration projects indicated correlated increases in biodiversity and ecosystem services in restored compared with degraded systems. But this is not necessarily evidence for a causal link and probably reflects common responses to restoration action. Indeed, rather than treating biodiversity and ecosystem services as a causeway effect relationship. We suggest that restoration projects should be designed with consideration of how biodiversity and ecosystem services will respond to possible management actions and whether these responses will coincide or conflicts. Some restoration initiatives illustrate how benefits to both biodiversity and provision of ecosystem services can be achieved in practise. However restoration will not inevitably enhance both biodiversity and services.

The policy shift towards restoration of ecosystem services might lead towards the selection of references based on provision of a single service and increase in the provisioning of a specific ecosystem service is the clear aim in some restoration focusing on Coastal protection soil stabilisation or aesthetic appeal it has been suggested that novel ecosystems could be created that do not resemble taxonomy and historical ecosystem but Telugu required services these aims might be more easily achievable than restoring the characteristics of reference ecosystem but they might lead to conflicts with biodiversity conservation and might be better considered as a rehabilitation rather than restoration.

New approaches to restoring biodiversity and ecosystem services:

Although recent evidence indicates that restoration can be successful in increasing both biodiversity and ecosystem services, it should not be assumed that restoring biodiversity will inevitably enhance ecosystem services, or vice versa. Biodiversity and different ecosystem services might display contrasting trajectories during restoration, leading to conflicts and trade-offs. Restoration actions focusing on a particular ecosystem service could lead to negative impacts on biodiversity or provision of other services, which will need to be considered during the planning process. Resolution of conflicts in delivery of different services and biodiversity will probably require a participatory process to land use planning. This approach would require a better understanding of how the provision of ecosystem services varies at a range of scales in relation to ecosystem condition.

Global environmental change, including climate change, spirit of invasive species and increased pollution could strongly affect the ability to restore systems. One response would be to determine how restoration might be used to increase resilience of biodiversity and ecosystem services to global change. Recent progress in understanding the resilience of coupled social ecological systems provides a basic for understanding how this might be achieved in practise. Further research should identify thresholds beyond which ecological recovery might be slow or impossible, and should suggest how changes in a human behaviour can be achieved to address because of ecological degradation.

(VII) Conclusion and course of action-

As we have analysed and seen the research available till date that biodiversity has a vital role in human existence on Earth and the regulation of the ecosystem. Biodiversity has several importance in environmental economic medical recreational and educational aspects. A wide range of types of organisms their genetic population and community diversity as well as the landscape diversity and the tropical networks among them are the key ecosystem service providers biodiversity is linked to agricultural food provision soil fertility regulation pollination and human disease regulation in a variety of ways ongoing studies have contributed significantly to understand the ways in which biodiversity is important for ecosystem services. But nowadays, biodiversity has been vanishing rapidly due to anthropogenic activities such as the over exploitation of natural resources. So, biodiversity must be conserved for the healthy functioning of the ecosystem and human life and in order to prevent the extinction of a species and to protect endangered and endemic species. Direct measurements of a wide variety of ecosystem services are needed as well as more data at landscape scale at which the most relevant connexions between biodiversity and services are expected systematic comparisons of the role played by biodiversity at a set of a special scales for many ecosystem services are needed also the final effects on biodiversity and human well-being through ecosystem services are still to be fully understood.

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Fueling Inclusion: An Analysis of the Impact of Social Protection Programs with emphasis on the Pradhan Mantri Ujjwala Yojana

Anup Kumar Mishra and Siddharth Singh

I.Introduction

The relationship between social protection programs and inclusive growth is at the forefront of global efforts to create equitable and sustainable societies. Social protection initiatives play a pivotal role in fostering inclusive growth by addressing the diverse needs of vulnerable populations and providing a foundation for their participation in economic development. This connection is vividly exemplified in the case of the Pradhan Mantri Ujjwala Yojana (PMUY) in India, a transformative program that transcends traditional boundaries by not only alleviating energy poverty but also contributing to broader dimensions of inclusive growth.

Social protection programs are designed to shield individuals and families from economic shocks, enhance their well-being, and mitigate disparities. Inclusive growth, on the other hand, envisions economic development that benefits all segments of society, ensuring that no one is left behind. The interplay between social protection and inclusive growth becomes particularly evident when examining PMUY, a flagship initiative launched in 2016 to provide clean cooking fuel to impoverished households in India.

PMUY extends beyond the immediate goal of ensuring access to liquefied petroleum gas (LPG) and stoves. It illustrates the interconnectedness between social protection and inclusive growth by addressing multifaceted challenges faced by vulnerable communities. This program not only improves health and environmental outcomes but also empowers women, enhances their economic participation, and contributes to overall economic development.

As we delve into the case of Pradhan Mantri Ujjwala Yojana, we unravel the intricate web of relationships between social protection programs and inclusive growth, shedding light on how targeted interventions can catalyse a more comprehensive and sustainable development trajectory for nations facing challenges related to energy poverty and socio-economic disparities.

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II. Literature Review

The intersection between social protection programs and inclusive growth has garnered increasing attention in scholarly discourse, reflecting a growing awareness of the intricate dynamics shaping development outcomes. A compelling case study that exemplifies this nexus is the Pradhan Mantri Ujjwala Yojana (PMUY) in India, where the transformative impact of social protection initiatives on inclusive growth is evident. A review of existing literature underscores the nuanced relationship between these two dimensions, offering insights into the complexities and potential synergies. Numerous studies emphasize the role of social protection programs in poverty alleviation. Sen (2019) highlights how social protection programs can serve as catalysts for gender equality, with a specific focus on enhancing women's agency and economic participation. The relationship between social protection and inclusive growth is explored through the lens of broader economic development. Barrientos and Scott (2009) argue that well-designed social protection policies not only alleviate poverty but also foster human capital development, laying the groundwork for sustained economic growth. Several scholars have delved into the impact of PMUY as a case study. Ghatak et al. (2020) assess the program's outcomes, emphasizing its potential to enhance energy access, improve health indicators, and empower women by reducing their drudgery associated with traditional cooking methods. A specific focus on energy poverty and its link to inclusive growth is explored by Sovacool and Dworkin (2015). They argue that access to clean energy, as facilitated by initiatives like PMUY, contributes to broader economic development by improving health, productivity, and overall well-being. Analysis by Kapoor and Ahuja (2018) sheds light on challenges faced during the implementation of PMUY and underscores the importance of addressing socio-cultural factors to ensure the inclusivity of such programs. In the Multidimensional Poverty Index (MPI), which is used to measure multiple dimensions of poverty, including health, education, and standard of living, the lack of access to cooking fuel is indeed considered an indicator of poverty. The choice of indicators in the standard of living dimension reflects aspects of material well-being and basic living conditions (Mishra and Singh, 2023).

III.Social Protection Programs

Social protection programs are initiatives implemented by governments or other organizations to provide support and assistance to individuals and families in need. These programs aim to alleviate poverty, reduce inequality, and promote the well-being of vulnerable populations. Cash Transfer Programs provide direct financial assistance to eligible individuals or households. Social insurance programs provide protection against specific risks, such as unemployment, disability, or old age. Food assistance programs aim to address food insecurity by providing subsidized or free food items to individuals or families in need. This can include school meal programs, food banks, or targeted nutrition interventions. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India is an example, offering 100 days of guaranteed wage employment in rural areas. Programs like health insurance, free medical services, or subsidized medication aim to provide access to healthcare services, especially for low-income individuals and families.

These social protection programs play a crucial role in promoting inclusive growth, reducing poverty, and ensuring a basic standard of living for all members of society. The specific design and focus of these programs may vary based on the country's economic context, social priorities, and the needs of the target population.

IV.Social Protection Programs and Inclusive Growth

The relationship between social protection programs and inclusive growth is integral to the broader discourse on sustainable development. Social protection programs, designed to provide support and assistance to vulnerable populations, play a crucial role in fostering inclusive growth by addressing the multifaceted challenges faced by individuals and communities. Social protection programs, including cash transfers, food assistance, and employment guarantee schemes, contribute directly to poverty alleviation. Social protection initiatives often invest in human capital development through education and healthcare components. By ensuring access to education and healthcare services, these programs contribute to building a skilled and healthy workforce, fostering inclusive growth through increased productivity and economic participation. Social protection programs aim to reduce inequality by targeting vulnerable groups, such as the poor, elderly, and disabled.

V.A Case Study: Pradhan Mantri Ujjwala Yojana

The Ujjwala Yojana, launched in 2016, is a significant social protection program in India with the primary aim of providing clean cooking fuel to rural households. The main objectives of the Ujjwala Yojana are as follows:

❖ **Empowerment of Women and Protection of their Health:**

By providing LPG cylinders and stoves, the program aims to empower women by relieving them from the burden of traditional cooking methods, often involving biomass or kerosene.

Access to clean cooking fuel can contribute to improved health outcomes for women, as they are less exposed to the harmful effects of indoor air pollution associated with traditional cooking methods.

❖ **Reduction of Serious Health Hazards:**

One of the primary goals is to reduce serious health hazards linked to the use of fossil fuels for cooking. The shift to cleaner fuels like LPG is expected to decrease the health risks associated with exposure to indoor air pollution, leading to a healthier population.

❖ **Reduction in Deaths Due to Unclean Cooking Fuels:**

The program targets a reduction in the number of deaths in India attributed to the use of unclean cooking fuels. Traditional fuels release harmful pollutants that can lead to respiratory diseases and other health issues, contributing to premature deaths.

The dual approach of combining theoretical insights with a rich array of external secondary data sources provides a solid foundation for the study. It not only ensures a rigorous empirical basis but also allows for a multifaceted exploration of the research topic, drawing on diverse perspectives and sources to enhance the overall quality and validity of the research. The use of external secondary data sources enhances the empirical basis of the study. By drawing on real-world information, the research is grounded in concrete data, providing a more objective and evidence-based foundation for the study's findings and conclusions. The study utilizes a diverse range of data sources, including government statistics, market research reports, and data from international organizations like the IMF, World Bank, UN, and WHO. This diversity ensures a comprehensive coverage of information, allowing for a more holistic understanding of the topic under investigation. The inclusion of data with both global and national perspectives broadens the scope of the study. It enables the researchers to analyze trends and patterns at different levels, providing insights into both overarching global dynamics and specific national contexts.The incorporation of academic journals, publications, and publicly accessible databases as additional external sources further strengthens the research. This demonstrates a commitment to utilizing peer-reviewed literature and authoritative databases, enhancing the credibility and reliability of the study.

IX.The Need of PMUY

The study conducted by Mishra in 2019 focused on the unequal distribution of unpaid work between men and women in rural areas of India, specifically in Uttar Pradesh (UP), Bihar, and Jharkhand. The study utilized the time use method, involving personal interviews and observational studies, to analyze the engagement of men and women in unpaid economic activities. The key findings suggest significant disparities, with women being considerably more involved in unpaid economic activities, particularly domestic tasks, compared to men in rural India. The study indicates that, on average, women spend 8-9 hours daily on various unpaid economic activities, while men dedicate only 2-3 hours to similar activities.

The study's specific insights into daily tasks, such as the 3.6 hours spent on cooking, serving, and collecting firewood, provide a detailed understanding of the distribution of women's time and labor. Additionally, the caste-wise breakdown of average time spent on the top five economic works per day offers valuable information, allowing for a nuanced analysis of how time allocation varies across different castes within the study area.

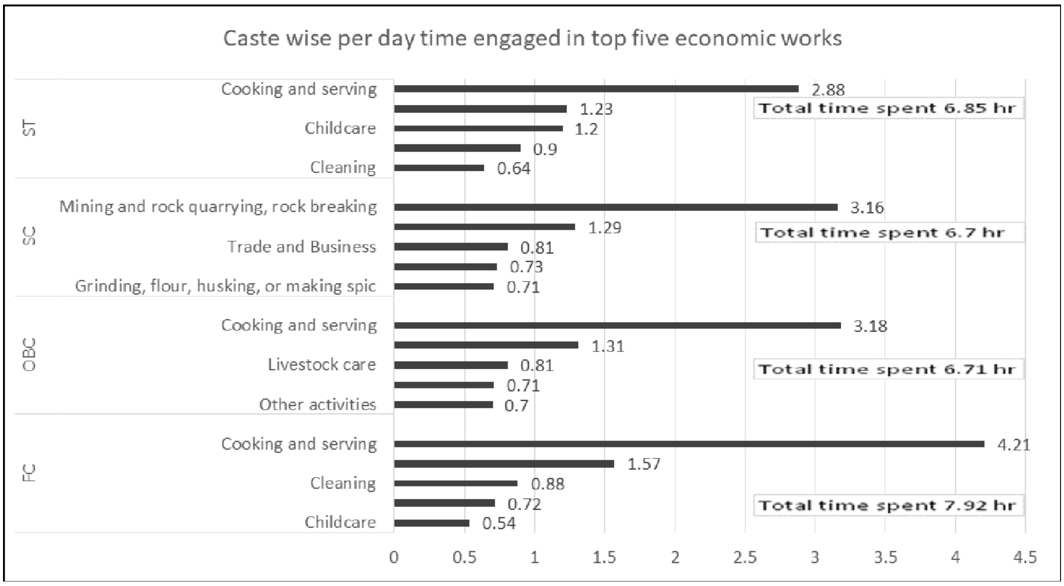

Fig.1: Caste wise per day time engaged in top five economic works

The Ujjwala Yojana's impact extends beyond the immediate time saved on fuel collection, encompassing various dimensions of poverty reduction, including health, income, empowerment, and food security. The scheme demonstrates the potential to create positive ripple effects that contribute to overall well-being and economic upliftment in households and communities.

X.The Pradhan Mantri Ujjawala Yojana and its Impact: An Analysis

The data on Pradhan Mantri Ujjwala Yojana (PMUY) connections distributed until April 1, 2023, reveals a notable regional variation in the number of connections provided. The highest number of connections, 32,084,941, has been distributed in the eastern region, while the lowest number, 5,303,710, is reported in the northeast region. It is essential to recognize that direct comparisons between regions may not be straightforward due to the inherent heterogeneity within and across these groups.

State-wise PMUY connections (as on 1.04.2023)	
	(Nos.)
STATE/UT	**01-Apr-23**
CHANDIGARH	659
DELHI	142164
HARYANA	767322
HIMACHAL PRADESH	140822
JAMMU & KASHMIR	1245438
LADAKH	11090
PUNJAB	1283976
RAJASTHAN	6927163
UTTAR PRADESH	17503067
UTTARAKHAND	496450
SUB TOTAL NORTH	**28518151**
ARUNACHAL PRADESH	49247
ASSAM	4414806
MANIPUR	202029
MEGHALAYA	214928
MIZORAM	33595
NAGALAND	91807
SIKKIM	13795
TRIPURA	283503
SUB TOTAL NORTH-EAST	**5303710**
ANDAMAN & NICOBAR ISLANDS	13447
BIHAR	10733364
JHARKHAND	3646220
ODISHA	5319685
WEST BENGAL	12372225
SUB TOTAL EAST	**32084941**
CHHATTISGARH	3492221
DADRA & NAGAR HAVELI AND DAMAN & DIU	15033
GOA	1265
GUJARAT	3843237
MADHYA PRADESH	8227427
MAHARASHTRA	4890055
SUB TOTAL WEST	**20469238**
ANDHRA PRADESH	512437
KARNATAKA	3757704
KERALA	341187
LAKSHADWEEP	309
PUDUCHERRY	14833
TAMILNADU	3704058
TELANGANA	1152850
SUB TOTAL SOUTH	**9483378**
ALL INDIA	**95859418**

Table 1: State-wise PMUY connections

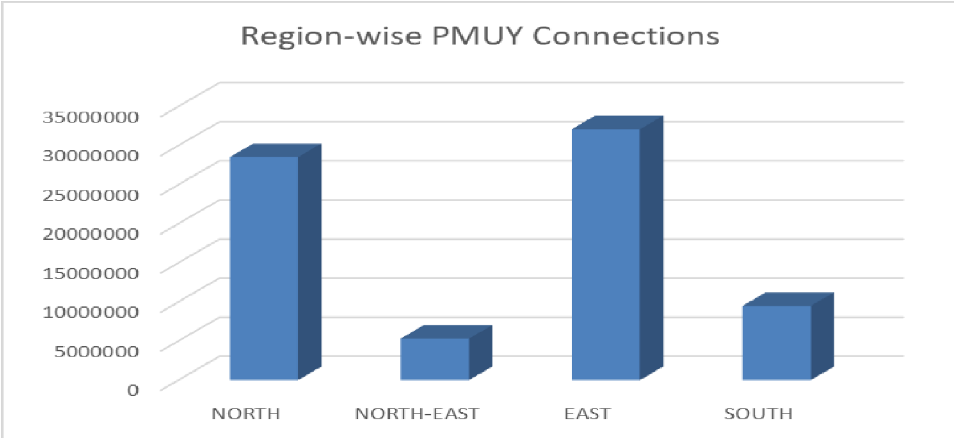

Fig. 2: Region-wise PMUY Connections

Source: https://ppac.gov.in/consumption/state-wise-pmuy-data

Total Connections Released under Pradhan Mantri Ujjwala Yojana *as of 15th February, 2024 (1,02,228,333) Connections released under Ujjwala 2.0 *as on 15th February, 2024 (22,371,674)				
				Growth
1	Total LPG Sales	17696 TMT (F.Y. 2014-15)	29339 TMT (F.Y. 2022-13)	65.79%
2	Domestic LPG Sales	16041 TMT (F.Y. 2014-15)	25381 TMT (F.Y. 2022-13)	58.23%
3	Improving Trend In Customer Base	**as on 1.04.2014**	**as on 1.04.2023**	
	• Domestic Customer	14.52 Cr	31.40 Cr	116.25%
	• PMUY Customer	0 Cr	9.59 Cr	
4	Bottling Infrastructure	**as on 1.04.2014**	**as on 1.04.2023**	
	• Number of Bottling Plants	186 Nos	208 Nos	11.83%
	• Bottling Capacity	13535 TMTPA	22225 TMTPA	64.20%
5	Distributor Network Augmented	**as on 1.04.2014**	**as on 1.04.2023**	
	• Total Distributor	13896 Nos	25386 Nos	82.69%
	• Distributor Related to Rural Areas	6724 Nos	17461 Nos	159.68%

Table 2: Number of Connections and other facilities

Source: https://ppac.gov.in/consumption/state-wise-pmuy-data

The data on the Pradhan Mantri Ujjwala Yojana (PMUY) and its subsequent version, Ujjwala 2.0, reveals significant achievements and positive impacts on LPG sales and domestic customer growth. As of February 15, 2024, the total number of connections released under PMUY stands at 102,228,333, while Ujjwala 2.0 has contributed an additional 22,371,674 connections. The growth in LPG sales, particularly in domestic households, highlights the success of these initiatives in promoting clean cooking practices and benefiting women in particular.

The overall LPG sales have witnessed a substantial growth of 65.79%. This indicates a significant increase in the adoption of LPG for cooking purposes. The growth in domestic LPG sales at 58.23% underscores the preference for clean cooking solutions in households. The domestic customer base has experienced remarkable growth, expanding by 116.25% from April 1, 2014, to April 1, 2023. PMUY has played a pivotal role in this growth, contributing to an increase of 9.59 crore customers. This indicates the program's effectiveness in reaching and benefiting households, especially those previously reliant on traditional cooking methods. The shift from traditional cooking methods to LPG directly benefits women in these households, enhancing their health, safety, and overall well-being. The focus on empowering women aligns with broader gender-inclusive development goals. PMUY has spurred indirect positive effects on bottling infrastructure, including the expansion of bottling plants and capacity. This indicates the broader economic impact and job creation within the LPG supply chain. The distributor network has witnessed substantial growth, with an increase in the total number of distributors. The phenomenal 160% increase in distributors related to rural areas highlights the program's success in reaching remote and underserved regions.

The comprehensive growth figures underscore the success of PMUY and Ujjwala 2.0 in achieving their objectives of providing clean cooking solutions, reducing indoor air pollution, and empowering women. The program's indirect effects on infrastructure and distributor networks also contribute to economic development and enhanced accessibility. The continued momentum of these initiatives is essential for sustaining and expanding the positive impacts on households across India.

XI. Conclusions

The relationship between social protection programs and inclusive growth is intricate and dynamic, with the impact of initiatives such as the Pradhan Mantri Ujjwala Yojana (PMUY) playing a crucial role in shaping the trajectory of inclusive development. Social protection programs are designed to address disparities, promote economic empowerment, and improve the overall well-being of vulnerable populations. The PMUY, focused on providing clean cooking fuel to women below the poverty line, exemplifies the transformative potential of such initiatives.

The Pradhan Mantri Ujjwala Yojana has demonstrated a multifaceted impact on inclusive growth. The provision of LPG connections to households previously reliant on traditional and often detrimental cooking fuels has not only resulted in significant time savings, especially for women who are traditionally responsible for fuel collection, but it has also contributed to improved health outcomes. Reduced exposure to indoor air pollution has led to fewer respiratory illnesses, resulting in lower healthcare costs for beneficiary families.

The PMUY has had a positive influence on income-generating activities and entrepreneurship, particularly for women. The time saved from fuel collection can be redirected towards education or engaging in income-generating ventures, thereby contributing to increased productivity and economic well-being. The entrepreneurial opportunities created by LPG access, such as starting food businesses, have the potential to uplift households economically and empower women, fostering a more inclusive and equitable society.

The scheme has addressed issues related to food security by promoting efficient cooking practices and reducing food waste. The improved cooking methods associated with LPG usage contribute to better food preparation and resource utilization, positively impacting the nutritional outcomes and overall food security of beneficiary households.

In essence, the Pradhan Mantri Ujjwala Yojana serves as a noteworthy example of how targeted social protection programs can catalyse inclusive growth by addressing immediate needs while fostering long-term positive outcomes. By addressing energy poverty and its associated challenges, the PMUY not only enhances the quality of life for marginalized communities but also contributes to broader socioeconomic development goals, ultimately fostering a more inclusive and sustainable path towards growth.

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E- Waste Management in India: An Analysis

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Introduction:

Electronic waste or e-waste describes discarded electrical or electronic devices like office electronic equipment, renovation, entertainment device electronics, mobile phones, television sets and refrigerators. This definition includes used electronics which are possible for reuse, resale, salvage, recycling, or disposal.The discarded and end-of-life electronics products ranging from computers, home appliances, audio and video products and all of their peripherals are popularly known as Electronic waste (E-waste).

The e-waste can, however, be considered hazardous if recycled by primitive methods. E-waste contains several substances such as heavy metals, plastics, glass etc., which can be potentially toxic and hazardous to the environment and human health, if not handled in an environmentally sound manner.

Electronics waste is becoming a major global issue. Huge accumulation of e-waste and its recycling through primitive means for extraction of precious metals are a real concern in the developing countries because of the presence of hazardous materials in e-waste. Current practices of e-waste management in India encounter many challenges like the difficulty in inventorization, ineffective regulationsand unsafe conditions of informal recycling and poor awareness of consumers to address the issues. As a result, toxic materials enter waste stream and creates adverse impacts on the environment and human health.

E-Waste recycling firm started formally first in Karnataka. According to P. Parthasarathy, director of India's first e-recycling firm, the Bangalore-based E-Parisara, says that "Less than five percent of waste generated reaches the organized recycling sector". E-Parisara's 50-odd customers are all major corporate, including IBM, Lucent-Alcatel, Hewlett Packard, Intel, Infosys and Motorola.

Literature Review:

- ❖ In Indian Scenario, electronics industry has emerged as the fastest growing segment in terms of production, exports and imports and early 1990s, the software industry

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has been growing at a compound annual growth rate of over 46% **(Supply Chain Management, 1999)**.

- **According to Ravi Agarwal, (2010)**, "In India e-waste is increasing at the rate of 10% per annum."
- **According to Pathak et al., (2017)**, "The volume of waste is growing at an estimated 21 per cent annually. This report predicts that by 2020, e-waste from old computers in India will increase by 500%; from discarded mobile phones will be about 18 times higher; from televisions will be 1.5 to 2 times higher; from discarded refrigerators will double or triple; than their respective 2007 levels.
- **According to Wath et al. (2010, 2011)**, have explored the use of market-based mechanisms like advanced recycling fees (ARF) for consumers and tax credits for producers and recyclers for effective implementation of an EPR based rule in India and have recommended ARF as part of EPR for its effectiveness.
- In e-waste generation, USA is leading followed by China by 30, 00,000 tonnes and 23, 00,000 tonnes respectively and It has become fastest growing waste in the municipal waste stream (**Rajya Sabha, 2010**).

The Present Paper describes E- Waste Management in India: An Analysis. The paper is divided into **Six** Sections. **Section I** deals with Components of Electrical and Electronic Devices; **Section II** discusses Need of E-Waste in India; **Section III** explains Health and Environmental Impacts of E-Waste;**Section IV** discusses the Treatment and Disposal of E-Waste; **Section V** discusses Role of Citizen for E-Waste Management. In the last, **Section VI** provides Conclusion along with Suggestions.

Section (I)

Components of Electrical and Electronic Devices: Various components/parts of computers, TV and Mobile phones are discussed separately and given below:

- **Computers:**It consists ofMotherboard, Power Supply, CPU,RAM, Hard Disk Drive, Video Card, Optical Drives and Input, Output devices etc.
- **Television:** The television consists of four principle sets of parts, including the outside or housing, the audio reception and speaker system, the picture tube, a complicated mass of electronics including cable, antenna, input and output devices.
- **Mobile Phones:** It includes Lens, internal antenna, aerial, speakers, earpiece, microphone, microphone connectors, loud speakers, buzzers, ringers, charging blocks, system connectors, chassis, slide mechanism, ribbon cables, SIM slot covers, readers, backup, battery, battery clip, covers, battery contacts, connectors and key pad membrane, etc.

Composition: The Composition of e-waste may be divided broadly into six categories such as Iron and steel used for casings and frames, non-ferrous metals especially copper used in cables and aluminum, glass used for screens & windows, plastic used as casing in cables and for circuit boards, Electronic components and others such as rubber, wood, ceramic etc. The Electronic and Electrical (E&E) products are homogenous solid components containing heavy metals, polymers, flame retardants, polychlorinated biphenyls, etc. Some examples are given below:

- Cathode ray tubes found in televisions and computers contain lead, mercury, cadmium, beryllium and brominated flame retardants.
- A mobile phone/ smart phone contains more than 50 different components, including base metals (such as copper, tin), special metals (such as cobalt, indium, antimony) and precious metals (such as silver, gold, palladium).
- The lithium-ion battery contains about 3.5 gram of cobalt. Iron and steel constitute about 50% of the waste, followed by plastics (21%), non-ferrous metals (13%) and other constituents. The presence of elements like lead, mercury, arsenic, cadmium, selenium, hexavalent chromium, and flame retardants beyond threshold quantities make e-waste hazardous in nature.

Section (II)

Need of E-Waste in India: E-waste is much more hazardous than many other municipal wastes because electronic gadgets contain thousands of components made of deadly chemicals and metals like lead, cadmium, chromium, mercury, polyvinyl chlorides (PVC), brominated flame retardants, beryllium, antimony and phthalates. Long-term exposure to these substances damages the nervous systems, kidney, bones, reproductive and endocrine systems. Some of them are carcinogenic and neurotoxic. The E-waste contains both hazardous and non-hazardous substances in their components. These hazardous substances like plastic, lead, mercury, cadmium, arsenic etc. pose health hazards on the human being to the most when treated in uncontrolled condition via air, water and soil.

Burden of E-Waste: In India, solid waste management, with the emergence of E-Waste, has become a complicated task. The total waste generated by obsolete or broken down electronic and electrical equipment was estimated to be 1, 46,000 tons for the year 2005, 8, 00,000 for 2012, 1.8 MT for 2016, 5.2 MT in 2020 and 8 MT by 2025. However, according to the Greenpeace Report India generated 3, 80,000 tons of E-Waste in 2007 and concludes that only 3% of this could be recycled. Because of these reasons for this is that the India has also become a dumping ground for many developed nations. India is one of the fastest growing economies of the world and the domestic demand for consumer’s durables has been skyrocketing. A report states that 50- 80% of E-Waste collected from USA is exported to India, China, Pakistan and to some of the African countries. Obsolete computers pose the most significant environmental and health hazard among the e-wastes.

Section (III)

Health and Environmental Impacts of E-Waste: E-Waste is a miscellaneous combination of various types of toxic elements, which are capable of creating an irreversible impact to the human health and environment. Hence, it should be handled properly. E-waste creates Health Hazards for all life forms available on planet earth supporting proper health of our environment, which is ultimate goal on the planet earth. Some ofThe hazardous substances and their impacts on human health and environment (Begum, 2013) are incorporated is given below **Table I**:

Hazardous Substances in E-Waste and Their Impacts

e-Waste components	Toxic metals	Limit, (ppm)	Disease caused by the exposure to above permissible limit
Ceramic capacitors, switches, batteries	Ag[a]	5.0	Excessive amount causing blue pigments on body, damages brain, lung, liver, kidney
Gallium arsenide is used in light emitting	As[b]	5.0	Chronic effect and causes skin disease and lung cancer and impaired nerve signaling.
Electron tube, lubricant, fluorescent lamp, CRT gun	Ba[b]	< 100	Causes brain swelling, muscle weakness, damage to the heart
Power supply boxes, motherboard	Be[b]	0.75	Causes lung cancer, beryllicosis, skin disease, carcinogens
PCBs, casing, PVC cables	Br[b]	0.1	Thyroid gland damage, hormonal issues, skin disorder, DNA damages, hearing loss
PCBs, battery, CRTs, semiconductors, infrared detectors, printer ink, toners	Cd[b]	1.0	Pose a risk of irreversible impacts on human health particularly the kidney
Printed circuit boards (PCBs)	CN[b]	< 0.5	Cyanide poisoning, > 2.5 ppm may cause to coma and death
Plastic computer hosing, cabling, hard discs, as a colorant in pigments,	Cr(VI)[b]	5.0	Toxic in the environment, causing DNA damage and permanent eye impairment
Batteries, LCD, switches, backlight bulbs or lamps	Hg[b]	0.2	Damages brain, kidney and foetuses
Mobile, telephone, batteries	Li[a]	< 10d	Diarrhea, vomiting, drowsiness, muscular weakness
Batteries, semiconductor, CRT, PCB	Ni[a]	20.0	Causes allergic reaction, bronchitis, reduces lung function, lung cancers
Transistor, LED lead-acid battery, solder, CRT, PCBs, florescent tubes	Pb[c]	5.0	Damages brain, nervous system, kidney, and reproductive system, causes acute and chronic effects on human health
CRT glass, plastic computer housing and a solder alloy	Sb[b]	< 0.5	Carcinogen, causing stomach pain, vomiting, diarrhea and stomach ulcer
Fax machine, photoelectric Cells	Se[b]	1.0	High concentration causes selenosis
CRT, batteries	Sr[c]	1.5	Somatic as well the genetic changes due to this cancer in bone, nose, lungs, skin
Batteries, luminous	Zn[b]	250.0	Nausea, vomiting, pain, cramps and diarrhea

Batteries, luminous substances	Zn[b]	250.0	Nausea, vomiting, pain, cramps and diarrhea
Cooling units and insulation Foam	CFCs[b]	< 1.0 for 8 h/day	Impacts on the ozone layer which can lead to greater incidence of skin cancer
Transformer, capacitor, Condensers	PCBs[b]	5.0	PCB causes cancer in animals and can lead to liver damage in human

Source:Pathak et al., (2017), a-Critical; b-Hazardous and Toxic; c-Radioactive Waste; d-Limit in Serum/Blood

The Danger of E-Waste: Electronic waste, or e-waste, is rapidly growing problem in the world and for our country. Every day, we produce mountains of e-waste. It’s estimated that 50 million metric tons of e-waste are produced each year, and only about 20% of that is properly recycled. India’s currently ranks third among the largest generators of E-Waste globally.

E-waste contains harmful chemicals that can leach into the ground and water if not disposed properly. E-waste is also a major contributor to climate change. The manufacturing of electronics requires a lot of energy, which results in greenhouse gas emissions.

Section (IV)

Treatment and Disposal of E-Waste:E-Waste has the complex composition of valuable and hazardous substances, specialized, often high-tech methods are required to process e-waste in ways that maximize resource recovery and minimize potential harm to humans and the environment. Unfortunately, the use of these specialized methods is rare.In developing countries, where crude techniques are often used to extract precious materials or recycle parts for further use. This also leads to localized pollution of environment and it creates health hazards for advanced life forms. The methods followed in general of which some are recommended are:

❖ **Land Filling:** This is the most common methodology of e-waste disposal. In this method, trenches are made on the flat surfaces by removing soil from the trenches and waste material is buried in it, which is covered by a thick layer of soil. Secure landfill is made using modern technique. Here, they are provided with some facilities like, impervious liner made up of plastic or clay, leachate collection basin that collects and transfer the leachate to wastewater treatment plant. The degradation processes in landfills are very complicated because it takes a wide time span and can be many years. However, landfill is not an environmentally sound process for disposing off the e-waste as toxic substances like cadmium, lead and mercury are released inside the soil and ground water.

❖ **Acid Bath:** Acid bath involves soaking of the electronic circuits in the powerful sulphuric, hydrochloric or nitric acid solutions that free the metals from the electronic pathways. The recovered metal is used in the manufacturing of other products while the hazardous acid waste finds its ways in the local water source- essentially trading one waste disposal problems for another.

❖ **Incineration:** This is a controlled way of disposing off the e-waste and it involves combustion of electronic waste at high temperature (900-1000oc) in specially designed incinerators. This e-waste disposal method has twin benefit because on one hand it reducedwaste volume extremely and on the other hand the energy obtained is also utilized separately which can further use for combustible materials. In this method some environmentally hazardous organic substances are converted into less hazardous compounds. However, it is also not free from disadvantages with the emission of the harmful gases like mercury and cadmium which affect the environment.

❖ **Recycling of E-Waste**: Mobile phones computer equipments and connecting wires can be re-utilized with the help of the recycling process. It involves dismantling of the electronic device, separation of the parts having hazardous substances like CRT, printed circuit boards etc. Strong acid are used for the recovery of the precious metals like copper, gold or lead. It can be done with the help of the efficient a powerful e-waste recycler. The most crucial thing here is choosing the right kind of recycler that does not break laws and handle the e-waste in the eco- friendly manner.

❖ **Reuse of Electronic Devices**: This is the most desirable e-waste recycling process where with slight modifications in the mobile phones, computers, laptops, printers can be reused or given as second-hand product to the other person. The old electronic equipment can also be donated in the various charity programs which fulfills the person's need. Moreover, there is a better way also by selling the old mobile phones or laptops to some recycling and refurbishing companies. Several websites are acting as the middleman between recyclers and electronic users. It is a win-win situation for the users as they not only get rid of the old mobile phones but also get paid after reselling it. This method also reduces the volume of e-waste generation.

❖ **Protective Protocol for Workers in E-Waste Disposal:** Workers are given formally recognized jobs where they can use skills and where occupational health safety i.e., information about their occupation-related health hazards involved and self-protection, protective gear and equipment and periodic medical check-ups are assured.

Section (V)

Role of Citizen for E-Waste Management: As a practice, **waste management** should be a responsibility and a duty of each citizen. People have to raise consciousness on that. If citizens do not recycle effectively, not only they will pay a material price for buying new products made out of the same material, but planet health will be affected.There are several ways to encourage citizens to take action in waste management, most importantly segregating the waste at source and recycling. Contributions of individual citizens can be increased by increasing public awareness.

Another action that can be taken is increasing citizen's willingness towards **The Three R's Rule**: Reduce, Reuse, Recycle waste management. Citizens need to see how they can do easy and effective efforts about recycling and reducing waste. For example, the zero-waste movement,continues to inspire many citizens to handle growing waste problems with recycling and environmentally friendly consumption.

As responsible citizen, it is our duty to contribute to environment by adopting following principles:

- ❖ **Sell Off our outdated Technology:** One man's junk is another man's treasure as the old saying goes. This can be applied to helping us to get rid of our old electronics.
- ❖ **Donating our Outdated Technology:** Old gadgets that we no longer need can be donated because they may be useful to others. Our old computer may be useful to either an NGO's or students.
- ❖ **Visit CivilInstitutions:** Government, universities, and schools conduct the recycling programs so that organizations have started assigning a certain day and place for environmentally conscious citizens to come and drop off their e-waste.
- ❖ **Give Back to Our Electronic Companies and Drop off Points:** A lot of electronic companies tend to have an exchange policy whereby they take back our old gadgets when we buy a later version, sometimes offering us a discount on our new purchase. A few recycling companies have set up electronic drop off initiatives along with drop off points for products such as cell phones and tablets after which they are recycled.

Section (VI)

Conclusion and Suggestions: e-Waste impact assessment on health and environment shall be carried to understand the current and future damage. Collection centers are established for clearing the e-waste from the users. Government shall start the repair centers throughout the country. E-Waste is considered a time bomb in the present globalized world. The annual production rate of e-waste is increasing gradually. China is the largest e-waste producer followed by U.S.E-Waste issue shall be dealt seriously to avoid the future consequences.

The e–waste management has become a complex and poses hazards to the environment in various ways and patients of chronic and acute diseases are increasing exponentially. It is evident that air pollution is root cause of these diseases. Recently AIIMS (All India Institute of Medical Sciences) revealed that Arthritis is caused by air pollution. The environment health condition is declining due to the partially managed e-waste in the country.

The technology boom is in 21st Century will bring more challenges ahead so our preparedness should be equipped with new infrastructure, awareness and technology for e-waste treatment. For the reduction of environmental loading **5Rs** (Report,Reduce, Reuse, Recycle and Recover)Principles should be followed in the country and a multi-crore lucrative business can be explored easily.

Presently there is no legislative binding framework for e-waste management. In view of that there is no e-waste collection mechanism at place. The CPCB has taken lead in declaring e-waste as a new waste stream made new e-waste rules came in force since 1st may 2012 governing all stakeholders of e-waste. It will be beneficial for our economy in the context of employment, reducing poverty and income inequality on one hand and will increase the development of country. By adopting proper e-waste management methods we can reduce the Global Environmental Problems specially Climate Change and Global Warming.

As Suggestions, there are following methods can be adopted for tackling e-waste and their management:

- Defining ‘User Codal Life’ of each electrical and electronic item.
- Disallowing a new model of a product with a small or medium improvement in the previous model.
- A time bound gap between introduction of new model and old model in the market should be made as part of regulation.
- Encouraging repairing of a product instead of ‘Use and Through’ Methodology.
- Disposing e-waste not at one place but spreading over wide area on the planet earth to avoid health hazards to human health and environment. This I called ‘e- Product for All and e- Waste for All’.
- Encouraging entrepreneurs to use various components of e-waste to manufacture a new product and government should give special subsidy to such manufacturing units.

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Improving Water Economy in Increasing Climate-Risks: An evidence based Kali River Rejuvenation through Agriculture Water Management in Bachhmai Distributary Canal Command, Kasganj, Uttar Pradesh

Er. Ravindra Kumar

Abstract

WWF-India and Uttar Pradesh Irrigation & Water Resources Department along with Kasganj District Administration is working on enhancing flows in Kali River through agriculture water management in 16155 hectares of Bachhmai canal command. In terms of implementation of Kali river initiative, a three-pronged approach was adopted: (a) Demand side management-reducing water requirement for the key crops in the region through adoption of better management practices and adoption of trench irrigation techniques, (b) Supply side management includes installation of metal gates as head regulator and establishing the gauges for level/discharge measurement, and (c) Institutional strengthening by exposure field visits and training members of Water User Associations. Trained and capacitated over 40,000 farmers spread across over 300 villages in 3 blocks of Kasganj district. On-farm demonstrations of various package of practices (PoPs) on maize and wheat crops to over 40,000 farmers. On-farm water use is reduced by 20% in maize and 25% in wheat. Crop productivity of wheat has enhanced from 34.38 qt/ha to 40.63 qt/ha: maize productivity has enhanced to 80 qt/ha from 79.5 qt/ha. The economic gain of farmers in wheat is 15% and in maize is mere 1%. Overall economic gains are 27% in input expenses reduction, eventually benefitting the farmers within a year.

Keywords: ecology, river rejuvenation, water benefits, water economy, economic gains, environmental flows.

Introduction

Global economy is facing increasingly climate-risks of hydro-cycle. Everybody is thirsty downstream. Some country spent up to thirty per cent of energy in pumping water horizontally

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or vertically and treating waste water for circular economy. Generated water benefits reduce on mining of groundwater or depletion of surface water, as many ecological services derived by society from water bodies become missing. Similarly when water starts changing colour, many civilizations perish. Hence, healthy freshwater ecosystems are essential for well being of all life forms dependent on it. Besides this, various natural processes also derive ecological services from rivers, wetlands and water bodies. For example- climate moderation, self cleansing property of river and maintaining river integrity: lateral, longitudinal and vertical. So, the management of maximizing water benefits is the aim of both the central and state government, through their various schemes and programmes- trying to prioritize the conservation of water resources, but often remains a serious problem even in water positive state like Uttar Pradesh.

Efforts like Kali river rejuvenation and an up scaling in nearby geographies of Ganga basin (as have been demonstrated by WWF India for Karula River-a tributary of Ramganga which is a tributary of Ganga River, can be really helpful in bringing, the much-desired change in the health of the rivers, ensure local water security, keep the groundwater levels intact in addition to benefitting the health of local poor farmer community and adding to their increase in income by enhanced crop and water productivity. States like Punjab, Tamil Nadu and Uttar Pradesh adopt policy like free electricity to farmers owning private tube wells and free irrigation by public irrigation system is inversely affecting water use efficiency, water economy and ultimately it returns to mining of resource-base of water sources.

The alteration of flows in the rivers has an implication onto the health of the river, in terms of causing stress to various life forms, besides causing geomorphological changes. WWF-India recognizes that environmental flows implementation in critical river systems in India, including river Ganga and her tributaries, would be a complex and time taking process. Therefore, this has to be dealt in a three-pronged manner- demand and supply side management, multi-stakeholder engagement and holistic view of water policy implementation at various thematic levels which would help sustain E-Flows in river:

❖ Agriculture: Agriculture being the largest water consumer (major diversions from dam/barrages for irrigation) requires policy interventions to promote better management practices in agriculture to reduce water use without negatively impacting the yield and economic returns. Even a minor intervention at ground level through policy uptake could save enormous amount of water.

❖ Wetlands: Healthy floodplain wetlands/ponds not only improve resilience of local communities but also helps recharging groundwater which contributes riverine base-flows. Policy around wetland rejuvenation and restoration would also benefit river systems in long run.

❖ Groundwater: Aquifers being major contributor of riverine flows in lean season, requires policy around sustainable extraction.

- ❖ Water Allocation: Water allocation rationalization including revising guidelines and manuals of dams and barrage operations.
- ❖ E-Flows: Policy around assessment of E-flows in various river systems and exploring avenues to realize the recommendations.

Project Area

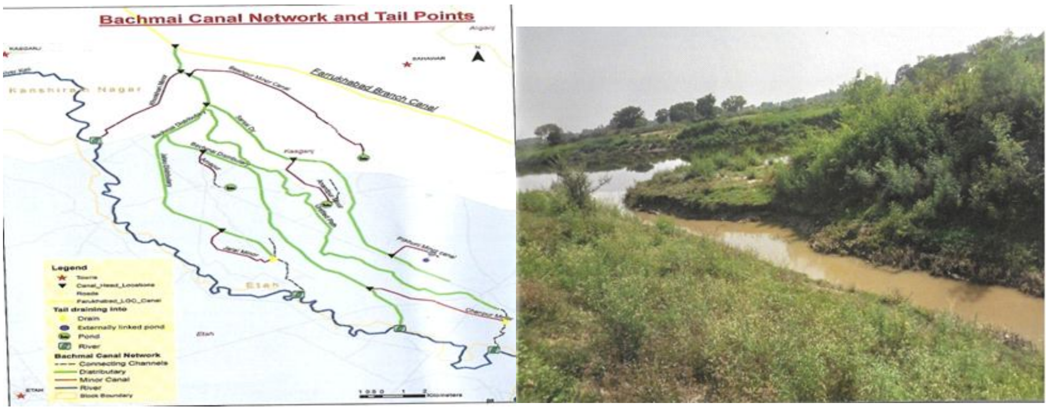
The project area falls under Kasganj district, Uttar Pradesh. Bachhmai distribuatry canal system off-taking from Farrukhabad branch canal (part of Lower Ganga Canal system off-taking from Narora Barrage, Bulandshahar) on Ganga River. Bachhmai canal system (head capacity 400 cubic feet per second) has 357 km long network of canal, with three distributaries and seven minors, Cultural Command is 16135 hectare with present irrigation intensity (of last five years) 51% of CCA against designed 82.5%. So canal distribution system deficiency was rectified by installation of metal gates to regulate water head on head of Distributaries/Minors as shown in Figure-1.

Figure-1 Head Regulator of Bachhmai distributary off-taking from Farrukhabad branch of LGC before and after project intervention

The mapping of tail-end of minors and distributaries was carried out with the objective to plan the kind of interventions that would be required for enhancing flows (from the saved water in irrigation) in the nearby river/s or rivulets or drains or ensuring local water security through water availability in the village ponds/wetlands.

Tail end connectivity of minors to river/drain restored is shown in Figure-2 below.

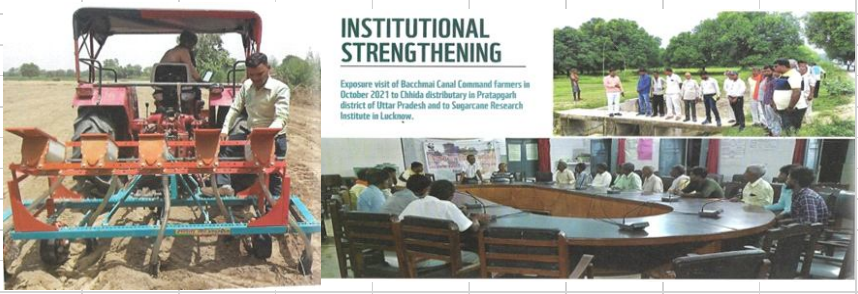
Figure-2.Bachhmai Canal Network Tail end connectivity to river/ drain leading to Kali River



Methodology/Approach

Initiative demonstrated during Karula river rejuvenation-Proof of Concept(20017-2020), the team planned to scale-up this in Bachhmai system that water can be saved in irrigation through simple interventions like adoption of trench irrigation instead of flood method. One trench was handed over to each of the WUAs in Bachhmai canal command. The tracter mounted trencher and institutional strengthening is depicted in Figure-3.

Figure-3.Capacity building of farmers on trench based farming



Canal rehabilitation and tail end connection of canal network to rivers, regular flow monitoring along with continuous and regular engagements with stakeholders. The engagement with UP Irrigation and Water Resources department, the command farmers, community members, Kasganj District Administration, local Krishi Vigyan Kendras was ensured throughout the initiative's timeframe.

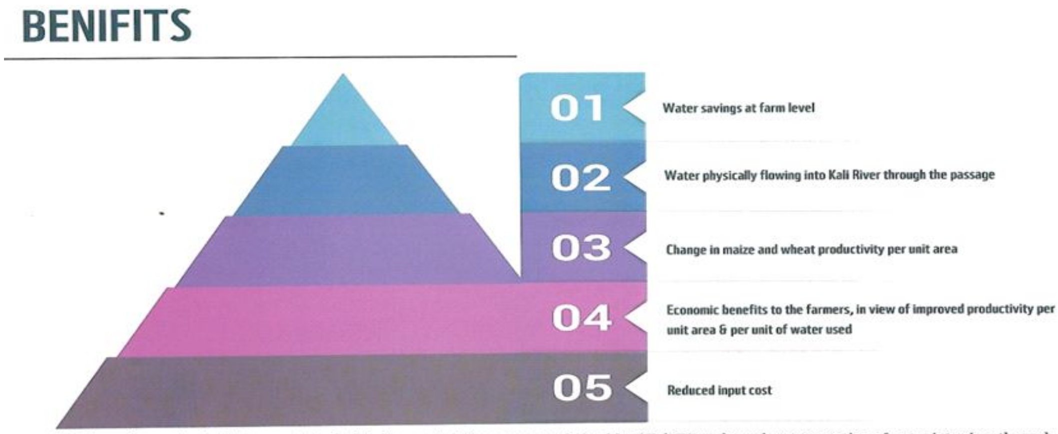
1. Demand Side Management – under this aspect, efficient irrigation water management and sustainable agricultural practices are being promoted, demonstrated and mainstreamed across the command farmers of Bachhmai system. The objective here is to save irrigation water and lead the saved water into Kali River either through direct passage from the tail-end of minors/distributaries to the Kali River or through enhanced base flows through rejuvenation of wetlands/ponds which are fed by tail ends of minors/ distributaries. This will also help improving local water security.
2. Supply Side Management – under this aspect, the rehabilitation of the canal irrigation system of Bachhmai distributary is being taken up; the purpose here is to ensure that the canals can take designed discharge and convey the irrigation water efficiently for equitable and optimal distribution. Plus, the monitoring of water in the irrigation canal is also planned through gauges at identified locations in the canal, mainly at the head of canal and tail-end of the canal. The idea is to monitor (i) the inflow for the command area and (ii) the available/remaining water in the canal at its tail-end.
3. Institutional Strengthening –strengthening the capacity of Water Users Associations (WUAs) that are constituted at the minor/distributary level. The capacity of the 100 WUAs is built/ strengthened around role and responsibilities of WUAs, their mandate, duties and related aspects under U.P. PIM Act 2011.

Picture 4: Release of Photo Journey Booklet showing pre and post intervention status

The Lokarpan (Inauguration) Ceremony of Rehabilitated Bachhmai Distributary Canal System was organized by WWF on 26th September,2023 which was attended by the large number of command area farmers, WUA representatives, Officers from UPIWRD / WWF/ HSBC, QCC Team and the district administration representative. A photo journey booklet “Kali River rejuvenation through agriculture water management in command of Bachhmai Distributary Canal” was released showing pre and post intervention status of the canal structures.

The accrued benefits are schematically shown in Figure-5.

Figure-5 Benefits motivation



Kali River rejuvenation initiative was intended to demonstrate improvement in health of Kali River through augmentation of water into river through saved water from irrigation that was supplied to canals in command area.
The interventions in Demand side, Supply side and Institutional Strengthening ensured multiple layers of benefits to both river health and farmers within command area.

Initiatives and Achievements

Demand-side Management

1. Trained and capacitated over 40,000 farmers spread across over 300 villages in 3 blocks of Kasganj district.
2. On-farm demonstrations of various Package of Practices (PoPs) on maize and wheat crops to over 40,000 farmers
3. On an average, on farm water use is reduced by 20% in maize and 25% in wheat
4. On an average, wheat productivity has enhanced from 34.38 Qt. to 40.63 Qt/ha: maize productivity has enhanced to 80 qt. from 79.5 qt/ha.
5. The economic gains of farmers in wheat is 15% and in maize is mere 1%.
6. Economic gains are 27% in input expenses reduction, eventually benefitting the farmers.

Supply side Management

1. All ten canals under Bachhmai Distributary were rehabilitated and passge constructed/ rehabilitated to connect to Kali river or nearby drain or a local pond.
2. Four of the canals have started releasing saved/ available water into Kali river.
3. Monitoring of flows into Kali river and water quality check to continue beyond project duration.

Institutional Strengtheni9ng

1. Village-level, district –level, state level exposure trainings cum knowledge-exchange programmes organized for WUA members.
2. All WUAs now have Bank Accounts and are well-versed with the process of operation and maintenance of canal and water management , with the support from department.

Way Forward

The major canal irrigation schemes are gravity based and flood irrigation method is popularly employed with poor water use efficiency and poor crop productivity. With more water availability at head water guzzling crops are practiced even against the design crop plan. Existing irrigation intensity is reduced by 50% due to non availability of water in rivers due to climate change and reduced base flows in the river due to excessive groundwater extraction in the river basin.

The tail-end of these canal system invariably terminate closer to rivulets, rivers, drains or ponds. This connectivity is valuable, not only for revival of rivers, but also ensure local water security. The construction of such connections would also keep the groundwater levels intact.

Both the central and state governments, through their various schemes and programmes, are trying to prioritize the conservation aspects of the river systems. Efforts like this one ob Kali river, can be really helpful in bringing the much-desired change in the health of the rivers in addition to benefitting local farmer community.

Socio Economic Risk Assessment of Climate Induced Natural Disasters: An Indian Perspective.

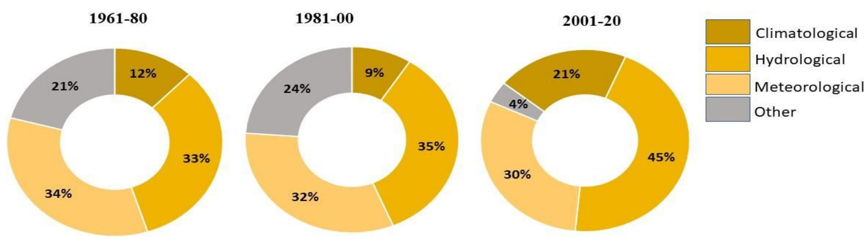
Dr. Swati Anand, Dr. M. Mishra, Dr. Arpita Roy, and Dr. Rakesh

Introduction:

Natural disasters are the shocks that disrupt the functioning of the economy and threaten the wellbeing of people. According to UNISDR (United Nations International Strategy for Disaster Reduction), disaster is "A serious disruption of the functioning of the community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources".

Fig 1:

composition of Natural Disasters



Source: based on EM-DAT data

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** *Dr. M. Mishra, Professor, BHU*
****Dr. Arpita Roy, Academician*
*****Dr. Rak*esh, Academician

EM-DAT Database of Centre for Research on the Epidemiology of Disasters (CRED) divides natural disasters into six main categories; Climatological, Meteorological, Hydrological, Geophysical, Biological and Extra-terrestrial. Among these disasters Climatological, Meteorological and Hydrological disasters are combinedly known as the climate induced natural disasters as these disasters are the result of interaction between different climate forces and are highly sensitive to the recently emerging disturbances in climatic conditions. climate induced natural disasters contribute a significant share in the composition of natural disasters, this study concerns itself with climate induced natural disasters and the risk assessment of impacts imposed by these types of disasters.

Climate induced disasters impose a large cost on the affected regions. These costs could be direct such as Loss of lives and injuries, loss of assets (fixed assets and capital including inventories), damage to raw materials and extractable resources, damages to infrastructure, houses and other constructions etc.(Cavallo & Noy, 2009) and indirect which include all those losses which are not the result of the physical event itself but are provoked by the consequences of these disasters.

This study tries to assess the aspects of these natural disasters on the people and economy of the nation of India, despite the controversies and complexities in the literature to assess the effects of these disasters. Climate induced natural disasters are unpredictable in nature and preparedness is the tool that can help therefore this study tries to understand the taxonomy of the impacts direct and indirect over the Indian economy along with the susceptibility and preparedness extent of the states of India to combat these disasters. Vulnerability integrates the aspect of susceptibility and preparedness and is an important variable in risk assessment, henceforth this study assesses the vulnerability of Indian states and union territories to climate induced natural disasters as well.

Rationale and objective : In spite of the increasing trend of frequency and intensity of Climate induced disasters, no specific study is available in India which tries to develop indicators regarding climate induced natural disasters. The impacts imposed by CINDs are different due to their high frequency and various indirect impacts. The impacts imposed by CINDs are large but heavy construction and job creation activities are not followed by these disasters due to their frequent nature therefore the creative destruction fails to materialize for these types of disasters contrary to other large disasters such as earthquakes. Holistic risk analysis of natural disasters is theoretically a new concept and we lack a nation-specific study which tries to assess the risk of climate induced natural disasters. Risk assessment can help in assigning proper pre-emptive policies to the more risk-prone areas and reduce the overall risk imposed by disasters. This study built a risk index of states and UTs for climate induced natural disasters and explored different dimensions of vulnerability along with environmental, adaptive, and coping capacity following the recent developments in literature. Therefore, this study is unique in its own kind of way and will help the policy makers in efficiently redirecting the limited resource that is available for disaster management.

Literature review:

Risk denotes the likelihood of the country receiving serious repercussions in the potential scenarios of the extreme event. These repercussions depend on the prevailing socio-economic condition of the society and the developmental level of the country is in, the pattern of development, settlement, socioeconomic changes and the process of urbanization affect the vulnerability and exposure condition of the economy which affects the disaster risk (IPCC, 2012).

The conversations regarding the possibility of the existence of a causal relationship between development level /behavioural practices with the impact of disasters Started in the 1980s. United Nations International Decade for Natural Disaster Reduction (IDNDR)1990, was the first major initiative to understand disaster risk and impacts. The widely accepted concept of risk in the research community is that Risk is the composite result of the event, exposure and vulnerability.

Disaster risk is the composition of two main components, first is the possibility element. The second component consists of consequences. people, human activity, and the natural resources and environment determine the outcome of a natural disaster. The term “vulnerability” is used to describe these characteristics of the human system. Based on the literature we can define disaster risk as a function of the hazard, exposure and vulnerability combined. Hazard, exposure, and vulnerability all combinedly constitute ‘Risk’. Hazards and vulnerabilities can explain the likelihood of physical events to some extent and the consequences resulting from the event (e.g., casualties and financial turmoil) (IPCC, 2014).

Therefore,

Natural Disaster risk = possibility* consequences

The possibility of the occurrence of events depends on the natural probable causes and increasing exposure as well. UNDP 2004 include the exposure factor by including the variable that includes the terms population exposed

$$R= H*Pop*Vul$$

Where R is the risk (number of people killed), H is the hazard which depends on the frequency and strength of the given hazard, Pop is the population living in an exposed area, Vul is vulnerability.

Hence, Hazard*population= physical exposure, Therefore

$$R= PhyExp*vul$$

Where PhyExp is the frequency and intensity multiplied by the exposed population. Frequency is computed average frequency per year i.e.no of events/no of observation year

- Natural Disaster risk (R) = disaster event/hazard(H)*exposure(E)*vulnerability(V)

Exposure and susceptibility are impacted by a wide range of social, economic, and cultural elements and processes that have been overlooked thus far, making quantitative predictions of future trends challenging (high confidence). Among these factors include wealth and its distribution, demographics, migration, access to technology and information, employment patterns, the quality of adaptive responses, societal values, governance systems, and dispute-resolution institutions. (IPCC 2014). In some literature, exposure is characterised as a component of vulnerability, however other literature suggests that exposure is a distinct critical element that should be considered separately from other factors such as total risk assessment. As per IPCC, 2012 exposure is a description of people, livelihoods, environmental services resources, infrastructure or any other capital private or public that could be adversely affected due to disasters.

The damage caused by a disaster is, of course, related to the physical intensity of the event (i.e., the severity of the storm or earthquake), but in the literature, there are many economic, social and political factors that also affect vulnerability (Cavallo and Noy, 2009). Kellenberg & Mobarak in their review paper published in 2011 have discussed the many factors that make nations more vulnerable to natural catastrophes in terms of their far-reaching effects. Susceptibility defines the defencelessness of the people; this defencelessness is the result of the historical development process. nIndicators and criteria that can help to translate the abstract concept of vulnerability into information that can be visualized and communicated are important steps towards improving policy and decision-making processes (Birkmann,2013). As per IPCC (2007), an important step toward successful risk reduction and climate change adaptation is the capacity to measure, analyse, and evaluate susceptibility, coping, and adaptive capacities. It is important to move away from the hazard-centric assessment to integrated risk analysis that includes vulnerability factors (UNDP,2004) These scopes make vulnerability measurement a prerequisite for reducing disaster risk and the development of adaptation strategies. In addition, the concept of vulnerability links various research areas such as disaster risk management, development research and climate change adaptation (Birkmann,2013)

Table 1.literature considered for risk indicator development process.

	World Risk Index (2010)	Social Vulnerability Index (SOVI) 2003	Vulnerability to Natural Hazards and Climate Change in Mountain Environments (2015)	Community-based Disaster Risk Index (2013)	CATSIM Model (2013)	Disaster Score card for States and Union Territories of India (2019)
Spatial level	Global scale study where nations are compared.	Sub-national level study (USA)	Region-specific (Mountain regions in the Alps)	Sub-national level (Indonesia)	National level (Developing countries)	Sub-national level (state level)
Focus area	Aspects of Risk are identified with emphasis on vulnerability.	Aspects of social vulnerability are identified.	Aspects of vulnerability and adaptive capacity are recognized for the concerned subject area.	Aspects of vulnerability and resilience capacities are studied.	The vulnerability of the fiscal sector to disasters is the subject matter of this study	identification of dimensions related to risk resilience along with computation of vulnerability.
Disasters included	earthquakes, storms, floods, droughts, sea-level rise.	Coastal disasters	Climate induced natural hazards which are Gravity triggered (landslide, avalanche etc.)	Flood Landslides Forest fire	All natural disasters	All natural disasters including coastal erosion

Source: Researcher (based on literature).

Data: This study is concerned with big incidences of climate induced disasters which include climatological, hydrological, and meteorological disasters. Climatological disasters contain events of drought and wildfire, hydrological disasters depict the incidences of floods and landslides (landslides can also perpetuate due to earthquakes but these types of landslide incidents are not included here) and meteorological events contain storms and extreme temperatures..

All disaster-related data have been accommodated from the EM-DAT(CRED) disaster database. The EM-DAT database selects the extreme event to be entered as a disaster in the database if either or some of the following conditions are fulfilled by the extreme event entry criteria of disasters for this database if the disaster has registered either/some or all of the following conditions:

The risk analysis is conducted based on secondary data. The information is obtained from the International Disaster Database (EM-DAT), the Indian Meteorological Department (IMD), the vulnerability atlas of India (BMTPC), the Census 2011, the Government of India, Financial statements of GOI, the Indian water portal, various other reports by different departments of government, reports by international agencies like WHO, IPCC, etc.

Methodology

A combination of qualitative and quantitative approaches is used in this study to capture the objectives given the constraints of limited data availability. The methods are borrowed through a literature survey and will be used with little or more variation as they go along with the Indian economy.

Risk = f (hazard, exposure, vulnerability)

R= H*E*V Where V= f (P, S, Eco, Env, r) And r = (A, C)

Table 2.Components of Risk

<table>
<tr><th>Natural disaster type</th><th>Subtype of disasters</th><th>Hazard (dimension)H</th><th>Exposure (dimension)E</th><th>Vulnerabilities (dimension)V</th></tr>
<tr><td rowspan="2">Climatological</td><td>drought</td><td rowspan="8">occurrence
intensity</td><td rowspan="8">Population
Gross domestic product</td><td rowspan="4">Social (S)
Physical(P)
Economic (Eco)
Environmental (Env)</td></tr>
<tr><td>wildfire</td></tr>
<tr><td rowspan="2">Hydrological</td><td>flood</td></tr>
<tr><td>landslide</td></tr>
<tr><td rowspan="4">Meteorological</td><td rowspan="2">Extreme temperature</td><td rowspan="4">Resilience capacity(r)
Adaptive capacity(A)
Coping capacity(C)</td></tr>
<tr></tr>
<tr><td rowspan="2">storm</td></tr>
<tr></tr>
</table>

Parameters and Weights: Each of these 6 hazards, 4 vulnerability dimensions, and exposure have several parameters. Based on the availability of data sets throughout the country in uniform formats several parameters were selected for the development of indexes on the hazards, vulnerabilities, and exposures.

Scale equivalence: since the range of various data use in our study differ, normalisation become an important tool before developing indicator. We have used the z score method, popular method among literature for normalisation, for normalising data. The value is later on scaled from 0 to 10.

$$Zij = Xij - min(Xi)/max(Xi) - min(Xi)$$

Hazard index: The hazard index is based on two parameters, the average annual frequency of disaster and the intensity of the disaster.

Average Annual Frequency of Disaster: frequency of disaster in the last 20 years i.e., from 2000-2020.

Intensity of disaster: intensity of disaster is calculated by weighted average formula Not all the parameters of hazards are equally important. Based on extensive literature review and historical impact data (death and damage) the importance and therefore weights have been assigned to included hazards in the study. Flood and storm are highly destructive and the Indian economy bears the high cost due to these disasters, both of these disasters are given the weight of 25 percent, drought and landslides are assigned the weight of 15 percent each and extreme temperature and wildfire are given the weight of 10 percent each.

Table 3: weights of parameters (Hazard Intensity)

Disasters	Intensity Extent parameter	Weights in parameters	Data collected from
Flood	1)flood prone areas in states (weight:0.08) 2) areas of urban agglomerations with more than 100,000 population weighted by flood proneness based on rainfall intensity. (Weight:0.02)	1.a) flood prone area by BMTPC and 1.b) GOI 2.a) urban agglomeration 2.b) average rainfall data	BMTPC, Rajya Sabha answer, Census 2011 IMD
Storms	1)wind velocity area %, 2) rainfall intensity Equal weights to 1,2	1)Wind Velocity m/s (area in %), 55&50 m/s (10), 47 m/s (8), 44&39 m/s (4), 33m/s (0) 2) average rainfall data	BMTPC, IMD
Landslides	landslide hazard zones	highly affected areas-10, moderately affected areas-8, marginally affected area-4, not affected-0	Rajya Sabha answer
Drought	drought hazard index		Dr. P.G.Dhar Chakrabarti, GOI
Extreme Temperature	1)heat wave index, 2) cold wave index equal weights		Dr. P.G.Dhar Chakrabarti, GOI
Wildfire	forest fire index		Dr. P.G.Dhar Chakrabarti, GOI

Exposure Index: To compose an exposure Index two parameters are considered the total population and gross domestic product of the states.

Vulnerability index: Vulnerability consists of two dimensions; susceptibility and resilience capacity. Susceptibilities of the society to disaster impacts are measured by four components which are social, physical, economic, and environmental susceptibility and an equally weighted joint index is created to denote the composite susceptibility of the states. To capture the second dimension of vulnerability (negative vulnerability) we have computed the adaptive capacity index, coping capacity index and also included the resilience index. These three components are then being averaged with equal weights to denote the composite resilience index.

Composite risk index: the composite risk is calculated by following formula and scaled to the value of 10 to develop risk index.

Risk= hazard*exposure* {susceptibility*(1-composite resilience)}

ArcGIS software is utilised to depict risk scores for Indian states and UTs.

Table 4: Parameters for vulnerability assessment:

Dimension	Component	Parameter Name	Parameter
susceptibility	Social	poverty	% of people below poverty line
		Literacy	% of people illiterate
		Clean water access	% of people with no access to clean water
		Dependency ratio	Dependent population/total working population
	Physical	Population density	People per km2
		Demographic pressure	Decadal Population growth rate
		Wealth inequality	GINI coefficient of asset/wealth inequality
		Unsafe settlements	%Vulnerable house based on wall structure Category – A(VH): Buildings in field-stone, rural structures, unburnt brick houses, clay houses (10) Category – B(H): Ordinary brick building; buildings of the large block and prefabricated type, half- timbered structures, building in natural hewn stone (8) Category – C(L): Reinforced building, well-built wooden structures (4) Category – X(H): Other materials not covered in A, B and C. These are generally light structures. (8)
		Slum	% of slum area
	economic	unemployment	% of people unemployed
		Agriculture dependent population(occupational)	a) % HH dependent on agriculture (self-employed) b) % HH dependent on agriculture casual labour
		No of factories	Factories per km 2
		Small businesses	a) MSME and small industries b) Factories with less than 20 people
		Dependence on agricultural sector	GSVA by agricultural sector/ GSDP
	environment	Degraded land	% of degraded land
		Forest cover	% of land with forest cover
		Arable land	% net sown area
Composite resilience	Adaptive capacity	Human development level	HDI
		Government attitude	GGI % Of Social sector expenditure to total expenditure % Of Health expenditure to total expenditure

		Gender equality	GDI
	Coping capacity	Access to state emergency funds	Average SDRF fund allocation
		Access to national emergency funds	Average NDRF fund allocation
		potential fund base	Own tax revenue
		Health coverage	Doctors and specialist per thousand people Beds availability per 1000 thousand people
	Resilience capacity	State disaster management capacity	Resilience index developed by GOI

Findings:

This paper assess the hazard intensity index of six climate induced disasters included in the study; drought, wildfire, flood, landslides, storms and extreme temperature and storm additionally with weighted composite hazard index. Exposure and vulnerability indexes are also computed in this chapter. Vulnerability is the joint result of susceptibilities that exist in the region that increase the risk and the capabilities that reduce the risk. We compute different score cards to depict social, physical, economic and environmental susceptibilities and conjoin them to denote the composite susceptibility index. Also, different indexes are prepared to depict the adaptive, coping and resilience capacity. These items jointly depict the resilience of the state's ant UTs.

The equally weighted average of both of these attributes constructs the hazard intensity index. State of Maharashtra (7.23), Karnataka (7.05), Andhra Pradesh (6.80), Rajasthan (6.67), and Jharkhand (5.98) are the state with comparatively high chances of severe Droughts.UTs are not affected by Drought that much, within UTs Daman & Diu (4.35) has the highest score of drought intensity. Arunachal Pradesh (2.92), Nagaland (2.67), Meghalaya (1.62), and Chhattisgarh (2.37) are the most endangered states to experience wildfires. Among UTs Chandigarh (0.920) has the highest score on the wildfire disaster intensity index. Punjab (8.00) has the highest flood hazard index followed by west Bengal (4.50), Kerala (4.01), and Uttar Pradesh (3.10), UTs comparatively are less affected by flood severity, Puducherry has the highest Flood hazard index among UTS. The landslide-affected areas are mostly concentrated in Himalayan regions, north-eastern states and some states situated in Western Ghats. Himalayan states Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Uttarakhand, north-eastern states Sikkim, Manipur, Mizoram, Nagaland and West Bengal depict the highest landslide hazard intensity index.

Floods and storms are highly destructible disasters and therefore are given weights of 25 percent each, draught and landslides are the disasters are given a Vulnerability has various dimensions. The factors and parameters to denote the vulnerability are selected based on literature. Vulnerability is the combined result of susceptibility and resilience capacity of the economy, however since both of these heads denote different constructs hence, we compute these two indexes separately and then conjoin them appropriately to deduct the final vulnerability index.

The value of Cronbach's alpha for social vulnerability indexes the value of Cronbach's alpha is .827, for the physical vulnerability index it is .737 and for the economic vulnerability index, the value is .807 which depicts satisfactory internal consistency. Only for the environmental vulnerability index, the value is only .654 which depicts the average internal consistency.Susceptibility Score: States of Maharashtra, Andhra Pradesh and Madhya Pradesh are found the most physically susceptible to the risk imposed by climate induced natural disasters. Daman and Diu among the UTs score a significant high score followed by Delhi, Chandigarh, Dadra and Nagar, which also score enough values to make these UTs highly susceptible to the potential damages imposed by future occurrences of extreme events.

the union territories of India.

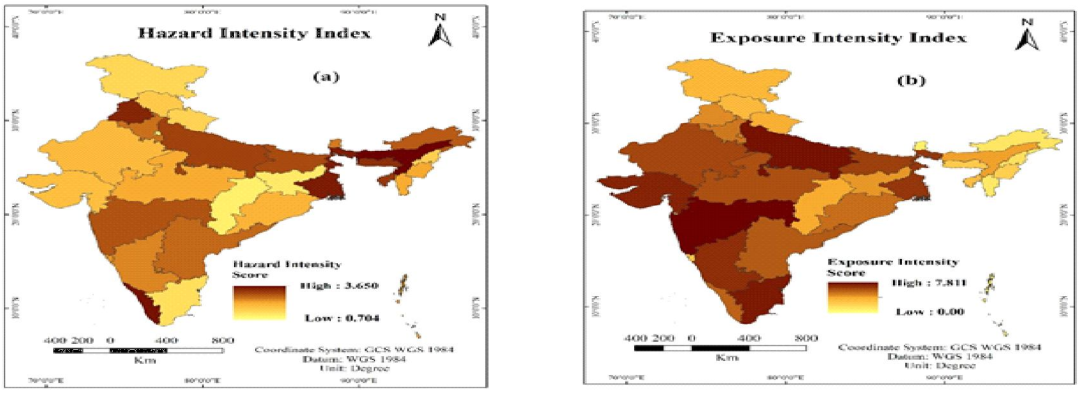

Fig 2: Geographical distribution of states in (a) Hazard Intensity Index and (b) Exposure Intensity Index

The exposure components denote the population and assets that are potentially exposed to harm imposed by extreme events. The normalized values of the total population and Gross state domestic product (GSDP) of states and UTs are used to compute the exposure index score of the affected regions. The theory is that the more concentrated the population and assets are in one region the more exposed these items would be to disasters. Maharashtra (7.81), Uttar Pradesh (7.76), Tamil Nadu (4.76), Gujrat (4.41), and Karnataka (4.20) are the top 5 states scoring the highest value in the exposure index. The combination of population and assets is large in these states and therefore the overall exposure index score of these states is also the highest. Among the UTs, the national capital Delhi (1.81) is highly exposed due to the concentrated population and asset availability in this region, followed by Chandigarh (0.081) and Puducherry (0.077). Social Susceptibility Score: Bihar, Jharkhand, Uttar Pradesh are the states that score the highest values in social susceptibilities, a large portion of the vulnerable population resides in these states and make these states more susceptible towards the risk imposed by the disasters. Union territories of Dadra and Nagar Haveli report highest social susceptibility followed by Delhi and Chandigarh.

Composite Vulnerability Index: Vulnerability is an important contributor to the overall risk. Vulnerability has various dimensions. The factors and parameters to denote the vulnerability are selected based on literature. Vulnerability is the combined result of susceptibility and resilience capacity of the economy, however since both of these heads denote different constructs hence, we compute these two indexes separately and then conjoin them appropriately to deduct the final vulnerability index.

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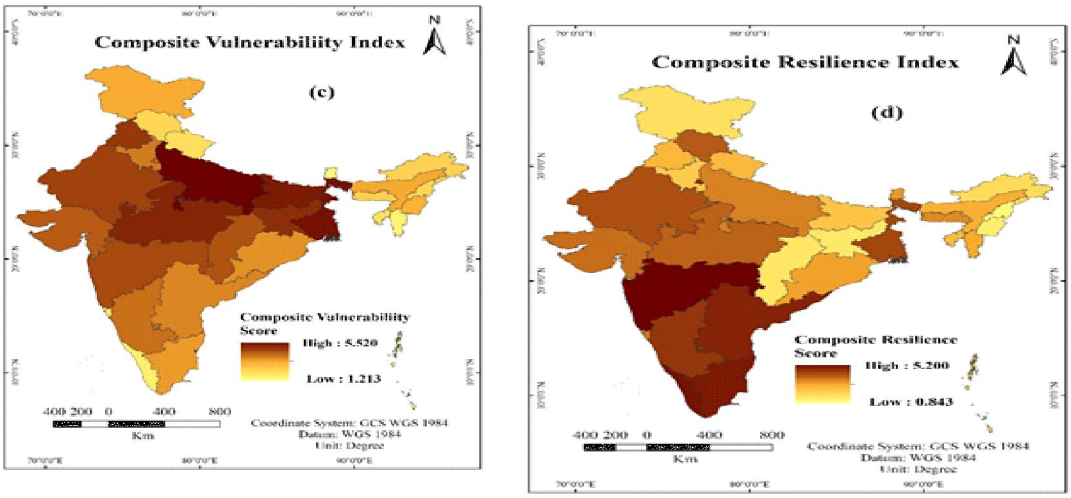

Fig. 3 Geographical distribution of states in (c) Composite Vulnerability Index and (d

Economic Susceptibility Score: West Bengal, Uttar Pradesh and Madhya Pradesh are the states with highest economic susceptibility score. Among the UTs, Puducherry, Lakshadweep and Andaman and Nicobar Islands score the highest values.

Environmental Susceptibility Score: States of Punjab, Gujarat and Maharashtra are found to be the most environmentally compromised states due to rigorous exploitation of environment in these states additionally with other causes. NCT of Delhi and Puducherry reports the highest values among the UTs.

Composite Vulnerability Index: Combining all the above susceptibility scores we compute the composite susceptibility index. States of Uttar Pradesh followed by west Bengal and Bihar score the highest values of composite susceptibility index. Delhi scores the highest among the union territories followed by Puducherry and Dadra and Nagar Haveli.

Adaptive Capacity Score: Kerala, Goa and Tamil Nadu are the highest scorers as these states have developed the policies in accordance with the inclusive development and support and therefore the adaptive capacity of these states are highest among all the states.

Coping Capacity: Maharashtra, Kerala and Tamil Nadu have achieved the best score that depicts their coping capacity, whereas the states of West Bengal, Manipur and Nagaland score the worst since these states haven't developed the measures and tools such as health care system or viable economic support etc. that can help coping with the after effects of disastrous events. In between the UTs, Lakshadweep, Puducherry and Chandigarh are the best prepared to cope up after disasters and Dadra and Nagar Haveli are the worst performing UTs, with lowest scores. Resilience Capacity score: Maharashtra, west Bengal and Uttar Pradesh score the best in resilience capacity. Amid the UTs, Delhi, Andaman and Nicobar, Chandigarh score the highest however when compared with the scores of the states UTs register the significantly low values in the resilience capacity scores.

Composite Resilience Index: Composite resilience index includes adaptive capacity score, coping capacity score and resilience capacity score. Among the states, Maharashtra, Kerala and Tamil Nadu score the best scores whereas Nagaland, Manipur and Jharkhand are the lowest scoring states and require development of policies to achieve resilience towards future incidents of disasters. Delhi, Puducherry and Lakshadweep are the best scoring UTs whereas Dara and Nagar are the worst performing union territories.

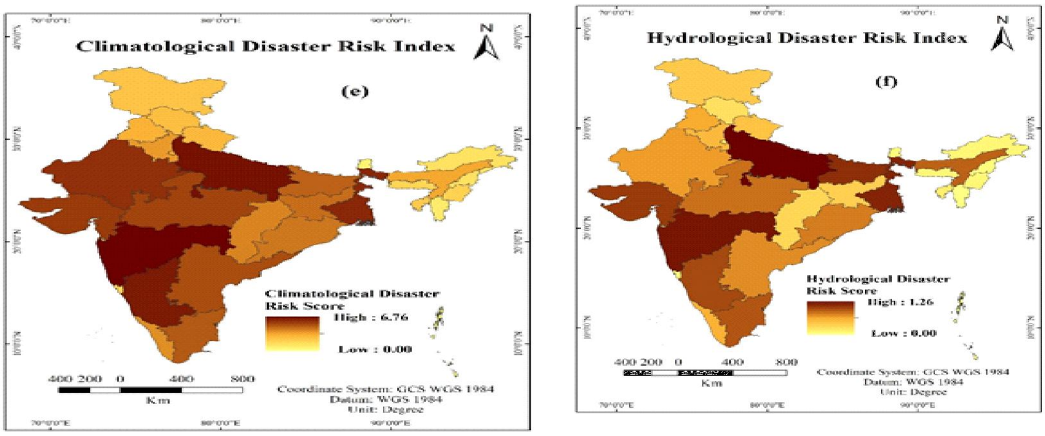

Fig. 4 Geographical distribution of states in (e) Climatological Disaster Risk Index and (f) Hydrological Disaster Risk Index

Climatological Disaster Risk Index: Climatological disaster includes incidents of drought and wildfire. Among the states, Maharashtra, Uttar Pradesh and Karnataka West Bengal and Rajasthan register the high values of risk index for climatological disasters. When compared to states the UTs of India are not as much susceptible to the risk imposed by climatological disasters due to their significantly low values in the risk index.

Hydrological Disaster Risk Index: Hydrological disasters contain the extreme events of floods and landslides and Uttar Pradesh, Maharashtra, West Bengal and Bihar register the highest values and therefore bear the large burden of risk imposed by hydrological disasters in India.

Meteorological Disaster Risk Index: Meteorological disasters contain the incidences of storms and extreme temperature, Uttar Pradesh, West Bengal Maharashtra and Bihar score the highest values and are more susceptible to the risk imposed by meteorological disasters. UTs does not share the high risk imposed by meteorological disasters however among UTs national capital Delhi scores the highest. UTs are comparatively not that susceptible to risk, however between UTs Delhi show the highest risk index value.

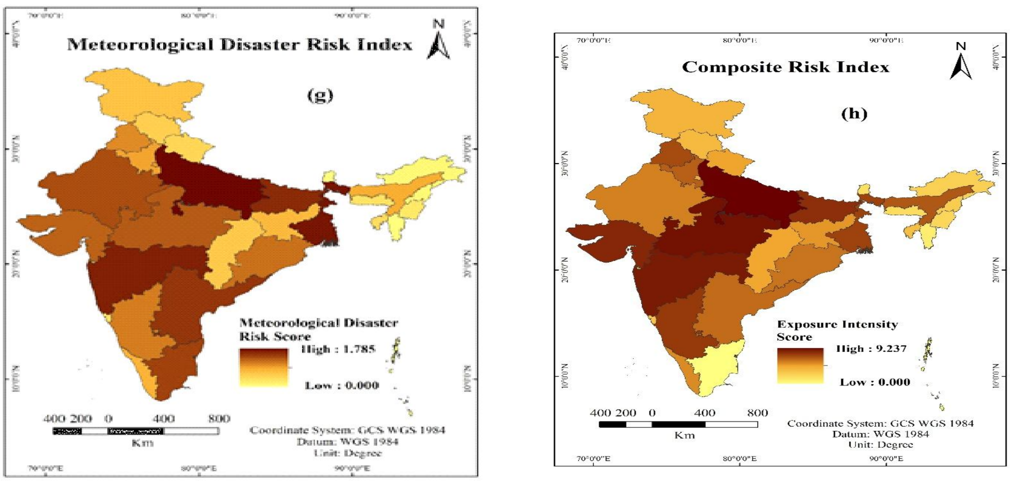

Fig. 5 Geographical distribution of states in (g) Meteorological Disaster Risk Index and (h) Composite Risk Index

Composite Risk Index: Composite risk index includes the composite hazard intensity index, exposure index and composite vulnerability index. Among the states Uttar Pradesh is a top scorer and therefore is the most vulnerable state to the risk imposed by climate induced disasters, followed by Madhya Pradesh, Maharashtra, Gujarat Bihar, Karnataka, West Bengal. Among the UTs Delhi registered the highest value for composite risk index.

Conclusion:

The Indian economy is one of the most vulnerable economies affected by the large incidences imposed by climate-induced natural disasters ,revealing wide discrepancies in CIND disaster risks among different types of disasters and states. These findings emphasize the necessity for disaster-specific policies tailored to each region's unique risks, rather than adopting a one- size-fits-all approach. The study provides valuable insights for policymakers, directing limited resources towards more risk-prone regions, thereby enhancing disaster reduction and prevention efforts.

Risk assessments play a crucial role in directing limited funds towards disaster-prone areas, thereby aiding in long-term risk prevention. Collaboration between government, public enterprises, and the underdeveloped insurance market is crucial for effective disaster management, particularly in a country like India prone to disasters..

Limitations of study: The study faces challenges due to the lack of a comprehensive database in India regarding disasters and their impacts, with existing fragmented and discontinuous data making it difficult to accurately represent concepts like risk and vulnerability. Incorporating updated data could provide a clearer understanding of disaster risk, and conducting more granular regional analyses, including interstate and district-level assessments, can enhance the accuracy of risk projections and inform more effective risk reduction strategies. Further empirical research is needed to validate qualitative assessments of vulnerability, exposure, and risk for each state and facilitate cost-benefit analyses, contingent on adequate data on various variables related to climate-induced natural disasters. Expanding risk assessment analyses to smaller geographic units such as districts, towns, and villages can provide deeper insights into ground-level realities, with the study aiming to refine its risk assessment methods based on the insights gained from this research.

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Capacity Generation and Union Government Budgetary Response with Special Reference to Paris Agreement

Rashid Gouhar and Sanatan Nayak

Abstract

This study, spanning 2007 to 2022, analyses India's renewable energy landscape in relation to renewable energy finance by the GoI. Utilizing data from CEA, MOSPI, and Budget Expenditure; it examines Pre and Post-Paris Agreement trends, revealing diverse Compound Annual Growth Rates (CAGRs) across states. Post-Paris, Thermal Energy CAGRs decrease, aligning with global climate goals. Budgetary scrutiny focuses on MNRE, IREDA, and SCI, indicating a substantial post-Paris surge in financial commitments to renewables. Correlation analysis underscores the link between budgetary allocations and renewable capacity growth, emphasizing their role in sector expansion. This research enriches the sustainable energy discourse by providing nuanced insights into state wise variations, capacity trends, and government financial commitments, offering a holistic view of India's strides toward a greener and more sustainable energy future.

Keywords: *Climate Change, Climate Finance, Renewable Energy, Renewable Energy Finance, Paris Agreement, Net Zero Emission, Energy Transition*

Introduction

Climate change stands out as a paramount global concern in contemporary times, demanding urgent attention and innovative solutions. Central to addressing this multifaceted challenge is the concept of climate finance, an indispensable instrument in mitigating and adapting to the adverse effects of climate change. The watershed moment in this arena can be traced back to the 2009 UNFCCC meeting, where a pivotal decision was made to establish a $100 billion climate fund transfer from developed to developing nations. However, the journey towards fulfilling this commitment has encountered hurdles, as evidenced by the historical reluctance of wealthy nations to meet the financial targets set for supporting climate initiatives in developing countries (CSE, 2022).

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The intersection of energy, economics, and environmental sustainability has positioned renewable energy at the forefront of global policy discourse. As nations grapple with the imperative to transition towards cleaner and more sustainable energy sources, the role of renewable energy capacity generation becomes pivotal in shaping the trajectory of a nation's energy landscape. This research endeavours to shed light on the dynamic relationship between the trends in renewable energy capacity generation and the corresponding budgetary responses from the Union Government.

The imperative to shift away from conventional, fossil fuel-based energy sources stem not only from environmental concerns but also from the growing recognition of the economic benefits and energy security offered by renewable alternatives. This study embarks on a comprehensive analysis of the various sources of renewable energy capacity generation, elucidating the trends that underpin the transformation of the energy sector. By delving into the intricacies of electricity generation derived from renewable sources, we aim to unravel the nuances that shape the energy mix in a given fiscal year.

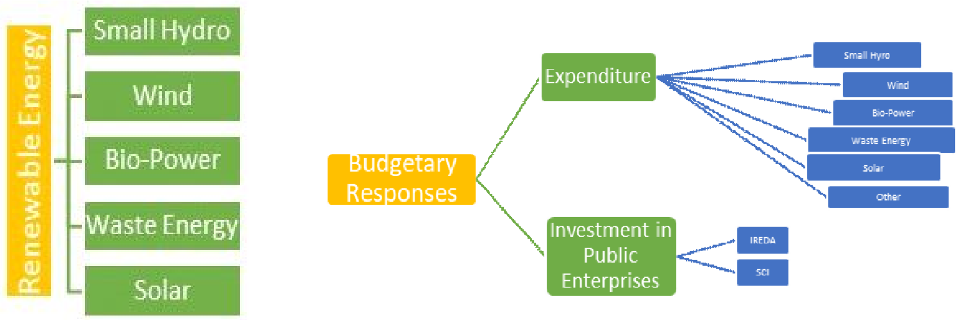
Crucially, the research extends its purview to the financial commitments and allocations made by the Union Government in the same timeframe. The budgetary response, as reflected in financial allocations, serves as a tangible indicator of the government's commitment to fostering a sustainable and resilient energy ecosystem. Through a meticulous examination of budgetary provisions, we seek to discern the priorities, incentives, and strategic investments that underpin the government's vision for renewable energy.

The existing landscape reveals a significant funding gap of three to six times between the demands and actual flows of climate funds. Notably, the aid provided constitutes only a fraction of the financial assistance, with loans further burdening developing nations. This financial dynamic, underscored by persistent challenges in fund transfer, raises critical questions about the efficacy of international mechanisms such as the UN in effectively addressing climate issues. Despite its prominence, the UN faces scepticism compared to other regional bodies like the G20, ASEAN, and Bricks, shedding light on the need to explore and leverage diverse organizational frameworks to bridge the financial disparity in climate finance (ORF, 2023).

Against this backdrop, countries, including India, have pledged to achieve net-zero emissions by specific timelines. India's commitment, set for 2070, involves a comprehensive approach encompassing government initiatives, private sector involvement, and international collaborations. The financial aspect of this commitment is substantial, with projections indicating the need for tens of billions of dollars by 2050 to realize the net-zero emissions goal. The revised NDC underscores India's requirement for $1 trillion by 2030 to enhance adaptive capacities (IFC, 2023).

In essence, this research not only offers a panoramic view of the evolving landscape of renewable energy capacity generation but also provides a nuanced understanding of the fiscal policies that accompany these changes. By linking the trends in renewable energy capacity generation to the financial commitments from the Union Government, we aim to contribute valuable insights to the ongoing discourse on sustainable energy transitions and the economic dimensions that underlie such transformative endeavours.

Flow Chart of Renewable Energy and Budgetary Response



Source: MOSPI, Annual Financial Statements of Ministry of Finance, and compiled by author.

Review of the Literature

In addressing the financial requisites for climate action, India has strategically positioned itself through various initiatives and collaborations. The Long-Term Low Emission Development Strategy, submitted to the UN in 2022, outlines key objectives such as increased utilization of biofuels, enhanced electrolyser production capacity, and expanded green hydrogen production. Moreover, India has championed initiatives like Mission LiFE, the Coalition for Disaster Resilient Infrastructure, and the International Solar Alliance, showcasing a commitment to fostering international cooperation and sustainable practices (RBI, 2023).

Assessing India's climate performance reveals a mixed picture. While the Climate Change Performance Index 2023 recognizes India as the top-performing G-20 country in climate protection, the Global Climate Risk Index 2021 positions India at seventh in terms of exposure and susceptibility to climate risk events. These indices reflect the complex interplay between India's efforts and the ongoing challenges it faces in managing climate-related risks (RBI, 2023). The evolution of renewable energy in India is a critical component of its climate strategy. The Ministry of New and Renewable Energy (MNRE) projects align with this trajectory, emphasizing the pivotal role of solar and wind energy in meeting future energy demands.

The academic landscape on renewable energy in India has witnessed a noticeable shift post-2008, with increased government focus on research and development. Gautam and Verma (2024) studied India's wind power sector excels globally, boasting advanced projects and an annual production exceeding 12,000 MW. Despite challenges in the rooftop solar goal, the country demonstrates commitment to sustainability. Biomass electricity sees minimal growth, but biogas holds potential, particularly with the 536.76 million cattle population. India's long-term vision for renewable energy, outlined in missions and initiatives, serves as a model for global energy transitions, emphasizing the need for flexible grids, innovative technologies, and harmonious coexistence of renewable and conventional sources. Kumar et al. (2019) study delves into this transformation, emphasizing the importance of a hybrid renewable energy model for rural electrification. Doso et al. (2020) advocate for the strategic utilization of small hydro power to enhance future energy security, emphasizing the role of societal and scientific engagement. Akter and Bagchi (2021) shed light on the significant impact of solar energy in alleviating energy poverty in rural India through subsidized or free access. Furthermore, Ghosh et al. (2021) emphasizes the potential of decentralized waste collection centres in promoting the use of agricultural waste for income generation and ensuring future energy security. The extensive potential of biogas, as indicated by Kaur et al. (2022), further reinforces the multifaceted approach required to bolster India's renewable energy sector and address its power needs.

Methodology

This paper uses the secondary data sources of CEA (Central Electricity Authority), MOSPI (Ministry of Statistical and Programme Implementation) for the time period 2007-2022 and Annual Financial Statement of Government of India for the period of 2005-06 to 2022-23. This is the descriptive paper which shows the trend analysis of renewable energy capacity generation state wise and renewable energy budgetary response from the government of India. This paper highlighted the trend change before and after Paris-Agreement 2015. CAGR is calculated to show the trend. CAGR is a measurement of the average annual growth rate of an investment over a given period.

5Ø6Ü5Ø4Ü5Ø:Ü5ØEÜ = [(E5ØIÜ/B5ØIÜ)1/5Ø[Ü –1]*100

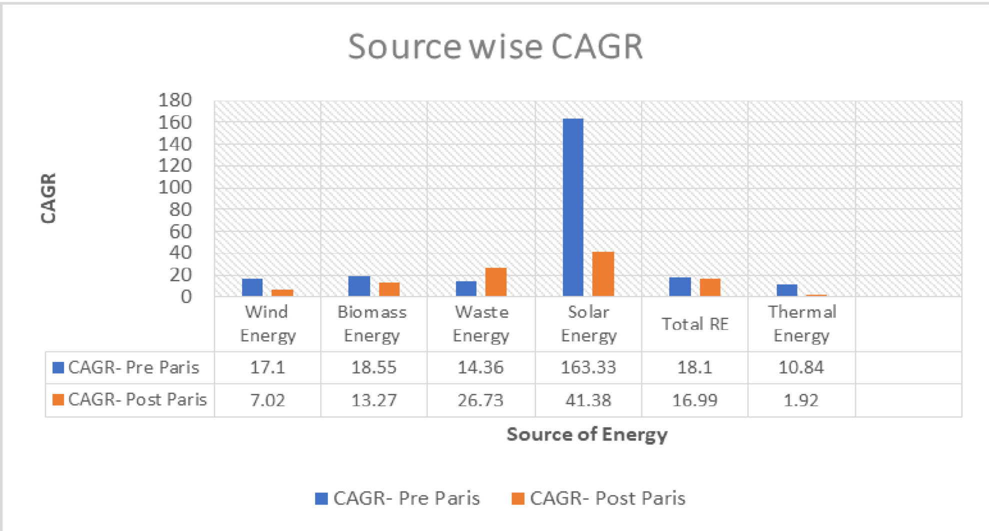
Where: EV= End value, BV= Beginning value n= Number of years

In the last part of the paper there is shown correlation among variables "Renewable Energy Install Capacity Generation, Budget expenditure for renewable energy, Investment in IREDA and SCI and Total Investment in Public Enterprises (sum of IREDA and SCI).

Result and Discussion

The provided graph 1 outlines the Compound Annual Growth Rates (CAGR) for various sources of renewable energy capacity generation and thermal energy, both before and after the Paris Agreement. Additionally, it includes the overall CAGR for the entire renewable energy sector. The graph identifies various sources of renewable energy, encompassing Small Hydro, Wind Energy, Biomass Energy, Waste Energy, Solar Energy, Total Renewable Energy (RE), and Thermal Energy. Subsequent columns provide data on Compound Annual Growth Rates (CAGR) for each energy source, differentiating between pre and post the Paris Agreement. CAGR, a measure of steady annual growth, offers insights into the performance of investments over specific periods. The analysis of specific data points reveals noteworthy trends. Solar Energy, for instance, exhibited a substantial pre-Paris CAGR of 163.33%, which decreased to 41.38% post-Paris, despite contributing significantly to the overall growth of the renewable energy sector. Waste Energy demonstrated a remarkable increase from 14.36% pre-Paris to 26.73% post-Paris, indicating accelerated growth. The overall CAGR for Total Renewable Energy slightly decreased from 18.1% to 16.99%, while Thermal Energy experienced a notable decline in CAGR from 10.84% pre-Paris to 1.92% post-Paris. The graphical representation (Graph 1) efficiently summarizes the growth rates of different renewable energy sources, enabling a comparative analysis of their performance before and after the Paris Agreement. This serves as a valuable reference for understanding the evolving trends and dynamics within the renewable energy sector.

Graph 1: Renewable Energy Source wise CAGR 2007-2022; Pre Paris vs Post Paris

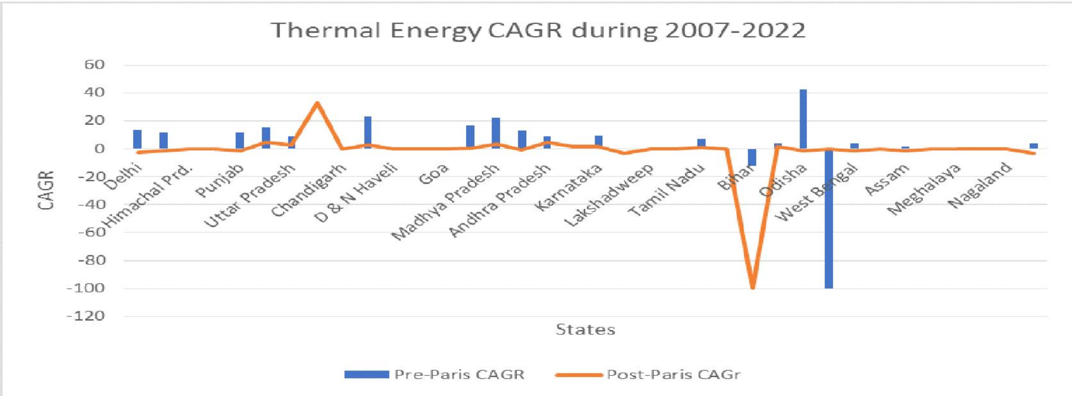


Source: CEA, MOSPI and estimated by the author.

State wise Analysis

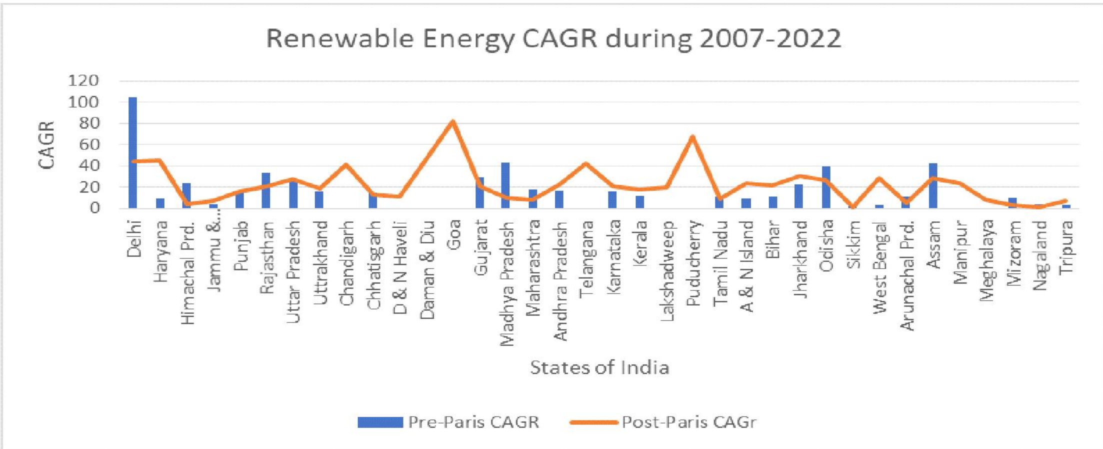
The following graph 2 & 3 provide a comprehensive analysis of the Compound Annual Growth Rates (CAGR) for thermal and renewable energy across various states in India, both before and after the Paris Agreement. The states are categorized based on their energy sources, with detailed insights into their CAGR trends. The analysis of the provided data on Renewable Energy and Thermal Energy Compound Annual Growth Rates (CAGRs) for various states in India reveals intriguing trends and implications. Across the nation, positive CAGRs in both Renewable and Thermal Energy signify a simultaneous growth in these sectors, indicating a complex energy landscape.

Graph 2: State wise CAGR for the Thermal Energy Pre Paris vs Post Paris for the period 2007-2022



Source: CEA, MOSPI and estimated by the author.

Graph 3: State wise CAGR for the Renewable Energy Pre Paris vs Post Paris for the period 2007-2022



Source: CEA, MOSPI and estimated by the author.

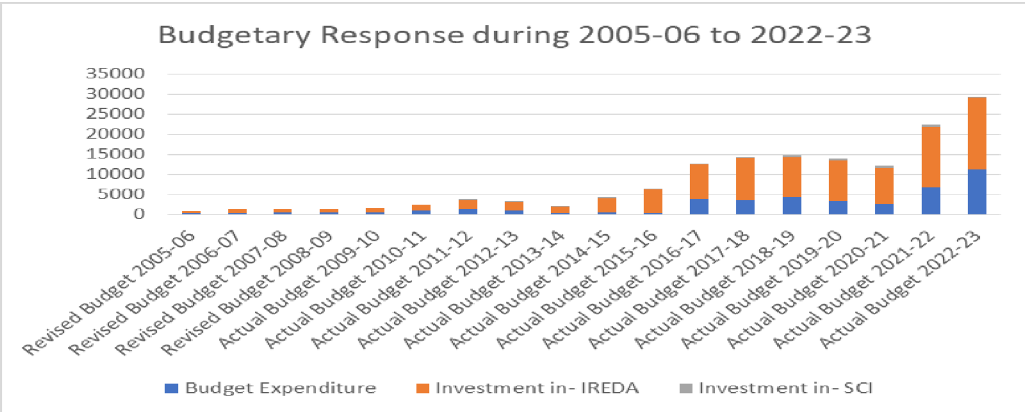
Several states in India, including Delhi, Haryana, Jammu & Kashmir, Punjab, Gujarat, Maharashtra, Telangana, Karnataka, Kerala, Lakshadweep, Puducherry, Tamil Nadu, Andaman & Nicobar, Bihar, Jharkhand, Odisha, West Bengal, Assam, Manipur, Meghalaya, and Tripura, exhibit a notable positive trend in Renewable Energy CAGR post-Paris Agreement. While some states show slightly lower CAGRs than the pre-Paris period, they are actively transitioning towards increased reliance on renewable energy sources, marking a significant shift from thermal energy.

Conversely, states such as Rajasthan, Uttar Pradesh, Uttarakhand, Chhattisgarh, Madhya Pradesh, and Andhra Pradesh are strategically expanding their energy capacity, simultaneously investing in both renewable and thermal energy sources. In these states, the CAGR of renewable energy surpasses that of thermal energy, indicating a deliberate move towards a more sustainable energy mix. Uttarakhand is the only state whose Post-Paris CAGR of thermal energy surpassed the CAGR of renewable energy.

At the national level, there is a substantial and encouraging decline in the trend of thermal energy, decreasing from 10.84% in the pre-Paris period to 1.92% post-Paris. Although there is a marginal decrease in the trend of renewable energy from 18.1% to 16.99% post-Paris, the latter figure remains robust and signifies a commendable commitment to sustainable energy practices. Overall, this analysis underscores the positive momentum towards renewable energy adoption in various states, contributing to India's broader goal of achieving a more sustainable and environmentally friendly energy landscape.

Budgetary Response From the Government of India

Graph 4: Budgetary reponse from the Union Government during the Period 2005-06 to 2022-23



Source: Annual Financial Statements of Ministry of Finance, GOI, and estimated by the author.

The budgetary allocations for the Ministry of New and Renewable Energy (MNRE), as well as investments in the Indian Renewable Energy Development Agency (IREDA) and Solar Corporation of India (SCI), reveal a compelling narrative of India's commitment to sustainable energy development. Before the Paris Agreement in 2015, MNRE's budget grew steadily at a CAGR of 4.06%. However, in the post-Paris period, there is a remarkable surge with a CAGR of 74.47%, indicating a substantial boost in financial support for renewable energy initiatives.

In terms of investments, the pre-Paris period saw IREDA experiencing robust growth at a noteworthy CAGR of 31.73%. Post-Paris, while the growth rate moderated to 16.9%, the consistent positive trajectory underscores continued support for renewable energy financing. Similarly, the Solar Corporation of India (SCI) demonstrated an extraordinary CAGR of 136.31% before 2015, highlighting the enthusiasm for solar energy projects. Post-Paris, the growth rate decreased to 2.82%, suggesting a more measured but still positive approach towards solar investments.

For the period of 2005-2022, MNRE's overall CAGR stands at an impressive 22.43%, reflecting a sustained commitment to bolstering the renewable energy sector. IREDA follows closely with a CAGR of 27.39%, signifying consistent growth in investment. SCI leads the pack with the highest CAGR of 38.75%, emphasizing a robust expansion in solar energy projects.

In conclusion, the budgetary response from the Government of India presents a compelling narrative of increased commitment to renewable energy, particularly in the post-Paris Agreement era. While the growth rates have moderated in some areas, the overall positive trajectory signifies a maturing but resilient renewable energy market. These investments underscore India's dedication to transitioning towards a greener and more sustainable energy future.

Correlation among Various Indicators

The correlation analysis focusing on Renewable Energy Install Capacity Generation (REIC) as the focusing variable reveals compelling insights into the relationships with various other variables. Notably, REIC exhibits a strong positive correlation (0.8553*) with the budget for renewable energy, suggesting that an increased financial commitment from the Indian government correlates with a substantial rise in the installed capacity of renewable energy generation. Moreover, REIC demonstrates very strong positive correlations with investments in the Institute of Renewable Energy and Development Authority (IREDA) (0.9558*), Solar Corporation of India (SCI) (0.8192*), and the total investment in public enterprises (TIPE) (0.9602*). These findings underscore the pivotal role of budgetary allocations and investments in influencing the growth of renewable energy capacity in India. The statistically significant correlations highlight the interconnected nature of financial decisions and their impact on the expansion of the renewable energy sector in the country.

Conclusion and Policy Recommendations

This research comprehensively examines India's evolution in sustainable energy, climate resilience, and fiscal commitments amid global changes, spanning over a decade with a focus on shifts pre and post-Paris Agreement. It provides nuanced insights into renewable energy capacity generation, fiscal policies, and climate finance interconnections. Fiscal policies play a pivotal role in shaping India's renewable energy sector, as highlighted by Compound Annual Growth Rate (CAGR) analyses, state-wise disparities, and substantial post-Paris financial commitments. State wise variations in energy generation patterns and reduced Thermal

Energy CAGRs post-Paris align with global climate goals. The correlation analysis underscores the interconnected nature of budgetary decisions and renewable energy capacity expansion, emphasizing the influential role of fiscal decisions. As India aims for net-zero emissions by 2070, this research contributes vital insights to ongoing sustainable energy transitions discourse. It stresses the need for tailored policies, international cooperation, and diversified financial mechanisms to bridge the climate finance gap. The paper suggests that policymakers must allocate budgets strategically, prioritizing sustained funding for MNRE and targeted investments in IREDA and SCI. Secondly, introduce state-specific incentives, including additional financial support, streamlined approval processes, and capacity-building initiatives to encourage lower-adoption states.

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Status of Rural Healthcare Infrastructure of North East States in India: An Inter-State Analysis

Manoj Kumar

The sustainable development goals (SDG) have been targeted SDG-3 were achieved by 2030, however, access to healthcare services in rural areas, especially the North East regions of the country, continues to be one of the major problems of healthcare delivery in Rural areas in India. The government of India and the state governments have initiated several healthcare schemes and sharp increased developed healthcare infrastructure since Independence, but there is still a large efficiency in improving rural and tribal health infrastructure. Against this backdrop, this paper aims to critically analyze and discuss the lack of rural health infrastructure and personnel in India with a focus on especially basic parameters of health, namely health profile, health infrastructure, health expenditure and health care Utilisation and we will check interdistrict disparities in health care sector at 8 predominant states (Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Manipur, Assam, Tripura and Sikkim) in detail. In this paper, data has been taken from the Rural Health Statistics Annual Report (RHS-2021-22) and the Population Census of the Government of India and other government agencies. objective of this study to analyze the current Status of Rural Human and Physical Healthcare Infrastructure in Health centers In North East Region in India.

Keywords: *SCs, PHCs and CHCs health centers, health infrastructure, health personnel, North east India.*

1. Introduction

Health is one of the most important indicators of the human development index after education and standard of living (UNDP). Good health not only provides a hygienic life but also provides better work efficiency in the labour market. The growth of the health care infrastructure is important for the enhancement of the economic development of a nation. a very long time, the main objective of most of the developing countries is to develop the health status of their citizens **(WHO,2000**). In a broad sense, it is a contributor to enhancing

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the expectancy of life and economic participation that leads to alleviation of poverty of a region. For any economic activities, infrastructure is necessary. So, it is defined, Infrastructure as the social capital or basic services of a country that make possible economic and social activities. There is a vast change seen in the twenty-first century in India, but still, the nation is deprived of its infrastructure development as compared to other nations of the world. Mainly the country still poor for its health sector compared with other developing countries of Asia i.e. China, Sri Lanka and Bangladesh. In the sense of health indicators like infant mortality, the life expectancy of birth, mortality under age five, India is still poor compared with the countries mentioned above. For the development of the health status of the citizens of the country, there is a need for adequate health care infrastructure. According to Rural Health Statistics (RHS), 2021-22, Govt. of India, the total number of Sub Centres (SCs) are161829(157935 rural + 3894 urban) and they are functioning. Similarly, 31053 Primary Health Centres (PHCs) is functioning in India (24935 rural + 6118 urban) and there are 6064 Community Health Centres (CHCs) (5480 rural + 584 urban) functional in the country. But the current numbers of SCs, PHCs & CHCs are not as per the **IPHS, 2012** norm.

2. Methods

The paper based on secondary data only. Data has been collected from different source such as Rural Health Statistics (RHS)- 2018-19 published by the Government of India Ministry of Health and Family Welfare Statistics Division, SRS Bulletin published by Office of The Registrar General, India, India HIV Estimates 2019 Report, published by National aids control organization, ICMR – National Institute of Medical Statistics, Ministry of health & family welfare government of India and Database of Government of India (https://data.gov.in) and Graphical method Used.

3.Analysis of Results

3.1Present Health Status of North-East India

The rural health care infrastructure of NER of India is still weaker than the states of the country. But after the implementation of NRHM, in 2005 there is a significant improvement seen in the region for its healthcare infrastructure. To analyze the current health status of NER, India the study focused on four indicators like- Birth Rate (BR), the Death rate (DR), Natural Growth Rate (NGR) and Infant Mortality Rate (IMR) of the region.

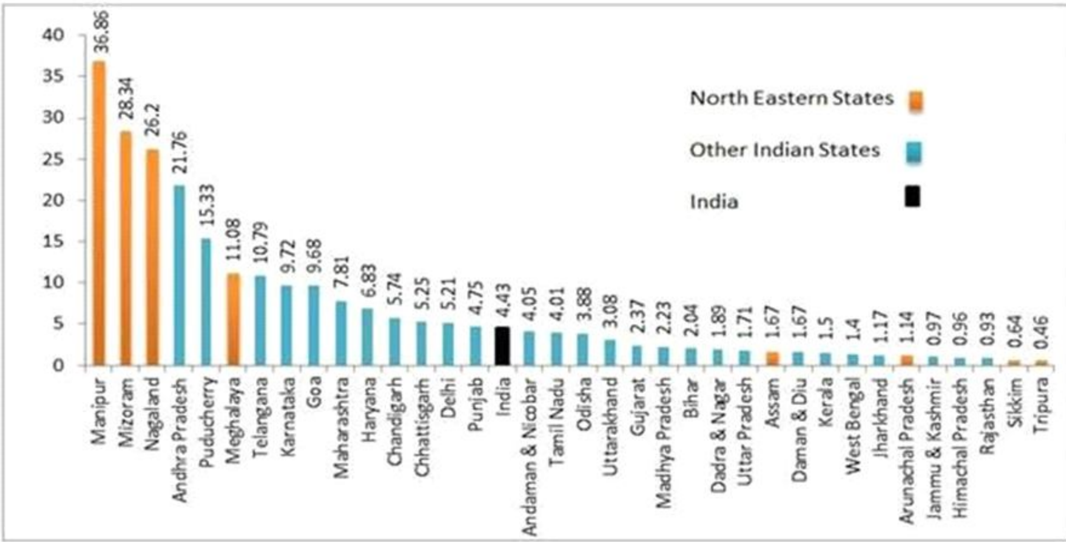
Table 3.1: Estimated Birth rate, Death rate, Natural growth rate and Infant mortality rate, 2017

States	BR			DR			NGR			IMR		
	T	R	U	T	R	U	T	R	U	T	R	U
ArunachalPradesh	18.3	18.8	15.5	6.1	6.4	4.9	12.1	12.4	10.6	42	44	34
Assam	21.2	22.4	14.7	6.5	6.7	5.3	14.7	15.7	9.4	44	46	21
Manipur	14.6	14.8	14.1	5.3	5.3	5.3	9.3	9.5	8.8	12	13	9
Meghalaya	22.8	24.8	13.7	6.1	6.3	4.8	16.7	18.5	8.8	39	41	25
Mizoram	15.0	17.7	12.2	4.0	4.0	4.1	11.0	13.8	8.0	15	20	7
Nagaland	13.5	14.0	12.7	3.6	4.2	2.7	9.9	9.8	9.9	7	7	7
Sikkim	16.4	15.2	18.3	4.5	5.3	3.4	11.9	9.9	14.9	12	13	9
Tripura	13.0	14.1	10.3	5.2	5.2	5.2	7.8	9.0	5.1	29	28	32
India	20.2	21.8	16.8	6.3	6.9	5.3	13.9	15.0	11.6	33	37	23

Note: Infant mortality rates are based on the three years 2015-17. Source: SRS Bulletin, Office of the Registrar General, India

The following Table 1 shows the four indicators that presented separately and categorized each of the indicators like- Total (T), Rural (R) and Urban (U). The total Birth rate of Assam and Meghalaya is more than of the national level (India). The same result happens in the case of rural birth rate also, but the only urban birth rate of all the states of north-east is lower than all India level (16.8). In the case of death rate, the total death rate of Assam (6.5) is higher than all India level (6.3). On the other hand, the rural death rate of all the states of NER is better to position in all India level (6.9) but in the case of urban death rate the states Assam and Manipur are in the same position with all India level (5.3) and the remaining six states are quite better positions than all India level. The natural growth rate of Assam and Meghalaya is greater than the national average also the same condition in the rural sector. But in urban NGR of Sikkim (14.9) is greater than all India average (11.6). In case of IMR the states Assam, Arunachal Pradesh and Meghalaya is shown the higher IMR than all India level (33) but the IMR of the remaining states is quite good than all India average. The state Nagaland is the most favored states with the lowest IMR (7) among all the states of NER, India. The rural IMR of Assam, Arunachal Pradesh and Meghalaya is also higher than all India average, but in the case of urban IMR the states Arunachal Pradesh, Meghalaya and Tripura are in bad position than all India average. It is also mentionable that, the rural IMR (37) of India is higher than urban IMR (23), resulted from an inadequate health infrastructure of rural India. The health status of North-East India cannot be equally treat- ed as shown in Table 1. This is because of the inadequate development of the health infrastructure or its unavailability of adequate manpower in the health sector. Poor conditions of health infrastructure of the country mean, there is a problem of non-availability of free medicines for rural poor, non- availability of good doctors and lack of the sufficient number of government hospitals in rural areas of the country.

Figure 3.1: AIDS Mortality by State/UT, 2019 (per 100,000 populations).



The graph is shows, AIDS-related mortality of India at 4.43 per 100,000 population in India. State-wise AIDS-related mortality per 100,000 population. the three north-eastern states estimated to be in highest position all over India i.e. – Manipur (36.86), Mizoram (28.34) and Nagaland (26.2). This means inadequate health awareness of AIDS disease among the citizens of the states. Similarly, Meghalaya (11.08) is also in the fifth position after Andhra Pradesh (21.76) and Pondicherry (15.33). On the other hand, it is reflected in the figure; the states Assam (1.67), Arunachal Pradesh (1.14), Sikkim (0.64) and Tripura (0.46) are somewhere is in a better position and below the level of all India average (4.43). India HIV Estimates report 2019 also mentioned that the HIV-AIDS detected persons are gradually increasing all over the country. So, it is a major concern for all human being. In this regard, there is a need for sufficient health infrastructure in the region as well.

3.2 Rural Healthcare Infrastructure of North- East State India

In Indian healthcare system is three-tire healthcare system. Sub-Centers, Primary health centers and Community health centers. These are located and establish at rural and urban areas basically Rural areas and main objective of SCs are assigned tasks relating to interpersonal communication to bring about behavioral change and provide services in different Programme like maternal and child health, family welfare, nutrition, immunization, diarrhea control and communicable diseases as well as non-communicable diseases and facility are provide in Rural villages this are establish 5000 population in plain areas and 3000 population in Hilly areas(IPHS, 2012). PHC is the first contact point between village community and the medical officer. The PHCs were envisaged to provide an integrated curative and preventive health care to the rural population with emphasis on preventive and primitive aspects of health care and PHCs has established on 30000 population in plain areas and 20000 population in hilly areas in India. CHC is required to be manned by four medical specialists i.e. Surgeon, Physician, Obstetrician/Gynecologist and Pediatrician supported by paramedical and other staff (See Annexure-I for IPHS norms). It has 30 in-door beds with one OT, X-ray, labour room and laboratory facilities. It serves as a referral center for 4 PHCs and provides facilities for obstetric care and specialist consultations it provides facility at block and tehsil level and CHCs has establish on 120000 population in plain areas and 80000 population in hilly areas in Rural India (RHS, 2022).

Table 3.2 Average rural population and total functioning Health centers and covered by SCs, PHCs and CHCs

NE State	Mid-Year R. Population2022	SCs	PHCs	CHCs
ArunachalPradesh	1156000 (0.13)	3256(355)	9175(126)	20281(139)
Assam	29996000 (3.34)	6427(4667)	32604(920)	174395(172)
Manipur	2168000 (0.24)	5517(393)	29297(74)	271000(8)
Meghalaya	2640000 (0.29)	5752(459)	21639(122)	94286(28)
Mizoram	555000 (0.061)	1850(300)	9737(57)	61667(9)
Nagaland	1222000 (0.135)	2816(434)	9473(129)	53130(23)
Sikkim	357000 (0.0397)	2459(147)	14875(24)	178500(2)
Tripura	2533000 (0.28)	2650(956)	23454(108)	120619(21)
All India(RP)	**898870000 (100)**	**5691(157937)**	**36049(24935)**	**164027(3480**

Note*: The percentage share of the population to the total Rural population in India.

Source: Rural Health Statistics 2021-22, Ministry of health and family welfare, Govt. of India

The table is showing the rural population of all the NE states in the year 2022 (SRS, 2022). It also shows the average population covered by the health services of those states. In the case of SCs, only Assam is in a better position than the national average. Similarly, the conditions of PHCs of all the NE states are very poor and it was lower than the national average. On the other hand, in the case of CHCs, only Sikkim is in a better position than the national average. The table is shows total population covered by per one Health center and in the brackets are shows total number of health centers in the states.

3.3 Status of Manpower in Rural Health Centers (SCs, PHCs and CHCs) in North East State

Healthcare infrastructure will not be sufficient if adequate manpower is not available to provide the services. Basically, it is called physical and Human Health infrastructure. The states of the North-East are in a good position for its female health workers/ ANMs in rural SCs excluded Sikkim and Tripura. There is a shortfall of 24 and 388 of these two states (Saikia 2014: 83-99). But the other states of the region are having surplus female workers in SCs of rural areas as per IPHS norms.11 In the case of male health worker in rural SCs, there is a huge deficiency shown all over the country including NER. Similarly, the availability of doctors, health workers in PHCs are also very important. Because the people of rural areas preferred the PHCs and SCs as their first choice if they facing general health- related problems. The following Table 3.3 shows the present status of rural PHCs, SCs and CHCs of NER in terms of their availability of doctors and other health workers as per IPHS norms.

Table 3.3 Availability and shortfall of Health Manpower in SC, PHC and CHCs in NE

State	HW (ANM) at PHC &SC			Doctor at PHCs			Specialist at CHCs			Radiographers atCHCs		
	R	P	Shortfall/*	R	P	Shortfall/*	R	P	Shortfall/*	R	P	Shortfall/*
Arunachal Pradesh	481	57	*	126	129	*	228	11	217	57	18	39
Assam	5587	8854	*	920	1381	*	688	179	509	172	93	79
Manipur	467	933	*	74	308	*	32	18	14	8	7	1
Meghalaya	581	1131	*	122	171	*	112	5	107	28	21	7
Mizoram	357	312	45	57	57	0	36	0	36	9	4	5
Nagaland	563	1319	*	129	130	*	92	9	83	23	2	21
Sikkim	171	319	*	24	38	*	8	0	8	2	4	*
Tripura	1064	649	415	108	236	*	84	3	81	21	12	9
All India	**182870**	**207587**	**6443**	**24935**	**30640**	**776**	**21920**	**4485**	**17435**	**5480**	**2448**	**3206**

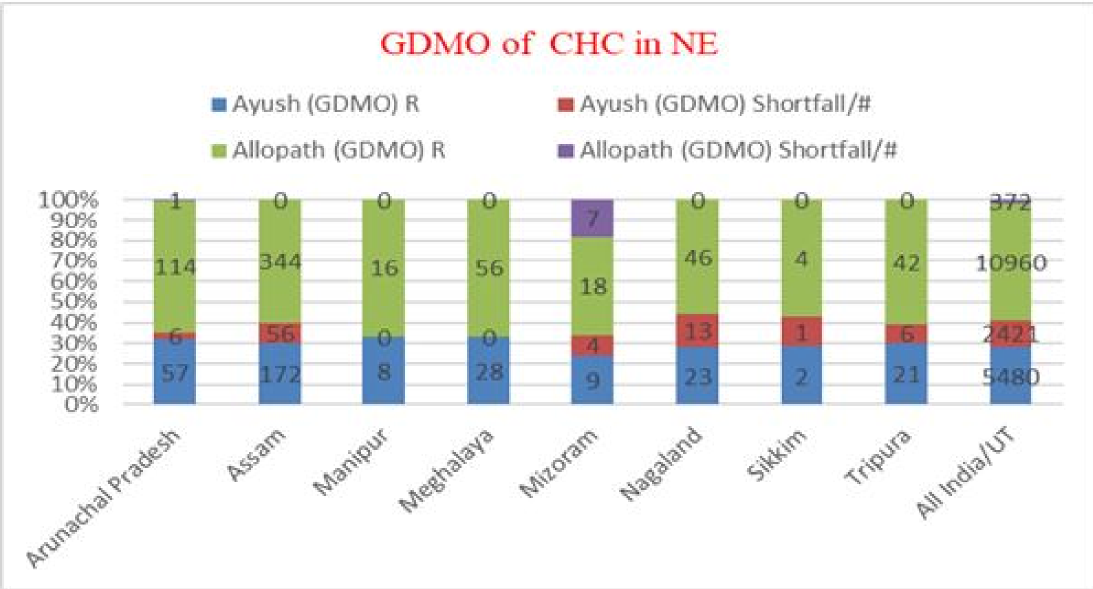
Note: **1 health worker each PHC, 2 doctors (Allopath & Ayurved) each PHC, 4 Specialist (Ob& gynecologist, Surgeon, physicians, and Pediatricians) each CHCs. R. required, P. in position, S. shortfall. *.Surplus. 1 Radiographers each CHCs.**

Continue——————-

State	Pharmacist at PHCs &CHCs			Laboratory Technicians atPHC s & CHCs			Nursing staff at PHCs& CHCs		
	R	P	Shortfall/S*	R	P	Shortfall/S*	R	P	Shortfall/S*
ArunachalPradesh	183	92	91	183	146	37	2115	3949	*
Assam	1092	1363	*	1092	1302	*	2124	3563	*
Manipur	82	163	*	82	113	*	130	405	*
Meghalaya	150	183	*	150	198	*	318	799	*
Mizoram	66	33	33	66	73	*	120	213	*
Nagaland	152	116	36	152	125	27	290	423	*
Sikkim	26	22	4	26	47	*	38	145	*
Tripura	129	163	*	129	150	*	255	683	*
All India/UT	**30415**	**27135**	**5423**	**30415**	**22772**	**8050**	**63295**	**79933**	**5472**

Note: one Pharmacist per each PHCs & CHCs, one laboratory Tech. per each PHC & CHC. One Nurse per PHC and 7 nursing staff per CHCs. **Source:** RHS, 2022, Ministry of Health &Family Welfare (MoHFW), Govt. of India. * Surplus. This table 3.3 data is showing status of health manpower of All the Health centers in Rural north east state India. Female health worker in PHC and SC are sufficient in PHC and SC excluded Tripura (415) and Mizoram (45) and other state in Surplus and shortfall of India level is 6443. Shortfall of Doctors at PHC is not in north east State this is good news for north east state but India level shortfall is 776 Doctors lacked and Assam (461) , Manipur (234), Meghalaya(49) Sikkim(14) and Tripura (128) are in Excess Doctors in PHCs. While short fall of Specialist (4 Doctors) in CHCs very poor conditions of in north east state showing had table. The radiographer's status in CHC is given also shortfall in the all-NE state excluded Sikkim (*). While shortfall of Pharmacist in PHC and CHCs Arunachal Pradesh (91) Mizoram (33) Nagaland (36) and Sikkim (4) are facing Lacking and Inadequate problems of availability of Pharmacist in Health cantres and other states are in Good/ Surplus conditions but shortfall on India Level is 5423. In the case laboratory technicians all the states of NER have an adequate number of manpower and it is a positive sign for the health sector of the region but Arunachal Pradesh (37) and Nagaland (27) are facing Shortfall the status of Nursing staff at PHC and CHCs in North east region is very sufficient and Surplus no any shortfall of this region. So, all over in Some state like Mizoram, AP, Nagaland Sikkim are Facing problem of unavailability of Pharmacist in the health centers and all the NER is facing short fall o Radiographers at PHC and CHCs.

Figure 3.2: Shortfall and Status of General Duty Medical Officer (GDMOs) in CHCS in NER



Source: RHS, 2021-22, Ministry of Health and Family welfare, Govt. of India. 0/# = Surplus. 1 GDMO (Ayush) and 1 GDMO(Allopath) on Each CHC, IPHS, 2012. R= Required

This figure is showing the shortfall of General Duty Medical Officer at Health centers on NER. Actually GDMO are working in CHCs and their work had given the training of CHCs Doctors in day by day. In figure 3.2 are shows Required and shortfall with Surplus of GDMO. Arunachal Pradesh (1), Mizoram (7) have an inadequate number of General Duty Medical Officers- A allopathic and other state have Surplus number. In the case of Ayush GDMOs shortfall Arunachal Pradesh (6), Assam (56) Nagaland (13), Tripura(6) and Mizoram(4) have an Inadequate no. of GDMO.

Table 3.4: Shortfall of SCs, PHCs and CHCs as per estimation of the mid-year population (as of 1st July 2022) in rural areas of North-East India

State	Mid-Year Population 2022	SCs			PHCs			CHCs		
		R	P	Short/#	R	P	Short/#	R	P	Short/#
Arunachal Pradesh	1156000	345	355	#	52	126	#	13	57	#
Assam	29996000	6546	4667	1879	1068	920	148	267	172	95
Manipur	2168000	546	393	153	86	74	12	21	8	13
Meghalaya	2640000	845	459	386	127	122	5	31	28	3
Mizoram	555000	182	300	#	27	57	#	6	9	#
Nagaland	1222000	395	434	#	59	129	#	14	23	#
Sikkim	357000	68	147	#	14	24	#	3	2	1
Tripura	2533000	645	956	#	101	108	#	25	21	4
AllIndia/UT	**898870000**	**193310**	**157935**	**48060 (25%)**	**31640**	**24935**	**9742 (31%)**	**7894**	**5480**	**2852 (36%)**

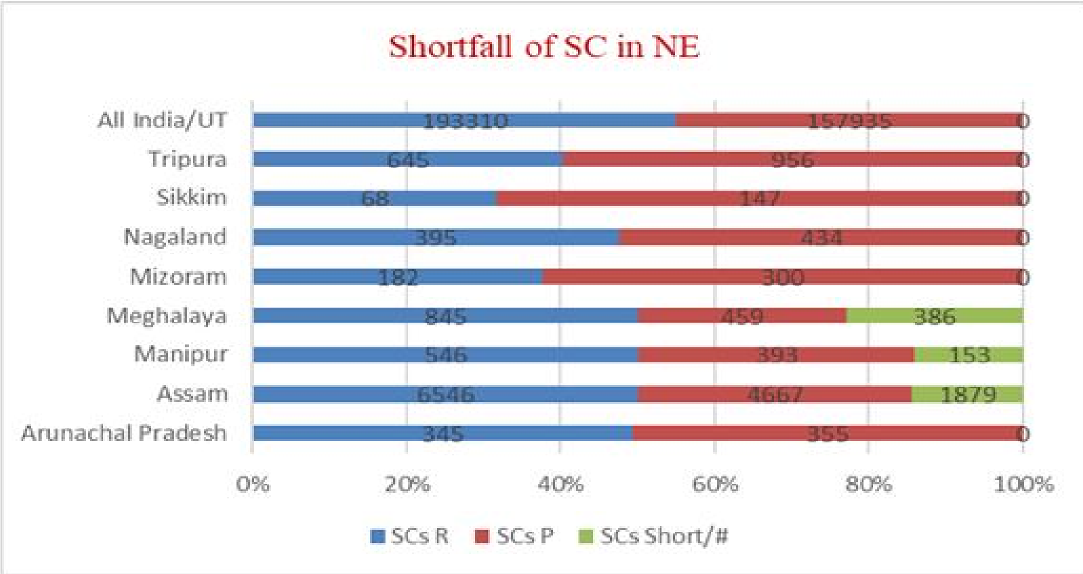
Notes: The requirement is calculated using the prescribed norms based on rural population estimation for mid-year for the year 2022.

R: Required; P: In Position; S: Shortfall; #: Surplus

Source: Rural Health Statistics 2021-22, Govt. of India, SRS, 2022.

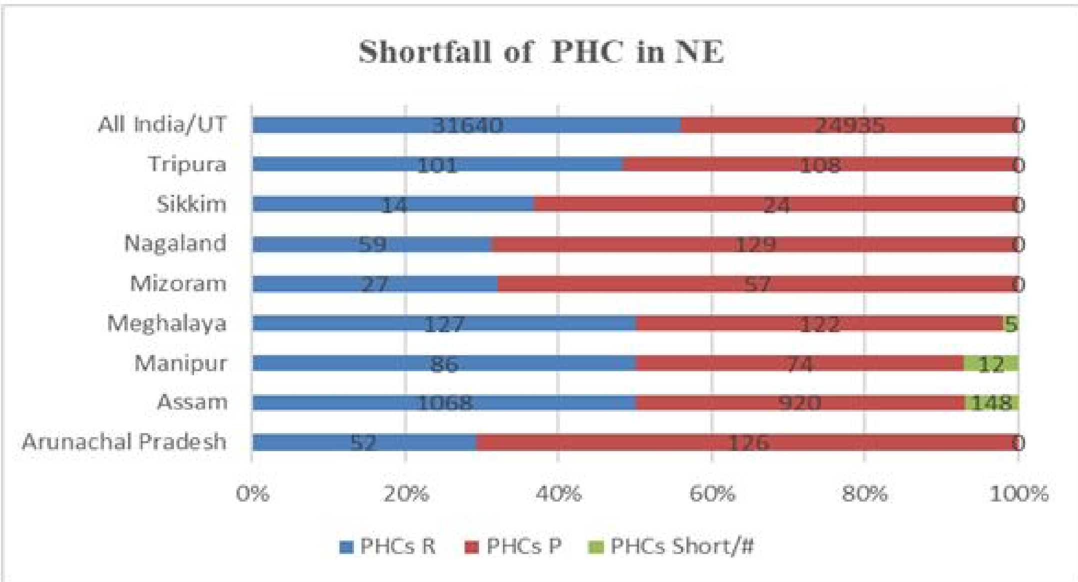
This table are shows the SCs in rural areas of Assam, Manipur, and Meghalaya still inadequate with the size of its population and shown a shortfall of rural SCs 1879, 153, 386 respectively. But the state Arunachal Pradesh, Mizoram, Nagaland, Sikkim, and Tripura have surplus SCs. Similarly, Assam, Manipur and Meghalaya have a shortfall of rural PHCs 148, 12 and 5 respectively but the other states of NER have in a better position with surplus values. In the case of CHCs, the states Assam, Manipur, Meghalaya, Sikkim and Tripura is facing a problem of unavailability of sufficient community health Centres. From this analysis, it is noticeable that the state Assam, Manipur and Meghalaya have a short- fall of all three types of healthcare infrastructure in the rural areas of those states. In the case of Assam, the health status of the rural areas is poorer than the urban areas. In the case of all India level, there is also a huge shortfall seen in all three categories CHCs (36%), PHCs (31%) and SCs (25%). It is implied that the health infrastructure of the country was still inappropriate.

Graph 3.1: Shortfall of SCs in North East State in India

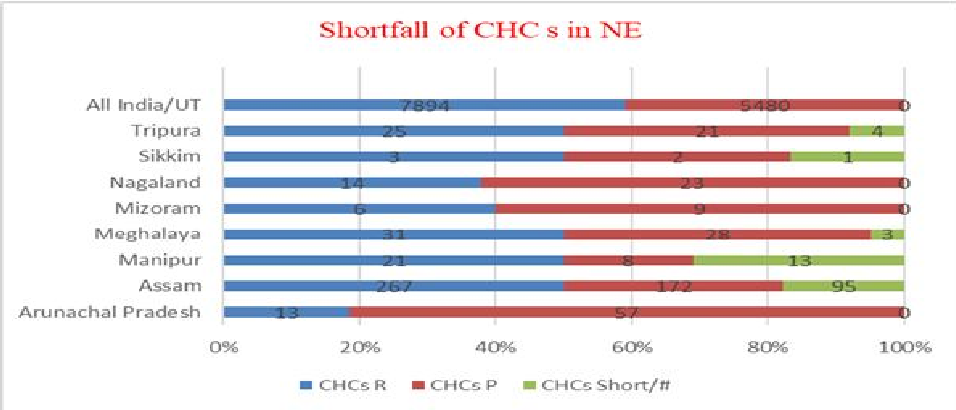


Source: RHS, 2021-2022, MoHFW, Govt of India.

Graph 3.2: Shortfall of PHCs in North East India



Graph 3.3: Shortfall of CHCs in North East India



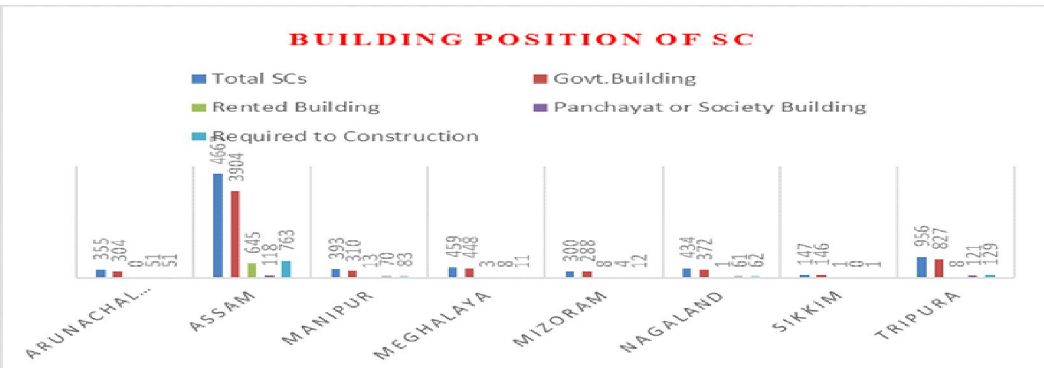
Source: Rural Health Statistics, 2021-2022., MoHFW, Govt. of India

Graph 3.1 is showing the shortfall of Sub centers in Rural Areas of north east India. Green color is presented Three state Meghalaya Manipur and Assam have huge lag of Unavailability of SCs and Other states in surplus and Good conditions According to Rural population NE. while in PHCs also Unviability Problem in Respective States (Graph 2). Condition of CHCs in states Tripura Sikkim Manipur Meghalaya and Assam are Facing Lack of Availability of CHCs (graph 3). Finally, the conclusion of this graph Manipur Assam and Meghalaya are facing problem in All the Health centers.

3.4 Status of building positions of the Rural health Centers in North East India

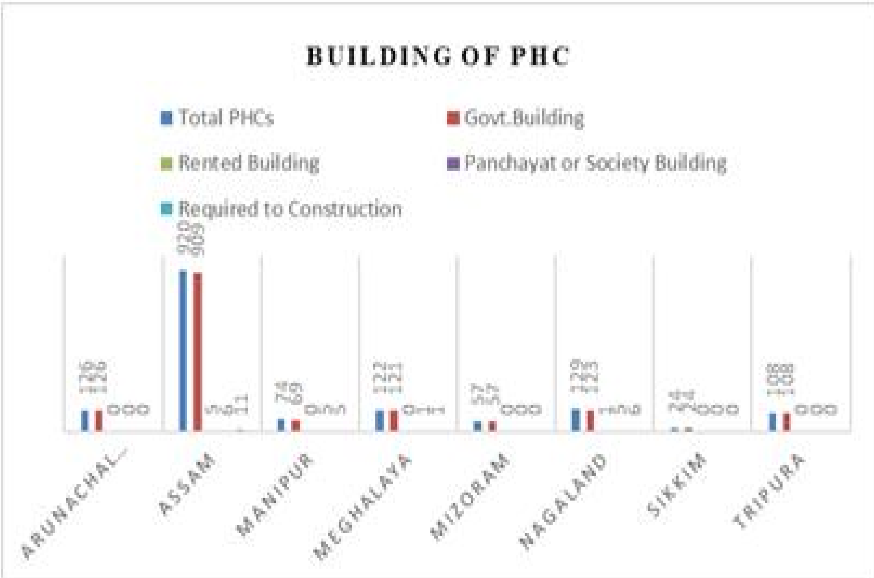
In India s health care system are three tier SC, PHC and CHC in Functioning in Three type building Government building, rented building and Free rented Panchayat and society building. in below the current building position of SC, PHC and CHC in Rural areas in north east India.

Figure 3.4: Building Position of Rural Sub- Centers in North East State



In this figure shows Arunachal Pradesh, Mizoram and Sikkim have an adequate number of government buildings. On the other hand, there is a deficiency of government buildings in other states of NER that accept these three states. Assam has the highest deficiency of buildings and required around 763 buildings. This has resulted in Assam; a government package is required to construct new buildings in rural areas mainly for SCs. In India need 48804 Building required.

Figure 3.5: Building Position of Rural PHCs in North East State



All the north east state PHCs building are in governmental and only Assam and Nagaland has deficiency of govt. Building. In India 2229 Building are required in Rural area of NE.

As per rural health statistics 2021-22, accept Arunachal Pradesh, Mizoram, Sikkim and Tripura all the states of northeast India have the sufficient number of Govt. building in rural PHCs. There is a shortfall of building in Nagaland (6), Assam (11) and Manipur (5). Overall, the northeastern states are in a better position in the case of buildings of their PHCs.

Figure 3.6: Building Position of CHCs in North East State

Notes: Required number of building to be constructed = Total functioning - (Government Buildings + Under construction) (ignoring States having excess.)

Source: Rural Health Statistics 2021-22, Govt. of India.

In figure 3.6 is showing all the North-Eastern states there is a sufficient number of Government CHC buildings and Total CHCs Functioning in Government building not any Rented or Panchayat building see can Figure. basic infrastructure facilities in the case of buildings in all the states of NER are in a better position.

4. Discussion

The health care infrastructure condition in Health centers in North East region is very poor and some of the states of this region do not have an adequate number of SCs, PHCs and CHCs, particularly in rural areas. It has also a shortfall in terms of availability of doctors, nursing staffs etc (**Saikia, and Das, 2016, Gogoi, 2021**). But in this paper has found infrastructure of manpower in NE have sufficient but Specialist Doctor and Radiographers at CHC and PHC Huge Shortfall Specially Arunachal Pradesh 217 Dr. and 39 Radiographers, and Assam 509 Dr. and 79 Rediog.it is very Bad conditions. And other variable like Laboratory technicians Nursing staff and Pharmacist have Sufficient and Surplus.

5. Conclusion

There is a vast change in healthcare infrastructure in the twenty-first century in India, but still the nation in general and the North-eastern region, in particular, is deprived of its healthcare infrastructure development. NER of India has a shortfall of an adequate number of SCs, PHCs and CHCs particularly in rural areas as compared to the national average. The study found that the improvement of health care infrastructure Like Healthcare manpower specialist Doctors and Radiographers at CHC in NER of India is unequal and therefore it is unsatisfactory. More and more Needed improvement in Arunachal Pradesh, Assam, Nagaland Tripura. While Budling Positions of Health Centers in North Eastern Region most of the Health Centers Building Are government at SCs and PHCs But in Arunachal Pradesh, Assam and Manipur, Mizoram, Nagaland and Tripura Building Under Construction. And all the CHC Building are working in the Government Building in all the North East State so this is Very Good sign of Development of Health infrastructure. Finally, The suggestions for Improvement urgent need to take some policies by the government to establish some new SCs, PHCs in rural parts of the northeastern region of India and also the existing infrastructure needs to be improved Manpower through increasing the number of health workers with proper train. Otherwise sustainable development goal 3 related to improvement in health which is targeted by 2030, will not be achieved Indian Government.

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Climate Change and its Impact on Agriculture, Health, Livelihood and its Solutions

Dr. Pragya Boudh

Introduction

The word "climate" is propounded from its roots in Greek, originally which means stemming from the word "klinein," meaning to lean. The Ancient geographers believed that the world could be divided into seven distinct zones based on the slope or inclination of the northern celestial pole as one moved north from the equator. The Greek word "klima" refers to inclination, slope or latitude, so these zones were called "klimata."

Climate change refers to the long-term shifts in temperatures and weather patterns. These shifts can be natural and this can occur due to changes in the sun's activity or large volcanic eruptions. But it has been observed that since the 1800s, human activities are the main driver of climate change, primarily due to the burning of fossil fuels like oil, gas and coal. Burning of fossil fuels generates greenhouse gas emissions which acts like a blanket wrapped around the Earth which traps the sun's heat and raises the temperature. The main greenhouse gases that cause change in climate includes carbon dioxide and methane. These gases are formed from using gasoline for driving a car or by using coal for heating a building, for example. Clearing of land and cutting down of forests also releases carbon dioxide. The major sources of methane emission is Agriculture, oil and gas operations. The main sectors causing greenhouse gases are Energy, industry, transport, buildings, agriculture and use of land etc.

People are experiencing climate change in diverse ways. First of all, Climate change can affect health, ability to grow food, housing, safety and work of the people. Some of the people are already more vulnerable to climate impacts, such as people living in the small islands, nations and other developing countries. Conditions like rise in the sea-level and the intrusion in saltwater has advanced to the point where whole communities have to relocate, and protracted droughts are putting people at risk of famine. In the future, the number of people displaced by weather-related events is expected to rise.

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Every increase in global warming matters UN reports mentions that thousands of scientists and government reviewers agreed that limiting global temperature gives rise to no more than 1.5°C which would help us to avoid the worst climate impacts and maintain a liveable climate. The emissions that causes climate change comes from every part of the world which affect each and every one, but some countries are responsible to produce much more emission than others. The seven biggest emitters countries alone are China, the United States of America, India, the European Union, Indonesia, the Russian Federation, and Brazil accounts for about half of all global greenhouse gas emissions in 2020. It is responsibility of everyone to take climate action, but people and countries which are creating more emission problem have greater responsibility to act first.

We are facing a huge challenge and we already know about the solutions also but the time has come to act on it. Many climate change solutions can bring economic benefits which can improve our lives and can protect the environment. We have global frameworks and agreements to guide our progress, such as the Sustainable Development Goals, the UN Framework Convention on Climate Change and the Paris Agreement. These three broad categories of action are: cutting emissions, adapting to climate impacts and financing required adjustments. Switching our energy systems from fossil fuels to renewables like solar or wind will reduce the emissions driving climate change. But we have to act now. While a growing number of countries is committing to net zero emissions by 2050, emissions must be cut in half by 2030 to keep warming below 1.5°C. Achieving this means huge declines in the use of coal, oil and gas: over two-thirds of today's proven reserves of fossil fuels need to be kept in the ground by 2050 in order to prevent catastrophic levels of climate change. Adapting to climate consequences protects people, homes, businesses, livelihoods, infrastructure and natural ecosystems. It covers current impacts and those likely in the future. Adaptation of these policies and solution will be required everywhere, but must be prioritized now for the most vulnerable people with the fewest resources to cope with climate hazards. The rate of return can be high. Early warning systems for disasters, for instance, save lives and property, and can deliver benefits up to 10 times the initial cost.

Impact of Climate Change on Agriculture

Climate is most important determinant of crop productivity, particularly in country like India, where about 2/3rd of the cultivated area is rainfed. Climate change, therefore, is of serious concern having large scale impacts, directly and indirectly on agriculture. It is manifested with increase in global temperature, increased intensity of rainfall, rising sea level, melting of glaciers, shifting of crop growing season and frequent occurrences of extreme events such as drought and flood.

Agriculture is crucial for ensuring food, nutrition and livelihood securities for India and it engages almost two- third of the workforce in gainful employment. On account of its close linkages with other economic sectors, agriculture growth has multiplier effect on the entire economy of the country. Although in the past years, Indian agriculture had made a significant progress, but it currently it is facing many challenges. Agriculture is very sensitive to weather and climate.[1] It also relies heavily on land, water, and other natural resources that climate affects.[2] While climate changes (such as in temperature, precipitation, and frost timing) could lengthen the growing season or allow different crops to be grown in some regions,[3] it will also make agricultural practices more difficult in others. The effects of climate change on agriculture will depend on the rate and severity of the change, as well as the degree to which farmers and ranchers can adapt.[4] India has to make many practices in order to adapt to a changing climate, including crop rotation and integrated pest management.

Impact of Climate Change on Agriculture

Climate change can affect agriculture at both local and regional scales. Impact of Climate Change on agriculture is described in this section.

1. Changes in Agricultural Productivity

Climate change can make conditions better or worse for the growing crops in different regions. For example, changes in the temperature, rainfall, and frost-free days are leading to longer growing seasons in almost every state.[5] A longer growing season can have both positive and negative impacts for raising food. Some farmers may be able to plant longer-maturing crops or more crop cycles altogether, while others may need to provide more irrigation over a longer time period for hotter growing season. Air pollution may also damage crops, plants, and forests.[6] For example, when plants absorb large amount of ground-level ozone, they experience reduced photosynthesis, slower growth, and higher sensitivity to diseases.[7]

Climate change can also increase the threat of wildfires. Wildfires pose major risks to farmlands, grasslands, and rangelands.[8] Temperature and precipitation changes will also very likely expand the occurrence and range of insects, weeds, and diseases.[9] This could lead to a greater need for weed and pest control. [10]

Pollination is vital to more than 100 crops grown in India.[11] Warmer temperature and changing precipitation can affect when plants bloom and when pollinators, such as bees and butterflies, comes out.[12] If mismatches occur between when plants flower and when pollinators emerge, pollination could decrease.[13]

2. Impacts to Soil and Water Resources

Climate change is expected to increase the frequency of heavy precipitation which harms the crop by eroding soil and depleting soil nutrients.[14] Heavy rains can also increase agricultural runoff into oceans, lakes, and streams.[15] This runoff can harm water quality.

When coupled with warming water temperatures brought on by climate change, runoff can lead to depleted oxygen levels in water bodies. This is known as hypoxia. Hypoxia can kill fish and shellfish. It can also affect their ability to find food and habitat, which in turn could harm the coastal societies and economies that depend on those ecosystems.[16]

Rise in the sea level and storms pose threats to coastal agricultural communities. These threats include erosion, agricultural land losses, and saltwater intrusion, which can contaminate water supplies.[17] Climate change is expected to worsen these threats.[18]

3. Health Challenges to Agricultural Workers and Livestock

Agricultural workers face several climate-related health risks which includes exposure to heat, sunstroke and other extreme weather, more pesticide exposure due to expanded pest presence, disease-carrying pests like mosquitos and ticks, and degraded air quality.[19] Language barriers, lack of health care access, and other factors can compound these risks.[20] Heat and humidity also affect the health and productivity of animals raised for meat, milk, and eggs.[21]

Climate Change and Human Health

Climate change brings a significant and emerging threat to public health today. The World Health Day – 2008 theme "Protecting health from climate change" raises the profile of health dangers posed by global climate variability and change. It was observed that climate change presents growing threats to international public health security. As temperature and precipitation pattern changes, the delicate balance of climate, weather events and life also get disrupted. Although few people are aware of the impact climate change but many may have on their health, the health effects are serious and widespread due to climate change i.e. Disease, injury and death can result from climate-induced natural disasters, heat stress and strain, air and water pollution. Children, the poor, the elderly, and those with a weak or impaired immune system are especially affected by climate change.

Climate change and air pollution is a serious matter concern all over the world in the last few decades. Presently, it has been reviewed that Indian cities with significant impacts of both the climate change and air pollution on human health is a matter of serious concern which should now be taken into consideration. The expansion of urban areas with extreme climate events like high rainfall, extreme temperature, floods, and droughts are posing human health risks day by day. The intensified heat waves caused by climate change has led to the elevation in temperature levels which causes thermal discomfort and several health issues to the people living in urban areas. It has also been observed that in Indian Megacities the level of air pollution is above the prescribed standards. The particles of aerosols inhaled by humans enter the respiratory system causes hazard to human health. The air quality during COVID-2019 lockdown in Indian cities with its health impacts is the biggest example of climate change. India's inadequate health systems makes the population of the country particularly vulnerable to the impact of climate risks on health. Climate change affects health directly, causing more sickness, death and impaired immune system. In more indirect ways, it affects nutrition, reduces working hours, and increases climate-induced stress.

Some of the major steps that need to be taken to reduce the impact of climate change on human health includes

1. Enhancing the capacity of society to adapt with the environment and people with impaired immune system should boost their immune system.
2. To undertake coordinated Research and development to unfold the climate and health nexus to device with appropriate medicines suggested.
3. Other protective measures should be taken to improve the human health.
4. Upscale health infrastructure and manpower to deal with the challenges posed by temporal and spatial spread of climate inflicted diseases, etc. Some of these steps can yield benefits for our health, environment, economy, and society.

Impact of Climate Change on the Livelihood of the People

Climate change has worsened the situation in some parts of the world that are already experiencing high levels of food insecurity. Greater variability of rainfall has significant repercussions for food security, the livelihoods of millions of people, and the migration decisions of vulnerable households. In order to make informed decisions about adaptation planning, development, and a transition to a more climate resilient future, policymakers need a better understanding of the linkages among changes in the climate, household livelihood and food security profiles, and migration decisions. Climate change has affected human life, especially the life of the farmers in rural areas. Farmers livelihoods are very dependent on the climate so that their socio-economic life becomes vulnerable. If there is a risk of crop failure, the community becomes vulnerable to poverty and hunger. The Economic Survey 2018 has flagged the impact of Climate Change on agricultural incomes. Rising temperature, prolonged period of droughts, flood and shifting of climatic zones are endangering the cropping system. The poor and marginal farmers are often the most affected by climatic variability. It adversely impacts agriculture, fisheries and forestry thereby limiting production which affects availability of food. Declining of production and diminishing resources also impact marketable surplus and access to market. Extreme weather events have caught attention of agrarian experts and scientists and practitioners alike and they are intensively focussing on natural farming, effective adaptation and coping strategies to arrest the impacts of climate change. The Conference on Climate change and its impact on livelihood will provide platform to interact with experts and participate in panel discussion on evidence of climate change, impact of climate change and effective adaption and coping strategies. agriculture and forestry more sustainable and more resilient to climate change. Also, it would cover how people can adapt to water shortages and flooding through land management and technological solutions i.e. improved water treatment and it will cover the way in which risks and uncertainties of climate change could be addressed by building societies, ecosystems and infrastructure that are resilient to environmental and socio-economic changes. It may include risk and uncertainty assessment, scenario development and planning, participatory modelling and nature-based solutions.

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Impact of Health Hazards on Maternal Mortality Due to Changing Climate Pattern

Neelam Katiyar and Dr. Alpana Srivastava

Abstract

Maternal mortality is greatly affected by health hazards, thereby putting women's health at risk during pregnancy, at childbirth, and in the postpartum period. These dangers consist of various aspects such as medical complications, social inequalities, lack of easy access to healthcare, and cultural beliefs. Appreciating the impact of these hazards is vital for devising effective actions on curbing maternal mortality rates worldwide.

Health risks are among the leading factors for maternal deaths because they result from instances like hemorrhage, hypertensive disorders, infections or obstructions. If left unattended, there could be severe consequences on health or even death. For example, obstetric hemorrhage remains one of the major causes of maternal deaths due to its high occurrence all over the world which stresses on the importance of emergency obstetric care and timely interventions and referral. Again, ill health caused by risks also leads to poor management of pre-existing conditions and complicates pregnancy-related challenges. Chronic diseases including diabetes, hypertension or heart diseases increase chances of maternally dying by rendering pregnancies risky processes besides making medical solutions.

Another element that strongly affects maternal mortality is socioeconomic disparities, limited accessibility of care services, poverty and lack of education. In some regions, differences among access to skilled birth attendants; emergency obstetric care; and necessary medications cause avoidable maternal deaths. Maternal mortality rates are also influenced by cultural beliefs and practices about childbirth. Women should be discouraged from opting traditional birthing methods, preference for home births without skilled attendants and stigma surrounding maternal health issues.

In conclusion, the impacts of health hazards on maternal mortality are multiple-layered as well as intricate involving medical factors, social backgrounds, economics conditions and cultural aspects. To address this issue, comprehensive strategies are required which prioritize quality healthcare access, education, and empowerment of women as well as culturally

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appropriate interventions targeted towards various population categories. By addressing health hazards effectively, we can work towards reducing global levels of maternal mortality while also improving outcomes related to the condition.

Key Words: *Maternal mortality, health hazards, climate change, lifestyle*

I. Introduction

A. Background and addressing health hazards: WHO defines Maternal mortality as "death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management (from direct or indirect obstetric death), but not from accidental or incidental causes".Despite advancements in healthcare, maternal mortality rates vary significantly across regions, with disparities particularly pronounced in low- and middle-income countries.

Maternal mortality is highly threatened by health hazards, which include infectious diseases, environmental factors, lifestyle choices and barriers to healthcare access. This exaggerates the rate at which mothers die during child birth hence the need for extensiveinterventions.

B. Purpose of the paper: This article seeks to analyze how different health risks contribute to maternal deaths, highlighting their causes and suggesting ways to manage them. Through this understanding, policymakers can come up with targeted interventions that would help reduce maternal deaths worldwide.

II. Overview of Maternal Mortality

A. Definition and measurement: Maternal mortality is measured by maternal mortality ratio (MMR). MMR is defined as "number of maternal deaths during a given time period per 100,000 live births during the same time-period".

B. Global trends and disparities: Although there are large disparities between regions in regard to MMR; Sub-Saharan Africa and South Asia have been most affected. Variations in terms of access to healthcare facilities, socio-economic status as well as education lead into these differences.

C. Leading causes of maternal mortality: Major causes of maternal mortality globally include anemia, unsafe abortions, pre-existing medical conditions ante/post-partum hemorrhage, obstructed labor, hypertensive disorders of pregnancy, co-morbidities, infections, and lack of access to skilled birth attendants.

III. Health Hazards and Maternal Mortality

A. **Infectious Diseases**

1. Impact of Malaria, HIV/AIDS, and Other Infectious Diseases on Maternal Mortality: Various infectious diseases like malaria and HIV/AIDS pose significant risks to maternal health, particularly in endemic regions. Pregnant women with infections like malaria face higher risk of severe anemia, maternal morbidity and mortality. Similarly, HIV/AIDS increases the likelihood of various infections like tuberculosis, due to poor immunity, leading to maternal mortality. Other infectious diseases, likehepatitis, sexually transmitted infections and tuberculosis also contribute to maternal mortality by exacerbating existing health conditions and increasing the risk of complications during pregnancy and childbirth.

2. Strategies for Prevention and Treatment: Implementing effective prevention and treatment measures for infectious diseases among pregnant women is imperative in the fight against maternal mortality. These crucial strategies encompass:

- Distributing insecticide-treated bed nets and administering malaria prophylaxis to pregnant women residing in malaria-endemic regions, thereby preventing malaria infection and associated complications.
- Integrating HIV/AIDS screening, prevention of mother-to-child transmission (PMTCT) services, and antiretroviral therapy (ART) seamlessly into routine antenatal care services. This comprehensive approach not only reduces the risk of vertical transmission but also increase chances of pleasant outcome of pregnancy.
- Providing vaccinations, screening, and treatment for additional infectious diseases like tuberculosis and hepatitis to pregnant women. These interventions play a pivotal role in preventing complications and lowering maternal mortality rates.

B. Environmental Hazards

1. Effects of Air Pollution, Water Contamination, and Climate Change on Maternal Health Environmental hazards such as climate change, air pollution, global warming and water contamination and pose significant threats to maternal well-being and exacerbate maternal mortality rates. Exposure to air pollutants like particulate matter (PM2.5), nitrogen dioxide (NO2), and carbon monoxide (CO) during pregnancy heightens the risk of adverse pregnancy outcomes, including preterm birth, low birth weight, and maternal mortality. Likewise, water contamination by pollutants, pathogens, and chemicals can precipitate waterborne diseases, infections, and pregnancy complications. Climate change further compounds these challenges, amplifying existing health risks such as heat-related illnesses, vector-borne diseases, and natural calamities, which disproportionately impact pregnant women and contribute to elevated maternal mortality rates.

2. Mitigation Strategies and Policy Interventionscomprehensive strategies and policy interventions are need of the hour for mitigating environmental hazards and their impact on maternal health. Some interventions could be-

- Strong implementation of regulations and emission standards, in order to reduce air pollution from different sources like household activities, industrial sources and transport etc.
- Ensuring access to safe and clean drinking water.

- Addressing climate change through adaptation measures, disaster preparedness, and sustainable development practices to protect maternal health and reduce vulnerability to environmental risks.

C. **Lifestyle Factors**

Lifestyle factors such as diet/nutrition, substance abuse/alcohol, physical activity and maternal age significantly affects maternal mortality rates. Inadequate nutrition during pregnancy increases the risk of maternal complications, including anemia, pre-eclampsiaetc and leads to adverse pregnancy outcomes and maternal mortality. Advanced maternal age (35 years and older) is also found to be associated with higher maternal mortality rates compared to younger women.

Behavioral interventions and education programs increase awareness about healthy behaviors and choices, which could ultimately help reducing maternal morbidity and mortality. Some of such interventions are:

- Nutritional counseling and supplementation, in order to ensure adequate intake of essential nutrientsto pregnant women and prevent maternal complications.
- Counseling about substance abuse, cessation programs, and support services available for pregnant women to reduce the risk of foetal and maternal harm.
- Spreading awareness and creating opportunities for support among women and families about the importance of optimal maternal risks associated with advanced maternal age.

D. **Access to Healthcare**

Importance of Prenatal Care and Skilled Birth Attendance: Timely and comprehensive prenatal care and skilled birth attendant are essential components of maternal healthcare which can significantly reduce MMR.Good prenatal care allows window for early detection and management of complications related to pregnancy, screening for pregnancy-related/ induced risks andinfectious diseases etc. Availability and accessibility of trained healthcare professionals, such as obstetricians,midwives and nurses ensures timely management for obstetric emergencies,safe childbirth and good postpartum care, which in turns reduce the risk of maternal complications.

IV. Determinants of Maternal Mortality

A. **Socioeconomic Factors**

Women living in Poverty and inequality often lack access to education, safe drinking water, nutrition and essential healthcare services. This increases their vulnerability to complications associated with/during pregnancy contribute significantly to higher MMR.

It has been seen in various surveys that educated women are well informed and educated about their needs and rights. They are more aware and empowered about reproductive health and family planning etc. Educated women have shown better compliance in using contraceptives, taking supplements and having proper spacing between 2 children.

B. **Health System Factors**

To provide good quality of maternal healthcare services, availability of skilled birth attendant, prenatal care and access to emergency obstetric care, and postnatal support is extremely important.

Also adequate healthcare infrastructure, with well-equipped facilities and properly trained healthcare professionals, are essential for providing responsive, prompt and effective antenatal/ peri-natal and postnatal services.Also it is crucial to have staff well trained on soft skills so that they can provide respectful maternity c are to all beneficiaries.

C. **Societal and Cultural Factors**

Gender roles/ norms and discrimination based on gender limits women's autonomy, health seeking behavior and decision making power. All these factors impact women's rights, which are essential for positive maternal health outcomes and contribute to MMR.

Cultural beliefs/myths and practices around childbirth influences maternal care-seeking behavior and practices, impacting pregnancy outcome. Community engagement, education and awareness are crucial to address misconceptions/ beliefs and cultural practices.

V. Strategies for Reducing Maternal Mortality byMitigating Health Hazards

A. **Healthcare SystemsStrengthening**

Enhancing access to maternal healthcare services especially in remote, outreach and underserved areas requires a comprehensive and multi-sectoral approach. Having great hospital will not work if the roads are not there. Family support is equally important as availability of medical/ paramedical and support staff. ASHA and aanganwadi must be used with their best potential to provide outreach services and motivating beneficiaries to take advantage of available services.

Healthcare infrastructure strengthening includes upgradation of facilities, continuous availability of essential drugs and equipment, availibilty of 24*7 ambulances for transportation. Additionally, investing in the capacity building and on the job training is crucial for providing quality maternal healthcare services.

B. **Addressing Environmental and Lifestyle Factors**

Governments and policymakers should implement policies which can address and mitigate environmental hazards like air pollution, water contamination, and climate change, which pose risks to maternal health. Regulations on industrial emissions should be implemented strongly, sustainable practices should be encourages and green energy should be subsidized.

Promoting Healthy Behaviors and Lifestyle Choices should be promoted especially in pregnant women.Health promotion initiatives should be aimed at encouraging physical activity,promoting healthy nutrition, discouraging substance abuse etc, so that incidence of maternal complications can be reduced and improve pregnancy outcomes. Educational campaigns, nukkad natak community-based interventions, focused intervention for high risk populations can promote healthy behaviors during pregnancy and reduce maternal morbidity.

VI. Case Studies and Best Practices

A. **Successful Interventions in Reducing Maternal Mortality**

1. India:

Government of India through its flagship programme **Janani Suraksha Yojana** provide cash incentive to pregnant women via direct befit transfer, if she opt for institutional deliveries This intervention has significantly increased the proportion of institutional deliveries in India, ensuring access to skilled birth attendants and emergency obstetric care, thus reducing maternal mortality rates.

Janani Shishu SurakshaKaryakram provides for free drugs, diagnostic, diet, blood transfusion and transport is being provided to pregnant women opting to deliver in public facilities. This initiative has helped India reducing them MMR significantly.

PRADHAN MANTRI SURAKSHIT MATRITVA ABHIYANis being run by Indian government to provide assured, comprehensive and quality antenatal care, free of cost, universally to all pregnant women on the 9th of every month.As per the mandate pregnant women in second & third trimester are receiving complete ANC checkup along with all required investigations including ultrasonography by an allopathic physician/ Specialist at govt. health facilities.

2. Global: Skilled Birth Attendant Training Programs Skilled birth attendants (SBAs) are mostly local people trained to assist in birthing; these play a important role in reducing maternal mortality. SBAs are equipped with skills, necessary knowledge and competencies to provide essential maternal healthcare services during pregnancy, childbirth, and postpartum. They contribute inreduction of maternal mortality worldwideby managing non serious obstetric emergencies, help provide safe deliveries, and offer postnatal care.

B. **Lessons Learned from Global and Regional Initiatives**

There have been positive outcomes for maternal health as a result of international efforts which prioritize investment into the basic health infrastructure. This improves access to necessary maternal healthcare services and decreases rates of deaths among mothers by strengthening primary healthcare facilities, particularly in rural and underserved areas. For example, Bangladesh and Rwanda implemented community-based models for care that targeted women’s reproductive health with impressive impacts on maternal mortality. Maternal mortality rates are determined by many factors hence global as well as regional programs focused at addressing these complex issues have been effective through fostering partnerships that collaborate across sectors. They leverage resources, knowledge and networks by involving governments, civil society organizations, international agencies and communities to scale up integrated programs on maternal health. A case in point is Partnership for Maternal, Newborn & Child Health (PMNCH) whose objective is to bring different stakeholders together to advocate, share information and develop capacity towards improved motherhood and childhood experiences globally.

Key leanings from these best practices and successful interventions highlight the importance of comprehensive approach, targeted interventions, collaborative efforts, multisectoral co-ordination and sustained investments in maternal healthcare to achieve desired result that is reducing MMR both globally and regionally.

VII. Future Directions and research opportunities

Research should focus on identifying and understanding emerging health hazards that pose risks to maternal health, such as the impact of new infectious diseases, environmental pollutants, and changing lifestyle factors on maternal mortality rates.Further research is needed to evaluate the effectiveness of interventions aimed at mitigating health hazards and reducing maternal mortality, including the implementation of new policies, healthcare delivery models, and community-based programs.

Policy recommendations argue that Governments should prioritize maternal health by: integrating it into national health policies and strategies; allocating sufficient resources; establishing clear targets and indicators for reducing maternal mortality.

Policymakers need to address social determinants of health. Poverty, gender inequality, and lack of education are among some of these factors. They can do this through targeted interventions such as poverty reduction programs, initiatives to empower women and education campaigns.

C. **Way forward**

Accessibility, affordability and availability are the keys. Policymakers should prioritize scaling up of infrastructure so that access to essential maternal healthcare services is easily available in every nook and corner, particularly in socially and financiallymarginalized, hard to reach and underserved areas. There is a strong need of more investment in environmental health initiatives and sustainable development practices in order to reduce impact/effect of environmental hazards such as water contamination, climate change, noise pollution and air pollution, which pose risks to overall health.

Also community engagement empowerment and awareness should be central to interventionsrelated with maternal health, with a focus to include women’s participation in decision-making and mobilizing community resources to address social and cultural barriers to maternal healthcare access.By adopting a multi-faceted approach and unwavering commitment to sustained action, communities, decision makers,healthcare providers and policymakers can help achieving maternal health goals and ensure well-being of mothers and her children.

VIII. Conclusion

Throughout this paper, authors have examined various factors ranging from pollution to socio-economic disparities, unhealthy beliefs and practicesand cultural norms.Key determinants such as gender inequality,poverty, lack of basic amenities, pooraccess to healthcareand scarcity of resources etcincreasesMMR. However, successful interventions both at the national and global levels, have demonstrated the capability to reduce maternal mortality.

The findings presented in this paper emphasized the immediate need for concrete action to address health hazards and their impacts on community with special focus to maternal health, so to reduce maternal mortality rates worldwide. Policymakers, self help groups, healthcare providers, non-government organizations, civil society and communities must prioritize maternal health as a fundamental/basic human right and commitment to implement evidence-based interventions to mitigate health hazards and their adverse impacts on maternal health. Strong advocacy for policy change, will power of people in power, investment in healthcare infrastructure, capacity building of workforce,promotion of environmental health initiatives, and empowering women and communities has the power to make changes in community, society and world. Furthermore, addressing social determinants of health, advocating for policy changes, and mobilizing resources are essential components of a comprehensive approach to maternal health. By working together and sustaining momentum, we can achieve substantial reductions in maternal mortality and ensure that every woman has the opportunity to experience a safe and healthy pregnancy and childbirth.

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Harnessing Solar Energy for Sustainable Economic Development: Pathways and Prospects

Ayushi Gupta and Dr. Sweta Kumari

Abstract:

Solar energy presents a promising avenue for sustainable economic development, offering abundant and renewable resources that can be harnessed to meet various energy needs. This paper explores pathways and prospects for leveraging solar energy to drive sustainable economic growth. We examine the current state of solar energy technologies, including photovoltaics and concentrated solar power, highlighting their potential to revolutionize energy production and distribution. Moreover, we analyse the economic implications of widespread adoption of solar energy, including job creation, cost reduction, and increased energy access. Additionally, we discuss policy frameworks and investment strategies necessary to promote the integration of solar energy into national energy systems. By elucidating the multifaceted benefits and challenges associated with solar energy deployment, this paper aims to provide insights for policymakers, investors, and stakeholders interested in advancing sustainable economic development.

Keywords: *Solar energy, Economic development, Sustainability, Photovoltaics, Concentrated solar power, Policy frameworks, Investment strategies.*

Introduction

Background and Significance of Solar Energy

Solar energy, derived from the radiation of the sun, has emerged as a promising renewable energy source with immense potential to mitigate climate change and foster sustainable economic development (IEA, 2021). As the world grapples with the challenges of fossil fuel depletion and environmental degradation, the transition towards renewable energy sources such as solar power has become imperative (REN21, 2020). Solar energy offers several

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advantages, including abundant availability, inexhaustible nature, and minimal environmental impact compared to conventional energy sources (Jacobson & Delucchi, 2011).

Statement of the Problem

Despite the considerable advantages of solar energy, its widespread adoption faces various challenges and barriers. These challenges include high initial investment costs, intermittency issues, inadequate policy support, and limited technological advancements (Khatib & Shah, 2019). Moreover, the lack of awareness and misconceptions about solar energy among stakeholders hinder its mainstream integration into the energy mix (Luque & Hegedus, 2011). Addressing these challenges is crucial to unlocking the full potential of solar energy for sustainable economic development.

Solar Energy: An Overview

Definition and Types of Solar Energy

Solar energy refers to the radiant energy emitted by the sun, which can be harnessed and converted into usable forms of power. There are primarily two types of solar energy technologies: solar photovoltaic (PV) and solar thermal. Solar PV systems utilize photovoltaic cells to directly convert sunlight into electricity, while solar thermal systems harness the sun's heat to generate electricity or provide hot water for residential and commercial use (Chowdhury et al., 2020).

Historical Development of Solar Energy Technologies

The development of solar energy technologies dates back to the 19th century when French physicist Alexandre Edmond Becquerel discovered the photovoltaic effect in 1839 (Yergin, 2020). However, it wasn't until the mid-20th century that significant advancements in solar cell technology were made, leading to the commercialization of solar PV systems. The oil crisis of the 1970s further spurred interest in solar energy, prompting governments to invest in research and development (R&D) efforts (Lewis, 2016).

Current Status of Solar Energy Adoption Worldwide

In recent years, solar energy adoption has experienced exponential growth, fueled by declining costs, supportive policies, and increasing environmental awareness (IRENA, 2021). According to the International Energy Agency (IEA), solar PV capacity witnessed a record expansion, reaching 707 GW globally by the end of 2020 (IEA, 2021). Several countries, including China, the United States, and India, have emerged as leaders in solar energy deployment, accounting for the majority of installed capacity (REN21, 2020). Despite this progress, solar energy still represents a small fraction of the total energy mix, highlighting the need for further expansion and integration.

Benefits and Challenges of Solar Energy Utilization

The utilization of solar energy offers numerous benefits, including environmental sustainability, energy independence, and job creation (IPCC, 2018). Solar energy is a clean and renewable resource that produces no greenhouse gas emissions during operation, helping mitigate climate change and air pollution (Jacobson & Delucchi, 2011). Additionally, solar power reduces reliance on finite fossil fuels and enhances energy security by diversifying the energy mix (Dincer & Rosen, 2019).

Literature Review

1. **Swami Prakash Srivastava & Surat Prakash Srivastava (2013**) studied SOLAR ENERGY AND ITS FUTURE ROLE IN INDIAN ECONOMY. The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. The National Action Plan on Climate Change also points out: "India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source. It also has the advantage of permitting the decentralized distribution of energy, thereby empowering people at the grassroots level."

2. Kawaljeet Kaur Kapoor, Yogesh K Dwivedi (2017) commented on a take on solar power in India. They studied that the country's economic growth, its rapid urbanization, and the gradual increase in its per capita consumption are all expected to sizably increase India's overall demand for electricity. Indian government has announced that it will achieve the 100 gig watts (GW) solar power target by 2022. With 8.1 GW, India's installed solar capacity has experienced an 80% growth since September 2015 (ET Energy world 2016).

3. Atmaja Gohain Baruah (2019) investigated about How Can India Become a Global Leader

in Solar Power Generation? He talked about the advancement of the International Solar Alliance by India and France has gained prominence in the field of solar power generation. However, there are some critical challenges that India faces, such as poor supply chain of production, severely low tariffs, and over-dependence on Chinese imports.

4. Ministry of New and Renewable Energy (2022), National Institute of Solar Energy has assessed the Country's solar potential of about 748 GW assuming 3% of the waste land area to be covered by Solar PV modules. Solar energy has taken a central place in India's National Action Plan on Climate Change with National Solar Mission as one of the key Missions. National Solar Mission (NSM) was launched on 11th January, 2010. NSM is a major initiative of the Government of India with active participation from states to promote ecological sustainable growth while addressing India's energy security challenges.

5. Subhojit Dawn & co- authors (2016) shows recent developments of solar energy in India: Perspectives, strategies, and future goals. Due to the continuous increment in electricity demand day-by-day, Indian power sector is interfacing some challenges to maintain the balance between the power generation and demand with suffering from supply constraints and shortages in power. For maintaining the ratio of generation and demand of power, moving from conventional sources to non-conventional sources is not only an option, it is a necessity.

Objectives of the Research

The primary objective of this research is to examine the pathways and prospects of harnessing solar energy for sustainable economic development. Specifically, the research aims to:

1. Assess the economic, social, and environmental impacts of solar energy adoption.
2. Provide recommendations for policymakers, industry stakeholders, and academia to promote the widespread adoption of solar energy.

Methodology:

In this research paper the researcher has done descriptive study with the help of secondary data and there is no use of primary data for analytical interpretation of data. The secondary data is taken from various journals, newspapers, government websites and research articles.

Data Interpretation

Rank	State	Solar Capacity	Prominent Solar Plant
1	Rajasthan	16.06 GW	Bhadla Solar Park
2	Gujarat	8 GW	Charanka Solar Park
3	Karnataka	7.8 GW	Pavagada Solar Park
4	Tamil Nadu	6.2 GW	Kamuthi Solar Power Project
5	Telangana	4.6 GW	Ramagundam Floating Solar Project

Figure 1 source: ornatesolar.com

Rajasthan has India’s largest solar power generation potential. As of December 2022, Rajasthan had installed over 16,060 MW of solar energy capacity, surpassing Karnataka as the largest state in solar installations. By 2025, Rajasthan intends to install 30,000 megawatts of solar energy. Gujarat recently eclipsed Karnataka as India’s second-largest solar-producing state. It makes up 25% of the country’s entire rooftop capacity and 13% of its overall solar capacity. The Charanka Solar Park in Patan district, which today generates 600 MW, has Gujarat’s single-largest solar power capacity.

Karnataka, located in the southwest of India, is the country's third greatest producer of solar energy. Karnataka's total installed solar power capacity is approximately 7,860 MW, not adding the 1,000 MW of projects in the pipeline.

Tamil Nadu has the fourth-highest solar capacity in India. As of September 2022, Tamil Nadu's total solar capacity was 6233 MW, up from 2,575 MW on March 31, 2019.

Telangana, India's southernmost state, is fifth in solar power generation capacity. It also ranks second in terms of solar energy capacity per unit area of land. As of September 2022, Telangana had a total installed solar energy capacity of 4637 MW. This included freestanding and grid-connected rooftop solar units. The state's total renewable energy capacity is 4919.19 megawatts.

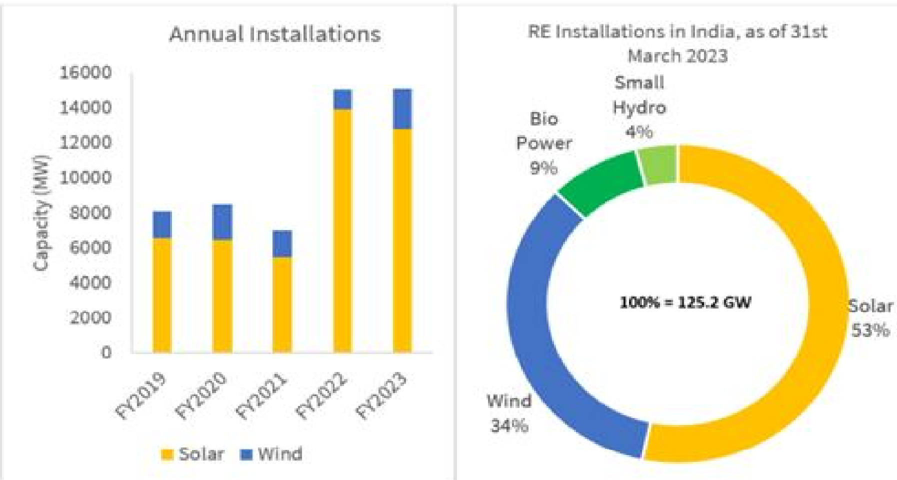
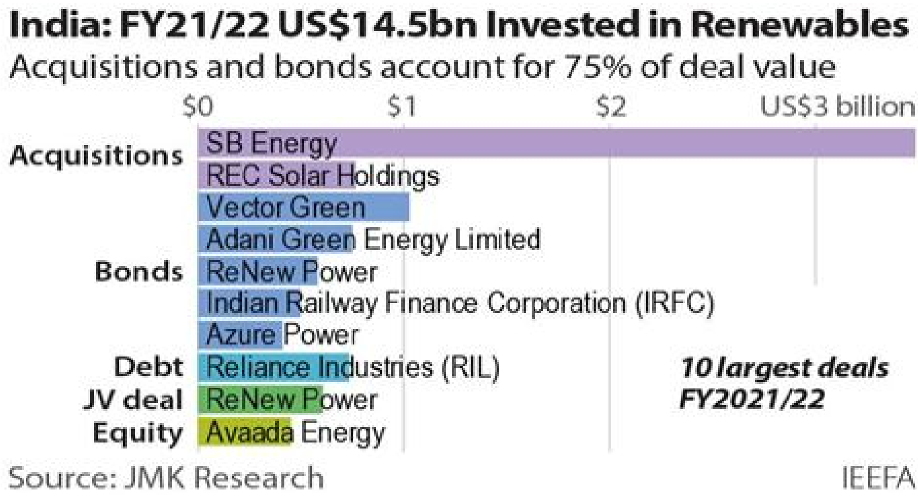


Figure 2 source: MNRE, JMK Research

In 2022, India installed 13,956 megawatts (MW) of solar and 1,847 MW of wind power. Rajasthan, Gujarat, and Tamil Nadu accounted for the majority of installed solar capacity. According to the Ministry of New and Renewable Energy, the country's cumulative installed renewable energy capacity stood at 120.85 GW as of December 31. Solar energy makes up approximately 53% of the total renewables mix, followed by wind at 35%, bio-power at 9%, and small hydro at 4%.



According to new research by the Institute for Energy Economics and Financial Analysis (IEEFA), India's investment in renewable energy hit a record US$14.5 billion in the last fiscal year (FY2021-22), up 125% from FY2020-21 and 72% from the pre-pandemic FY2019-20.

Findings:

Solar Energy Potential: India receives approximately 5,000 trillion kilowatt-hours (kWh) of solar energy incidence annually across its land area. Most regions in India receive around 4-7 kWh per square meter per day of solar energy.

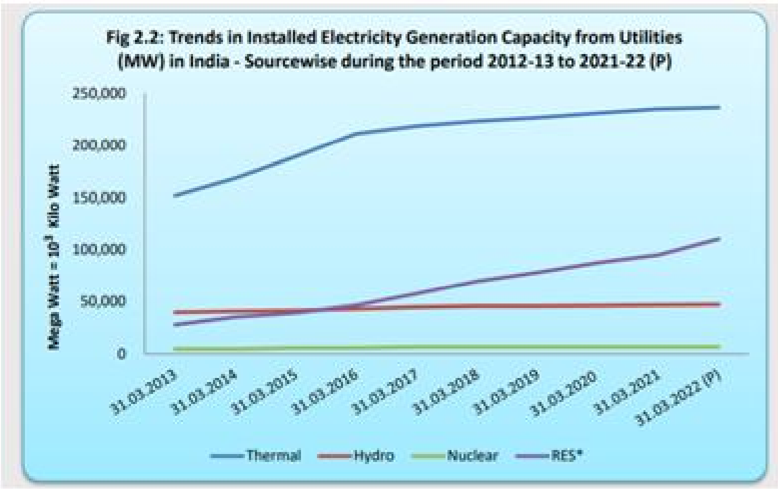


Figure 3 source: Energy Statistics India - 2023

Installed Solar Capacity: As of November 30, 2022, India had a total installed solar capacity of 61.97 gigawatts (GW), making it a global leader in solar power deployment. Most of the solar capacity is concentrated in states like Rajasthan, Gujarat, and Tamil Nadu.

Cumulative Renewable Energy Capacity: As of December 31, 2022, India's cumulative installed renewable energy capacity stood at 120.85 GW. Solar power contributes significantly to this capacity, along with wind, bio power, and other renewable sources.

Shift Toward Renewable Sources: India's energy mix is gradually shifting from conventional resources to renewables. The country aims to optimize the use of multiple energy resources, promote eco-friendly technologies, and reduce reliance on primary fossil fuels.

Job Creation: The government expects the Production Related Incentive Scheme (PLI) to create 30,000 direct jobs and 120,000 indirect jobs by encouraging domestic manufacturing of high-efficiency modules. India's grid-connected solar sector will add 137,000 jobs in 2021, up 47% from 2020. About 80,000 people are working in the off-grid solar industry, India's target of deploying 500 GW of non-fossil energy sources by 2030 will create 3.4 million new job opportunities (short and long term), or about 1 million direct full-time equivalent opportunities.

In summary, India's solar energy journey is marked by impressive growth, competitive tariffs, and a commitment to sustainability.

Conclusion

Solar energy is environmentally sound, cost-effective, and multipurpose. It stimulates the economy while providing a consistent and lasting power source. Once installed, solar panels have minimal environmental impact and produce clean energy without emitting greenhouse gases. The renewable sector suffers notable obstacles. Some of them are inherent in every renewable technology; others are the outcome of a skewed regulative structure and marketplace. The absence of comprehensive policies and regulation frameworks prevent the adoption of renewable technologies. The renewable energy market requires explicit policies and legal procedures to enhance the attention of investors. There is a delay in the authorization of private sector projects because of a lack of clear policies. The country should take measures to attract private investors. Inadequate technology and the absence of infrastructure required to establish renewable technologies should be overcome by R&D.

Suggestions

Based on the findings of this research, several recommendations are proposed for policymakers, industry stakeholders, and academia to promote the widespread adoption and integration of solar energy:

1. Policy makers should prioritize the development and implementation of supportive regulatory frameworks, including financial incentives, procurement mechanisms, and grid integration policies, to accelerate solar energy deployment.

2. Industry stakeholders should invest in research and development to drive innovation and technological advancements in solar energy technologies, focusing on improving efficiency, reducing costs, and enhancing reliability.
3. Academia should collaborate with industry partners and government agencies to conduct interdisciplinary research and knowledge exchange initiatives, addressing key challenges and research gaps in solar energy adoption and integration.

Limitations:

Financial Barriers and Access to Capital

Financial barriers and limited access to capital pose significant challenges to the widespread adoption of solar energy, particularly in developing countries and underserved communities. High upfront costs associated with solar PV installations deter many consumers and businesses from investing in solar energy systems, despite the long-term cost savings and environmental benefits (Blyth & MacLean, 2019).

Technological Barriers and Research Gaps

Despite significant advancements in solar energy technologies, several technological barriers and research gaps persist, hindering the scalability and efficiency of solar energy systems. Key challenges include improving solar panel efficiency, enhancing energy storage capabilities, and developing integrated solutions for grid integration and management (Fthenakis et al., 2019).

Policy Implementation Challenges

Policy implementation challenges, including regulatory barriers, administrative hurdles, and political instability, pose significant obstacles to the effective deployment of solar energy projects. Inconsistent or outdated regulatory frameworks, lack of enforcement mechanisms, and bureaucratic delays can hinder project development and discourage investment (IRENA, 2020).

Public Awareness and Education Initiatives

Limited public awareness and understanding of solar energy technologies and benefits pose challenges to adoption and acceptance, particularly in communities with low levels of education and awareness. Misconceptions about solar energy, such as perceived high costs, reliability issues, and aesthetic concerns, can deter potential adopters and hinder market growth (Walker et al., 2010).

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The Millets Renaissance for a Sustainable Future

Dr. Anamika Choudhary

Abstract

India is the harbinger of millet revolution. India's millet tale has drawn interest from all across the world as it paves the way for a future that is more sustainable and healthier. The difficulty of providing a nutritious, balanced diet for the world's expanding population and the dangers climate change poses to agricultural crops underscore the urgent need to take advantage of millets' advantageous qualities. This could be used to enhance millets as a whole as well as other connected grass species. However, the story of millets is about to enter a fascinating new phase. The Indian government made a bold suggestion to the UN that 2023 be declared the International Year of Millets. The UN General Assembly declared 2023 the year to honor these modest grains after receiving support from 72 nations, acknowledging their contribution to a healthier and more sustainable future. This will become a people's movement in India. On such perspective, the present paper is divided into five sections. The first section deals with the introduction. The second section gives a brief outline of the historical background of millets, the third section throws a light on the production and consumption of millets in various parts of world as well as in India. The fourth section deals with the state of millets before and after the green revolution and the fifth section highlight the role of millets in building a sustainable future along with the future challenges that this crop may face. The methodology used is an exploratory and descriptive one using different source material from various journals and reports. The objective of this paper is to demonstrate the millets' rich flavors and healthfulness and to understand how the promotion of millets can usher to step in achieving the Sustainable Development Goals (SDGs). The findings of the paper are that millets have innumerable health benefits and efforts must be taken to promote its cultivation to make a healthier and sustainable future for human beings and environment.

Introduction

According to studies on the origin of grains used for food, millet is a native of Africa. It was created some 4,000 years ago (Dr. A. Shanmugam, 2020). It is actually one of the

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oldest food crops that we are aware of. Like other grains, millet is a kind of grass that produces tiny, edible grains. Millets also known as 'Shree Anna', as it holds the distinction of being one of the oldest foods is also a great source of protein, fiber, and minerals all while possessing a low glycemic index, iron, and calcium. They also have the benefit of being adaptable to different agroclimatic situations. flourishing in arid, sparsely fertile, rain-fed, and mountainous terrain. Due to their short growth season, these super grains also smoothly fit into diverse cropping systems, both under irrigation and dryland farming.

Millets offer a practical approach to addressing the threats to food security posed by climate change, impacting changes to food production, pricing, and general security. Their ability to adapt to a wide range of ecological circumstances, little irrigation needs, improved growth and productivity under low nutrient input, vulnerability-reduced settings, and resilience to environmental shocks are all examples of their climate-resilient characteristics. It is emphasized that milletsets offer a different way to address climate change and give farmers a reliable and sustainable source of income. Farmers should anticipate a higher price for their produce as millets' popularity grows.

With less reliance on weather, larger yields, and higher value for millets, farmers have discovered a dependable source of income. It is indeed a match for the climate of India. Due to their direct impact on human health and their connection to the emergence of several diseases, the growing use of pesticides and chemicals in agriculture has given rise to grave concerns. Additionally, we must know our millets. Strong millets are high in calcium, iron, zinc, and magnesium nutrient content. They are advantageous for digestive health because they are a rich source of dietary fiber. It is a gluten-free grain,contains vitamin B3, which helps lower triglyceride and cholesterol levels. A diet high in millet has been found to reduce oxidative stress and help diabetics control their blood glucose levels.Thankfully, the government and foreign organizations have acknowledged the importance of millets this year and are bringing this crop to public attention. The moment has arrived for small farmers to start growing millet, which will boost their profitability and growth. Millets have become adaptable ingredients in the current cooking methods.

Various studies have been conducted with regard to millets and its role in building a healthier life. Some have focused on the cultivation aspect while others have stressed on its fate after the green revolution. Some researches have also studied the nutritional aspect of millets and its spread of this crop cultivation worldwide. Following are some such studies:

Pandiyan, A., Barbhai, M., &Medithi, S. (2019): focused its study on the transition of millets to other crops after the green revolution. discusses the concept of "The Millet Movement" in India. Goron, T. L., & Raizada, M. N. (2015): focused in his study on the little millets and their nutritional benefits, yet they got less scientific attention for which they were termed as orphan cereals. In order to accelerate a New Green Revolution for subsistence farmers in Asia and Africa, the review outlined current trends, gaps in the research, and recommendations on how to better preserve and exploit variety among these species. Dosad, S., & Chawla, H. S. (2016) explained that in arid and semi-arid regions of Asia and Africa, where the bulk of cereals cannot be counted on to generate a sustainable yield, millets are a category of small-seeded cereals and forage grasses. Bandyopadhyay, T., Muthamilarasan, M., & Prasad, M. (2017) promotes the beginning of in-depth studies on millets in order to analyze their agronomic, nutritional, and stress tolerance qualities and create methods for transferring the beneficial traits to farmed major cereals like rice, wheat, maize, and sorghum. Sood, P., Singh, R. K., & Prasad, M. (2019) discusses the major obstacles that still need to be solved as well as potential uses of transgenic techniques in various millets. It also shows the progress that has been made in millet genetic transformation. The main barrier to millet transformation is the plant's resistance to tissue culture-based methods of regeneration The study concluded that to create an advanced transformation system for each millet species, extremely effective regeneration technique optimization is required. N. Swaminaidu, S. Ghosh, K. Mallikarjuna (2015)concluded in their study that the best grain accessible in disadvantaged communities is millets.

II. Brief outline of the historical background of millets

Millets are basically a collective group of small seeded annual grasses and are grown as grain crops for consumption purpose. The earliest evidence of millets is found in Indus civilization approximately around 3000 B.C. It is believed that it was the ancient food grain and the first plant which was cultivated for food consumption. For example, finger millet was domesticated 5000 years ago in Africa (Chamoli et al., 2018); pearl millet 4000 years ago (Taylor, 2018); foxtail millet 8000 years ago (Lu, 2002). Being a drought resistant crop, they are grown and cultivated on marginal dry lands in temperate, sub-tropical and tropical regions. Though this crop is grown in about 131 countries but for Asis and Africa, it is the traditional food for not less than 59 crore people.

Nine types of millets (coarse grains), three major and six minor are grown in the country. Major millets include jowar (pearl millets), bajra (sorghum), and ragi (finger millets). Minor millets are kodo, kakun (foxtail millets), sanwa (little millets), kangni (barnyard millet), harikangni (browntop millet) and chena (proso millet). The top five states that grow millet crop are Rajasthan (Bajra/Sorghum), Karnataka (Jowar/Ragi), Maharashtra (Ragi/jowar), Uttar Pradesh (Bajra) and Haryana (Bajra).

Primary millets grown in Uttar Pradesh are jowar, bajra, kodo and sanwa. Traditionally considered as the coarse grain and consumed by the lower class, this highly nutrient grain has shown a comeback with a gained momentum and the rich class and the elite section of the economy are seen to increase

Classification of grains based on nutritional value:

On the basis of nutritional value, the millet grains are broadly classified in three types:

- ❖ Positive millet grains
- ❖ Neutral millet grains
- ❖ Negative millet grains

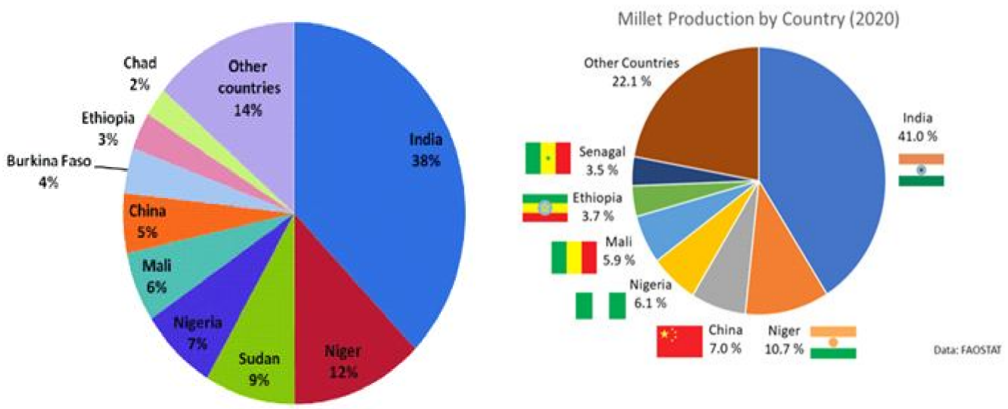
1. Positive grains: all minor millets are positive grains as they have nutritional value in them and they do not generate any toxic waste. They have dietary fiber ranging from 8% to 12.5%. Instead, consuming these grains detoxify the body. Positive millets have numerous health benefits as they have the highest dietary fiber. Examples are Foxtail millet (Kangni), Barnyard millet (Sanwa), Browntop millet (Korale/ chhoti Kangni), Kodo millet (Kodra), and little millet (Kutki). Only Proso, popularly known as chena or barri in India is not considered as positive grain.

2. Neutral grains: Three major millets fall in this category. The dietery fiber content is between 3 percent to 6 percent. The feature of neutral grain is that though they have immense nutritional value but neither they are toxic to the body not do they detoxify the body. They are simply neutral. Pearl Millet (Bajra), Finger Millet (Ragi), Proso Millet, and Sorghum Millet fall in this category.

3. Negative grains: all hybrid varieties fall in this category. Wheat and rice are considered as negative grains. Chemical fertilizers are used in their cultivation to increase their production so that the increased demand is catered through high yield production.

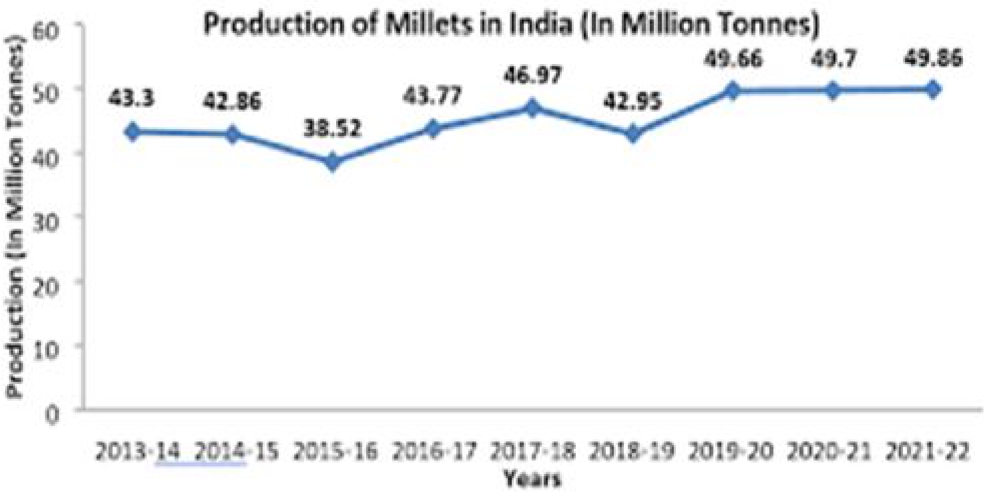
III. Production and Consumption of millets- Global and India level

A comparative study of the millet production in the year 2018 and 2020 (data by FAO) states that the production in India which was 38 percent in 2018 increased to 41 percent in 2020. The production in China also marked an increase by 2 percent. Other countries which accounted for only 14 percent in 2018 also showed an increase of 8 percent in just two years' time. This shows that the world had recognized its nutritional value and the cultivation is being attempted in other countries as well beside the countries of Asia and Africa.



Millet production (%) in different countries of the world 2018 and in 2020 (FAO)

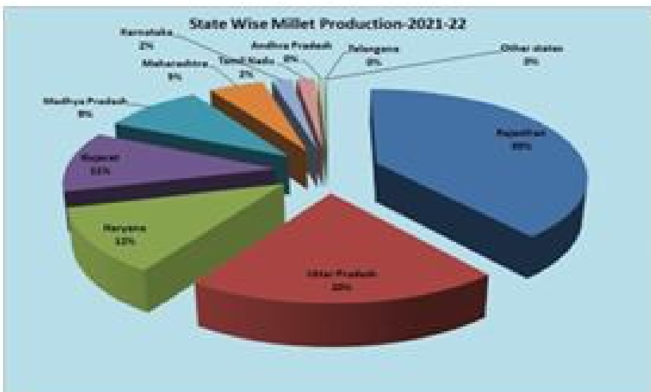
According to reports by FAO, 2021, India produces about 80 percent of Asia and 20 percent of global production. In weight, it produces more than 170 lakh tons of millets covering an area of 138 lakh ha. While the global average yield is 1229 kg/ha, the Indian economy average is 1239 kg/ha. India is considered to be the top consumer of millets in the world as stated by FAO. Indians eat about 42 percent of millets produced globally, next succeeded by Nigeria whose consumption is 27 percent.



Over a period of 9 years, i.e., from 2013-14 to 2021-22, the production of millets in India in million tonnes have shown a mixed trend of rise and fall in different years but since 2018-19, the trend has been on an increase. This reflects the increased demand for this grain due to which its production has been on the rise successively.

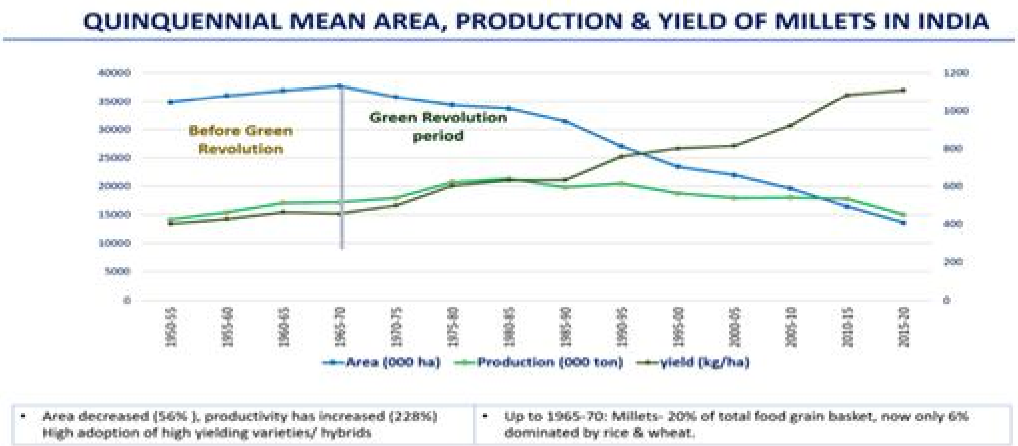
State wise production of millets:

As per the 2018-19 data, Rajasthan produces 44 percent, followed by Uttar Pradesh (21 percent), Haryana and Gujarat contributing to 10 percent of production each while Madhya Pradesh, Maharashtra and Karnataka produce only 7 percent, 4 percent and 2 percent respectively. In the year 2021-22, the production of Rajasthan fell to 39 percent and that of Uttar Pradesh to 20 percent, while that of Haryana and Gujarat increased to 12 and 11 percent respectively.



IV. State of millets before and after green revolution:

An article in Ethnic Food Journal, Springer Nature, observed that before the advent of Green Revolution the production of wheat, barley and maize combined together was not as much as the production of rice and millets. But when the wave of green revolution occurred, the production of wheat, maize accelerated but that of millets fell down considerably. A consumption food grain was left to become a fodder for the crop in a couple of decades. This was one of the bad consequences of green revolution. The area under the production of millets is declined as it started to be used more for the production of rice and wheat. Around 1965-70, millets constituted 20 percent of our food consumption in grain form which subsequently declined to 6 percent in later years. A comparison of wheat and jowar would give a clear picture of the cropped area. While the cropped area under jowar declined from 12 percent to 3.1 percent, that of wheat increased more than double from 7.6 percent to 16.2 percent.



V. Role of millets in building a sustainable future

Researches have shown that this coarse grain acts as a good defence in fighting against diabetes and also has climate resilience properties. The promotion of millets is also an attempt to attain the Sustainable Development Goals (SDGs), particularly SDG 2 related to zero hunger, SDG 3 concerned with good health and well-being, SDG 12 which deals with sustainable consumption and production and SDG 13 of climate action.

Of the 17 SDGs, five goals relate to the role of millets in attaining them. Goal 2 which is attaining zero hunger aims to end hunger, achieving food security and improving the nutrition and promoting sustainable agriculture (UN General Assembly, 2015) can be achieved with the promotion of millets cultivation. Millets are considered to be climate resilient crop and can help to promote sustainable agriculture (Thilakarathna & Raizada, 2015). Without harming the environment, the production of millets which does not use fertilizers and insecticides etc. is considered to preserve the ecology and promote sustainable agriculture. In contrast to the other crops which damage the ecology because of the excessive use of inputs like fertilizers, millets are a healthy nutricereal which does no damage to environment. The sustainable development goal of sustainable production and consumption can be achieved through millets. The Goal 13 of climate action can also be met as millets provide climate resilience features. The target and indicators of the SDG 13 (13.b section) aim to 'promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States' (UN General Assembly, 2015). It can be explained in the way that millet based agriculture would not use fertilizer and pesticides as input in the production process which would then not impact the environment adversely. The adverse effects of global warming and climate change can be overcome when millets are considered for food production.

Additionally, the significance of (N) fertiliser in linking grain production systems to SDGs has been emphasized upon (Ladha et al., 2020). Nitrogen has been seen as a crucial resource for improving food security and achieving numerous SDGs. By lowering the demand for fertilizer, millets could, in the future, play a significant role in satisfying food demand and enhancing food security. Similar to rice cultivation, increasing millet production's value-added processing could assist rural communities produce revenue and achieve SDG 1.

Consuming millet could assist in achieving SDG 3. (Good health and well-being). Essential nutrients might not be present in modern food systems. For customers to consume more millet, they must change their eating behaviours. It has been reported that changing the food system and promoting regional cuisines like millets are crucial for achieving the SDGs (Pradhan et al., 2021). Promoting millet cultivation and consumption could assist in achieving many UN SDGs because many other SDGs are interconnected. To address the problems associated with agriculture's water shortage, millets are also seen as crops of the future. Most millets require only 70 to 80 days to mature, requiring less time on the ground to maintain than major grains like rice and wheat, which need more than 100 days. Therefore, encouraging millet farming could aid in promoting sustainable agriculture and achieving the UN SDGs.

Conclusion:

Future challenges

The size of production must be raised whenever the demand for coarse grains surges, is reportedly the biggest obstacle for millets. It is very evident that native seeds do not require fertilizers, but they do not yield much. When millets are in high demand, as they appear to be in the current and future scenario, hybrid seeds will be required, which will encourage the use of fertilizers rather than chemically based inputs. This will adversely affect the nutritional value of the crops.

Efforts to popularize millets:

The Uttar Pradesh government initiated various efforts to popularize this nutritional grain by hosting dinners for ministers where food made from millets were served. The Chief minister expected that ministers should try to host such lunches and dinners where millets could be the chief ingredient in the food served. Various food items could be made out of millets and would be relished by people in general. Some items like gulab jamun made of jowar, gur ki kheer made from Kakun, makka palak and rotis made from ragi, chana, jowar, bajra and makka and also kheer made of sanwa may be prepared to let the people know that millets can replace those grains which are of less nutritional value and are in fact detrimental to health.

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Solid Waste Management and Inclusive Green Growth in Kanpur City

Dr. Vandana Dwivedi

Abstract-

Inclusive green growth is necessary, efficient and affordable(World Bank 2012).

Solid waste management and inclusive green development are two interconnected concepts that address environmental sustainability and social inclusivity. Solid Waste Management involves the collection, transportation, disposal, and recycling of solid waste. Resource conservation, public health protection, and pollution prevention all depend on effective solid waste management. An efficient solid waste management policy may work as an effective tool to achieve inclusive green growth. Sustainable economic growth that benefits all facets of society- especially marginalized or vulnerable groups - is the main goal of inclusive green development. It integrates environmental, social, and economic aspects to make sure that the development is environmentally sustainable, socially equitable, and economically viable. Both concepts emphasize the sustainable use of resources. Efficient solid waste management helps to save resources by encouraging recycling and minimizing the demand for raw materials. This research paper studies solid waste management in Kanpur city. It tries to highlight the inadequacies in the existing mechanism of solid waste management in the city. An effort has been made to analyze the causes of prevailing inefficiencies. The paper gives certain suggestions for a robust mechanism of solid waste management in Kanpur city which would help in achieving a larger goal of inclusive green growth in the city.

Key words: *Inclusive Green Development, Solid Waste Management, Kanpur city, Zero* Waste

Introduction

One of the most significant responsibilities of municipalities is solid waste management (SWM), which also acts as a helpful proxy for good administration. Effective SWM decreases negative environmental and human health impacts, saves resources, and improves city livability. However, inadequate SWM practices have a negative impact on both environmental sustainability

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and public health. This effect is exacerbated by rapid urbanization, as well as institutional and fiscal restrictions.

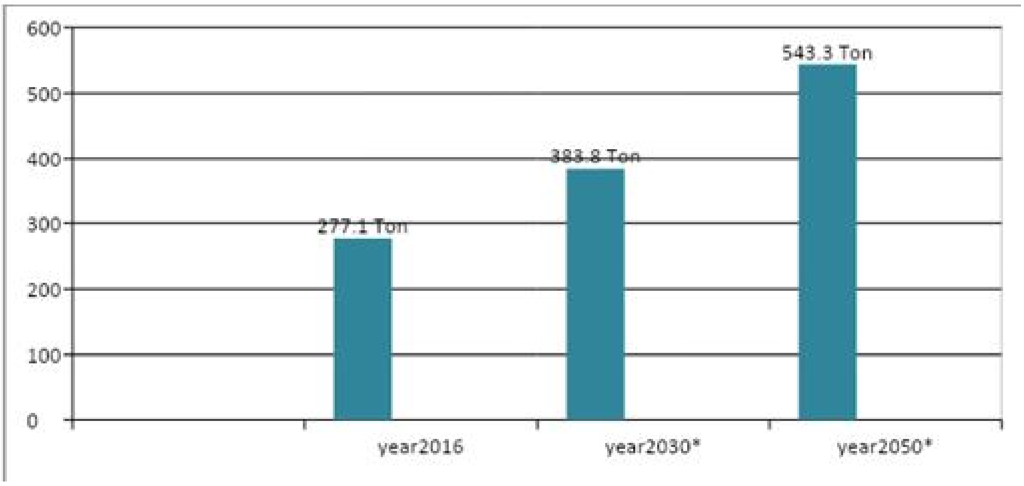
Inclusive green development is a concept that includes raising standards of living, social and economic justice and eliminating environmental problems. Better allocation of resources for the green economy in which solid waste is used as a raw material, this process will reduce waste and will make it easier to achieve the goal of zero waste. Solid Waste Management is a problem in most of the countries of the world. World Bank Report (2018) says Every year 2.01 billion tons of solid waste is generated in the world, out of which 33% waste is not treated in any way. Waste generation is High in most high-income countries. Out of total waste, 34% or 383 million tons is generated in these countries.Waste generation in the world is expected to exceed 3.4 billion by 2050.

Due to rapid urbanization, increasing population and indulgent economic activities, India is among the top 10 countries in solid waste generation. According to TERI (The Energy and Resources Institute) India generates 62 Million Tons (MT) of waste every year, out of which only 43 MT of total waste is collected, 12 MT of waste is treated and the remaining 31 MT tons of waste is thrown away[1]. Research shows that this 62 MT tons of waste generated includes 7.9 MT of hazardous waste, 5.6 MT tons of plastic waste, 1.5 MT tons of e-waste and 0.17 MT tons of biomedical waste and most of this waste is thrown into dumping yards without treatment. The Indian Central Pollution Control Board estimated that waste generation in India would increase to 165 MT tons by 2030.

From 1990 to 2014, India's GDP has increased by 357% and greenhouse gas emissions have also increased by 180%. It has become the first country in the world in terms of population. In 2014, Greenhouse Gas emissions in India were 3,202 million metric tons, which included carbon dioxide and other greenhouse gasses. India's share in global greenhouse gas emissions is 6.55%, of which 68.7% comes from energy sector, 19.6% from agriculture, 6.0% from industrial sector, 1.9% from waste and 3.8% from other activities.[2]

Graph-1: Solid Waste Generation in India

(millions of tonnes/year)



Source-Times of India

https://timesofindia.indiatimes.com/india/in-30-years-india

Note-*Expected Data

The above graph shows India's increasing waste generation in future years. Looking at the figures, it can be inferred that to cope with the problem of waste generation, there exists a need for a proper working system which may address this burgeoning problem of solid waste management.

Solid Waste Management and Inclusive Green Development

"Green growth is about fostering economic growth and development while ensuring that the natural assets continue to provide the resources and environment services on which our well-being relies. To do this it is necessary to catalyze investment and innovation which will underpin sustained growth and give rise to new economic opportunities." OECD Report (2011). [3]

Natural resources, capital, and human resources are the foundations of any country's economic growth; the proper use of these three components leads to favorable socioeconomic and environmental outcomes. Proper allocation of market factor land, labor and capital helps in increasing the growth rate. Green economy is a means to ensure proper allocation of all factors in an environmentally friendly manner, leading to low carbon emissions, inclusive and sustainable development. As growth in any economy increases, consumption capacity also increases which increases the quantity of solid waste. Under the green economy, efforts are made to use solid waste as a new means so that the amount of solid waste can be reduced and new sources of resources can also be obtained. In inclusive green development, efforts are made to make better use of natural resources, reduce population and improve the environment. Solid waste management has a direct relationship with inclusive green development. If solid waste is managed efficiently in an environmentally friendly manner, inclusive growth is enhanced. Due to industrial development and urbanization, problems like resource depletion, environmental degradation and ecological imbalance have increased, especially in urban areas. All these problems are related to solid waste management. Inclusive green development ideas may be used to meet the unlimited needs of the people in the process of rapid development. It includes the use of solid trash as an input resource for generating electricity, composting, production of manure, methane and oil etc.

Literature Review

The World Bank Report (2018) says Solid waste management affects all living beings in direct and indirect ways. Urbanization, economies moving towards indiscriminate development, increasing population have increased solid waste generation. Waste generation across the world is expected to be 3.40 billion tons/year by 2050. Therefore, at present, all levels of solid waste management, including waste collection, treatment, processing and waste disposal, need to work efficiently, including financing and operational models. Technology can be used in a positive way.[4]

Misztal and Dziekanski (2023) have studied waste management keeping in mind the goals of sustainable development. They studied the level of waste management with the the concept of zero waste, green economy and sustainable economy. Apart from this, suggestions have been made to reach the target of zero waste in waste management by involving local authorities.[5]

Rahmawati et al.(2023) have studied the techniques for the management of generated waste in rural areas and they found that the solid waste management process in rural areas includes inclusive development. The research paper has studied the aspects necessary to increase rural public participation and awareness.[6]

Abubakar(2022) studies urbanization, environmental damage, health effects, landfill, recycling and solid waste management processes. He focuses on risk exposures by studying the impacts of solid waste management practices on human and environmental health.[7]

Assessment of Solid Waste Management in Kanpur City

Kanpur city is one of the major cities of India where solid waste generation occurs in large quantities. Because of the city's growing population, there is an increase in solid waste creation from the home sector, as well as industrial trash from industrial regions. A Report received from Kanpur Municipal Corporation reveals that the total quantity of existing legacy waste in the city is 742931 tons and 68.39 acres of land is occupied by dumpsite (Kanpur Nagar Nigam Report). During the pilot survey, It was discovered that the work of removal of these dumpsites by the Municipal Corporation has not been done in an environmentally friendly manner which would negatively affect human health and other living beings. As a result, it will not be easy to achieve the goal of inclusive green growth in the city.

Table-1: Kanpur City Population Statistics

Time	Population	Household
Census 2011	2765348	2765348
Current Scenario	3223188	671120
Projected in 2025	3450742	718501

Source: Report received from Kanpur Municipal Corporation

On the basis of many research studies, it can be said that there is a direct relationship between population growth and solid waste generation. At present the total solid waste generation in Kanpur city is 1773 TDP (ton per day), out of which 1200 TDP is collected , the remaining waste is thrown in open places. By 2025, solid waste generation in Kanpur will be 1897.91TDP (Kanpur Nagar Nigam Report).

Table-2: Solid Waste Management in Kanpur City

1.	Current MSW total generation of TPD	1773
2	Per capita generation in grams	550
3.	Total waste collection TPD	1200
4.	No. of wards and percentage of wards practicing sources segregation	No. of wards- 44 Percentage of wards- 40%
5.	No. of wards and percentage wards practicing 100 % door to door waste collection	No. of wards- 110 Percentage of wards – 100 %
6.	Total quantity transported in TPD	Processing plants- 1200 SLF- 120 Dumpsites- 453
7.	Projected waste generation in 2025	1897.91 TDP
8.	Total quantity of existing legacy waste in tones	742931
9.	Land occupied by the dumpsite	68.39 acres
10.	Total C&D waste (Construction & Demolition) currently generated in TPD	250.18
11.	Existing capacity of C&D waste processing plant available in TPD	200
12.	Proposed capacity of C&D waste in TPD for 2025	55

Source: Report received from Kanpur Municipal Corporation

TPD- Ton Per Day

SLF- Secured Landfill Facility

Here, inefficient waste management is visible from the first level itself. Table 2 shows a huge gap in generation and collection of solid waste in Kanpur city. Total current municipal solid waste generation is 1773 tonnes per day while the collection is only 1200 tonnes per day which is around 67.7 percent of waste generation. It exhibits the fact that around 33.3 percent of total waste is thrown without any treatment. The untreated waste adversely affects the environment, creates health problems, reduces soil productivity and hinders the path of green growth and sustainable development. The third table shows waste characterisation and its percentage in total waste generated in Kanpur city. It shows that 50% of total waste generated is wet waste which is 886.38 tonnes per day. Dry waste comprises 35% of total waste generated in the city. These two types consist of 85% of total waste. The remaining 15% of total waste includes sanitary waste, domestic hazardous waste and other waste. For efficient waste management, the first thing need to be done is to collect these waste separately in different bins from households and inform them to store all types of waste separately in their houses. If the Kanpur Municipal Corporation remains successful in doing so, lots of human labor and unhealthy waste segregation procedures followed could be avoided which would be a highly cost effective and environmentally safe mechanism.

Table3: Kanpur City Waste Characterization and Its Quantity and Percentage

MSW Waste Streams	Quantity in TPD	% of MSW
Wet waste	886.38	50%
Dry waste	620.46	35%
Sanitary waste	88.64	5%
Domestic hazardous waste	88.64	5%
Other wastes (drain silt & inert)	88.64	5%

Source: Report received from Kanpur Municipal Corporation

MSW- Municipal solid Waste

Results and Discussions

Due to migration, population growth, consumerist lifestyle and industrial area in the city, solid waste is generated in large quantities. Being the center of economic activities of the state, the amount of waste generation will continuously increase as many researches show that there is a strong link between economic growth and solid waste generation.

This study shows inadequacies in solid waste management in Kanpur city. The mechanism of solid waste segregation is not scientific and methodical. Solid waste is not being disposed of properly in most areas of the city, it is generally dumped in landfills without treatment which acts as a hindrance in zero waste and inclusive green development.

It has also been found that there is very little awareness and lack of responsibility among the people towards solid waste management. Lack of sense of responsibility was found even at the authority level. Efficient waste management can not only be achieved by waste collection, but all levels of solid waste management, from segregation to disposal which needs to be done in an environmentally-friendly manner.

The 3R concept needs to be adopted along with managing solid waste efficiently. For this, greater efforts are required to use solid waste as a resource for generating electricity, composting, production of manure, methane and oil etc. It has lots of scope for creating new job opportunities in an environmentally sustainable manner.

Solid waste management can be made efficient and environmentally sustainable by creating awareness among all its stakeholders like households, urban authorities, state government etc. The fund allocations and its proper use needs to be ensured and monitored. For a circular economy, planning about development is not sufficient. While, it is equally important to have robust planning and mechanism for solid waste management including the 3R (Reduce, Reuse, Recycle) concept. The sustainable development goals can be obtainable only when the cities march ahead with the thought of Zero waste.

Conclusion

The effective solid waste management is crucial for encouraging inclusive green growth, ensuring environmental sustainability, and enhancing community well-being. Societies can reduce their environmental footprint by implementing comprehensive waste reduction programmes, recycling activities, and embracing circular economy ideas. Inclusive green growth extends beyond environmental considerations to include social and economic factors, ensuring that the benefits of sustainable practices are dispersed equitably across all segments of the society. Solid waste management plays a vital function in this process by creating job opportunities, encouraging community engagement, and protecting public health.

To attain these objectives, coordination across governments, corporations, and communities is required. Policymakers should prioritize the creation and execution of strong waste management legislation, and businesses may help by implementing sustainable methods and investing in environmentally friendly technologies. Communities, on the other hand, play an important role by actively participating in waste reduction and recycling initiatives.To summarize, implementing sustainable solid waste management methods is both an environmental obligation and a catalyst for inclusive green growth. By working together, we can create a more sustainable, resilient, and prosperous future for all, one in which waste is reduced, resources are preserved, and everyone benefits from green growth.

Acknowledgement

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Exploring Nature & Drivers of Economic Growth in Uttar Pradesh: Transitioning from BIMARU to Sarvottam -Viksit Pradesh by 2047[1]

K. V. Raju and Shivakar Tiwari

Abstract

Embarking onthe path of developed Uttar Pradesh, pushing up the trajectory of economic growth is a necessary condition. The historical experience with this is abysmal. Despite the fact of being populous statein India with diverse agro-climatic condition, wide tract of fertile land, educated skilled workforceand tourism destinations, the state is unfortunately lagging much behind the other states in realising its economic potential. To understand the way to the developed state the period can be divided into two phases: Functional (2017-18 to 2029-30) and Futuristic Phase (2030-31 to 2046-47). Action cannot be delayed and thus concerted effort by GoUP has started since 2017 on both the front,streamlining, designing & implementing policy as well as rationalisation of public expenditure towards infrastructure development, the result of which is visible in recent economic outcome indicators like improving investment ecosystem. The policy actions during the functional phase will lead to distinct nature of growth in the futuristic phase.

1. Background Context

In the myriad determinants of economic growth, as explained by the neo-classical economist atleast in the short to medium termis per capita capital/saving (Solow, 1956). The experience of developed and emerging economies shows the specificity of multiple drivers of economic growth including external demand, human capital etc. However, in the developing countries the role of manufacturing sector and export competitiveness seems to be a common factor in all the success stories for example China, South Korea, Hong-Kong etc.

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In the last decade,led by state, India has aggressively enhanced its capex and addressed growth bottleneck through implementation of pro-industry reforms. These have lifted the prospect of higher economic growth that is also widely recognised by international economic institution like IMF projecting it become third largest economy by FY 2027.Undoubtedly, India is going to be economic success story of 21st century with reaching immediate goal of USD 5 trillion economy. In this growth journey the participation of the Uttar Pradesh is crucial. Geographically it is the 3rd largest and the most populous statein India with 238 million population in 2024 as per projected census figures (200 million, census 2011). Along with highest youth population (demographic dividend), there are nine agro-climatic zones in the state, that underlines huge potential to contribute to the economic growth of the country.

Economically state has been laggingto its actual potential as visible in the relatively lower GSDP share as compared to its population share at all India level.The relative economic backwardness of the state is drag on the standard of living of the people as is reflected in the per capita income. In in the year 2016-17, at current price, it was ₹ 59250for Uttar Pradesh as compared to ₹ 103870 of All India average. One of the main reasons of low per capita income growth is the relatively slower economic growth in comparison to population growth. The gap in the per capita income of Uttar Pradesh and all India was just 3.0 percent in 1951-52 that increased to 51 percent by 2016-17 (Singh, 2023). The decelerating rank of the state in per capita income is testimony to the observed pattern. During the period between 1981-82 to 2016-17, the average GSDP growth rate of the state has been lower than only states like Maharashtra, Gujarat, Tamil Nadu & Karnataka, however, the per capita income growth is higher only few states like Biharetc.

Borrowing such lagging economic parameters it has been a challenging task to promote investment and economic growth as it requires big push and a critical minimum in multiple sectors. The present leadership has taken this task to build a developed state and its effort is now started showing visible outcome. To provide further clarity on required effort for promoting investment as well as the larger development outcome in the long-term to be aspired, a detailed serious analysis is needed that include both theoretical proposition as well as empirical validation.

On this background, the present note is an attempt to understand the drivers and growth path of the state to achieve the goal of a developed state by 2047. The journey from 2017 to 2047 is divided into two phases: Functional and Futuristic. The functional phase is focused dominantly on quantitative aspect of economic growth while the latter sketch out the footprint of the distinct growth path to achieve the characteristics of developed state with environmentally inclusive &sustainable development.

2. Functional Phase (2017-18 to 2029-30)

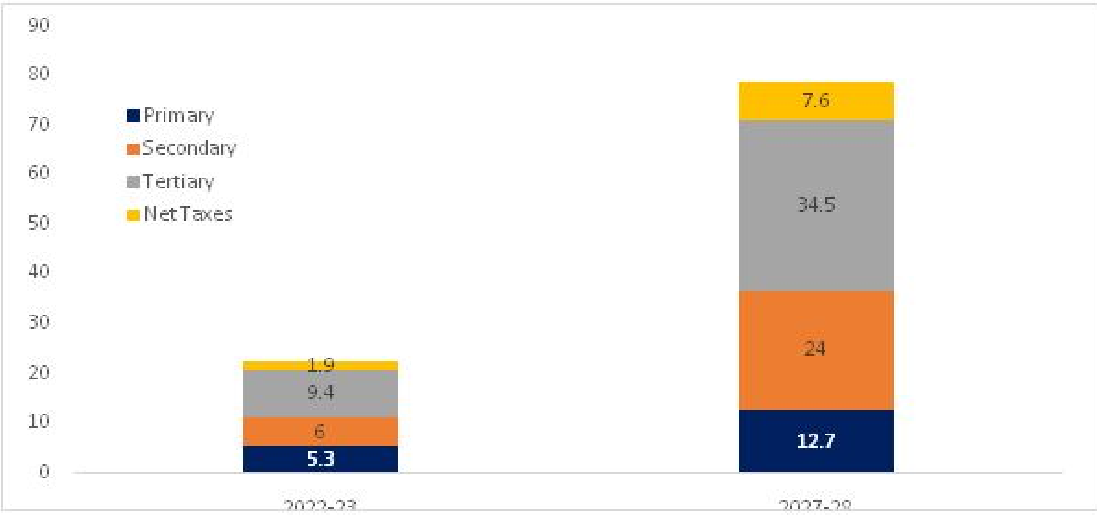
The commitment of the government, since 2017-18, is to achieve economic potential of the state that is going to have impact on improving the standard of living of the 230 million people of the state. The functional growth phase (12 years) period will put the state on resilient/sustainable growth path for achieving the goal of developed state by 2047.

Since growth is necessary condition for economic development, one of the prime requirements in uplifting the state to a category of developed state was achieving higher economic growth.It was only possible if productive sectors of the economy participate in the growth process. Thus, functional phase has the challenge of both realising the immediate growth potential as well as implanting the seed of emerging sector for sustainable growth.

Aiming to Become One Trillion Dollar Economy-

Goals without dreams is just a dream. Government of Uttar Pradesh has adopted ambitious target of making the state a one trillion-dollar economy by FY28. It aims positively to contribute its due share in nations mission of 5 trillion-dollar economyby increasing its share in GDP proportional to its demography from the currently share of around 8 percent to 16 percent. The size of economy will increase from current level of 22.6 lakh crore in 2022-23 to 78.8 lakh crore in 2027-28 (Fig. 1).

Figure 1: Sectoral contribution by FY28



Source: Derived from Strategic Report of Deloitte, 2023

The analysis of strength and gap has been thoroughly conducted to achieve the OTD target. As Uttar Pradesh is a landlocked state, specific key focus/growth sector has been identified along with most crucial enabling sectorto realise the maximum potentialas shown in Table 1. Core sector identified are- Agriculture, Manufacturing, IT/ITES and Tourism. To achieve the growth from these core sector, enabling sectors crucial for its growth includes-Urban Development, Infrastructure, Health, Energy and Education & skilling.

Table 1: Core and Enabling Sectors

Core Sectors	Enabling Sectors
Agriculture	Urban Development
Manufacturing	Infrastructure
IT/ITES	Health
Tourism	Energy
	Education & Skilling

One of the important steps is effective implementation of strategy for achieving OTD target. To ensure effective implementation, high powered committee on Economy (HPCE) headed by Chief Secretary is regularly monitoring department wise progress on activity.

Improved Economic Outcome- In the last six year since 2016-17 the GSDP has been almost double from 12.88 lakh crore in 2016-17 to 22.58 lakh crore in 2022-23. The economic growth during this period has been around 10 percent per annum. Interestingly, per capita GSDP has increased at the CAGR of 8.5 percent from ₹ 59K to ₹ 96K.

Importantly, the achieved higher economic growth has been broad-based as all the three sub-sectors registered significant growth during this period: Primary (9.5%), Secondary (10.1%) and Tertiary (9.2%).

The capital expenditure push of the government is reflected in the highest CAGR of around 12.6 percent for construction sector. Similarly, road transport has also registered CAGR of around 12.2 percent.

The share of productive manufacturing sector in the income structure in the 2016-17 was just 15 percent which was much lower than 21percent and 35 percent share of Tamil Nadu & Gujarat. Also, the state has the challenge to attract investment in the sunrise sectors like Al, robotics & IT/ITES.

Improved Investment Ecosystem

To make the state an investor friendly destination there has been specific initiatives taken in the last seven year that result in improved ranking of the state in EoDB (Ease of Doing Business). The rank of Uttar Pradesh in EODB in 2015-16 was 14th which has improved significantly to 2nd in in 2019-20. Further, in the 2020-21 the state has been awarded achiever category in EODB ranking. The positive impact of improved ranking is reflected in the investor interest in the state necessary for desired economic growth to increase the share of state GSDP in GDP by FY30.

Better law & order situation-

The improved law & order situation has been the cornerstone of government governance since it came into power in March 2017. The positive effect of the better is visible in the NCRB report that shows the crime rate in the state is much below the national average. It has immense dividend for economic growth of the state by promoting investors' confidence. In the GIS 2023, MoU of around 40 lac crores has been signed and more than 30 percent has been brought on the ground in just less than a year.

Policy for Promoting Private Investment

Along with public infrastructure,consistent and clear signal on economic incentive is essential for promoting private investment to achieve sustained growth. In the last six year since 2017, to provide critical push to investment and promote economic activity in different sectors of the economy, **26 policies** have been crafted and published (Annexure).It aims to promote industrial investment in the emerging sunrise sectors and other focus sector. Sunrise sector status is provided to Pharmaceuticals, Logistics & Warehousing, Electric Vehicle Manufacturing and Defence & Aerospace.

The outcome of such policy incentives is visible in the realisation of in the recently held 'GroundbreakingCeremony', (GBC) on 19th to 21st February 2024. In a span of one year since Global Investor Summit (GIS) 2023, around 14000 projects have been implemented with the investment of approximately ¹ 10.0 lac crore.

One District One Product- As per MoSPI estimate, Uttar Pradesh has largest MSME units in India (around 90 lakhs) that account for 14.2% of total MSME in the country[2]. These units are engine of inclusive growth, employment generation as well as export. It contributes around 60 percent of total industrial output and 45 percent of total state's export. In the last six year, to give further impetus to MSME sector alongODOP scheme has been launched in year 2018. One of the main objectives of the scheme to promote indigenous product at the national and international level by addressing challenges of the sector like working capital, branding of the product.

Better Logistics through Improved Connectivity- Logistics cost is one of the important factors that affect GSDP through negative affect on profitability of the enterprise through increased transaction and time cost (NCAER, 2023). Also,along with poor road & air connectivity, being a landlocked state creates the major challenge to attract industrial investment.It keeps the state at competitive disadvantage compared to the port states like Gujarat, TamilNadu and Maharashtra in attracting investment. In the last six years, ensuring world class road, air and water connectivity remained at the forefront of government economic policy in improving business ecosystem in the state.

Since 2017 the number of expressways has increased from to 14 and are now arteries of growth. Today every region (Annexure) of the state is well connected with airport and there is five international airports in the state which is the largest in any state in India. Further to this progress is the inland waterways and the state has first inland waterways facility that connects from Varanasi to Haldia port.

Tourism and Trade- Tourism is the growth potential sector that has direct linkages with Trade, Transport and Hotel & Restaurant. Investment in the tourism destination and their branding is contributing to the overall economic growth of the state. Although state has rich natural heritage, revered religious places, historical monuments but lack of proper connectivity & basic facilities protect us to realise its full growth potential. International tourist with much higher per tourist expense in the total tourist footfall has lower proportion. The effort of state is started showing results with the remarkable increase in tourist footfall. As per official estimate around 31 crores[3] has been tourist footfall in 2023 which is highest in the country.

State Capital Region (SCR)- Urban area is a centre of economic growth with strong positive externalities. At the same time, it also poses challenges of sustainable living with increased population pressure on resources. To achieve the best of both, the state government has announced to develop state capital region (SCR) on the pattern of NCR including six districts- Barabanki, Lucknow, Unnao, Sitapur, Raebareli and Hardoi. SCR is going to be hub of both economic and cultural development.

Development of Industrial Corridor- To realise the target of increasing manufacturing sector share in GSDP regions surrounding expressway is being further planned to be developed as Industrial corridor. Example, Yamuna Expressway Industrial Development Authority (YEIDA). Also Uttar Pradesh Industrial Defence corridor, YEIDA and Bundelkhand Industrial Development Authority (BIDA) is going to make the state a manufacturing hub.

Index for faster and Inclusive Growth- Administratively, the state has 75 districts spread over nine agro-climatic zone. There also exist huge disparity in the level of economic developed measure through DDP (District Domestic Product) and other reliable economic indicators. The participation of each district is extremely important in achieving the target of OTD by FY 208. To fill the necessary measurement gap for participatory growth DDP estimation through bottom-up approach is being taken in four pilot districts that is planned to further be scaled up for all 75 districts. Further comprehensive district index on Education, health, Living Standard, Infrastructure, Competitiveness and Climate Vulnerability is under process of development. This together will not only ensure inclusive development but will be provide synergy for higher economic growth of the state.

3. Futuristic Growth Path (2030-31 to 2046-47)

Having achieved the path of sustained economic, India's realistic aspiration ofbecoming developed nation (Viskhit Bharat) by 2047 will only be possible with the participation of Uttar Pradesh and so it sets a goal for the state as well to become a developed state by 2047. It has also set the unique nature of economic growth path the state should be achieving on the base of higher economic growth in the period up to 2030. The sketch of characteristics of nature of economic growth and development during this phase may including:

Sustained GSDP Growth- It is the necessary condition and thus momentum provided to the states growth during the functional phase will ensure sustained double-digit growth. The higher economic growth must be accompanied by smoother income distribution curve. It will be achieved by increased participation of SME & traders catering to both domestic and export sector.

Demographic Transition- As per recent NFHS report, total fertility rate has peaked out in the state with TFR falling below replacement level of 2.0 in coming years.Due to this, in the next decade the state will start facing the challenge of advanced stage of demographic transition like ageing along with decreasing demographic dividend. It will create major opportunity in tertiary healthcare and related sector.

Higher Per Capita Income- Higher per capita income is one of main criteria for classification of developed state. As per world bank criteria, to be tagged as developed state required per capita income is $13205 at the current exchange rate[4] and the per capita income of Uttar Pradesh is just $1160. So, in the next 25 years the per capita income of the must grow by CAGR of 10 percent on the backdrop of 8.4 percent per capita income growth in the last six years. Thus, along with increase in the GSDP, improvement in per capita is required for broader increase in standard of living of the people. Higher GSDP growth with stable population will lead to increase in the level of per capita income. This will also be possible with the lesser inequality with the achieved higher economic growth.

Balanced regional development- The state is spread over large geographical area and 9 agro-climatic zone. Presently due to various factors there exist huge gap in the level of economic status across district and regions (Dubey and Tiwari, 2019). The economic approach adopted in the functional phase to bridge the infrastructure gap among the region including massive improvement in connectivity (road & airway). Due to catch up, the further growth will come from relative backward region like Bundelkhand & Purvanchal. There exists huge scope in achieving higher economic growth as they will catch up with relatively developed region like Western and central region.

Increased enrolment in higher education- Population with higher level of education is one of the important prerequisites not only for economic growth but also for development. As per AISHE 2023, the state's GER in higher education of 21.8 percent is lower than the national average of 27.3 percent and is much lower than Tamil Nadu (49.3 percent). The investment in the higher educational institution infrastructure will lead to increase in significant increase in the GER.

Digital and Spatial Technology- it is rightly said, "anything that can be measured can be improved". Thus, harnessing the technology will be a major driver for development. In this context, platform like **agristac** is going to play a major role in assessment and measurement of crop production and its planning. Further,asset mapping in urban area will be an impactful in revenue assessment and mobilisation for urban local bodies. Similarly, resource mapping is going to be efficient guide for sustainable planning for urban area.

Higher rate of urbanisation- Increased share of urban population is the characteristics of higher economic development. As the current urbanisation rate in the state is much below the national average the share will increase significantly over the period. As per census 2011, urbanisation rate in the state was just 22.27% much lower as compared to the all India average of 31.16%.

Increased share of renewable and green energy- The sustainable development will be a distant dream without addressing the energy need. As discussed above, the state is massively investing in solar power and other renewable energy source. Even though the dependence on thermal will be important but the share of the new energy will go up significantly and the household participation with solar rooftop will go up.

Annexure Tables

S.no.	Policy Implemented
1	Uttar Pradesh Pharmaceutical and Medical Device Policy, 2023
2	Uttar Pradesh FDI, Fortune Global & India-500 Investment Promotion Policy, 2023
3	Uttar Pradesh Township Policy 2023
4	Uttar Pradesh Film Policy 2023
5	Sports Policy 2023
6	Uttar Pradesh Food Procession Policy 2023
7	Uttar Pradesh Warehousing & Logistics Policy 2022
8	Uttar Pradesh Solar Energy Policy, 2022
9	Tourism Policy 2022
10	IT and ITES Policy of Uttar Pradesh 2022
11	Uttar Pradesh Poultry Development Policy 2022
12	Uttar Pradesh Export Promotion Policy, 2020-2025
13	Uttar Pradesh Startup Policy 2020 (First Amendment- 2022)
14	Private Medical College (Unserved Districts Scheme 2022)
15	Uttar Pradesh Agriculture Export Policy 2019 (First Amendment- 2021)
16	Dairy Development Policy, 2022
17	Uttar Pradesh Textile and Garment Policy, 2022
18	Uttar Pradesh Aircraft Maintenance Repair and Overhaul Policy, 2022
19	Uttar Pradesh Defence &Aerospace Unit & Export Promotion Policy 2022
20	Uttar Pradesh Electric Vehicle Manufacturing Policy, 2022
21	Uttar Pradesh State Bio-energy Policy, 2022
22	Uttar Pradesh Micro, Small & Medium Enterprise Promotion Policy, 2022
23	Uttar Pradesh Data Centre Policy, 2021
24	Uttar Pradesh Electronics Manufacturing Policy, 2020
25	Uttar Pradesh Film Policy, 2018
26	Uttar Pradesh Pharmaceutical Industry Policy, 2018
27	Uttar Pradesh Civil Aviation Promotion Policy, 2017

Table: Expressway Constructed in the State

Expressways	**Kms**
Yamuna Expressway	165.5
Agra-Lucknow Expressway	302.33
Purvanchal Expressway	340.824
Bundelkhand Expressway	296.070
Gorakhpur Link Expressway	91.352
Ganga Expressway	593.947

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(Footnotes)

[1]This paper is submitted by the authors for the 19thAnnual conference of Uttar Pradesh and Uttarakhand Economic Association (UPUEA) on " Sustainable Growth and Equity: Sectoral Growth, Trade and Social Protection in 21 st Century". The views expressed here are personal and should be considered as academic exercise.

[2]https://www.fortuneindia.com/macro/why-one-district-one-product-is-critical-to-up/105040

[3]https://timesofindia.indiatimes.com/city/lucknow/up-to-become-no-1-tourist-destination-tourism-footfall-records-broken/articleshow/107376159.cms

[4]https://www.deccanherald.com/opinion/viksit-bharat-or-developed-india-in-2047-the-task-ahead-2871769

जलवायु परिवर्तन और इसका कृषि पर प्रभाव

Dr. Priya Kumari* Ayushi Yadav**

वर्तमान परिदृष्य में जलवायु परिवर्तन कोई एक देश या राष्ट्र से सम्बन्धित अवधारणा नहीं है अपितु एक वैश्विक मुद्दे के रूप में उभर कर आया है जो समस्त पृथ्वी के लिए चिन्ता का कारण बनती जा रही है। जलवायु परिवर्तन से भारत सहित पूरे विश्व में बाढ़, सूखा, कृषि संकट एवं खाद्य सुरक्षा, प्रवासन, बीमारियाँ आदि का संकट बढ़ा है जिसमें कृषि विशेष रूप से जलवायु परिवर्तन के प्रति संवेदनशील है। जलवायु परिवर्तन के कारण वातावरण में विभिन्न परिवर्तन जैसे कम या ज्यादा बारिश, तापमान में वृद्धि, हवा की दिशा में बदलाव आदि हो रहे हैं जिससे कृषि उत्पादन पर खतरा बढ़ा है। जलवायु परिवर्तन कृषि को प्रत्यक्ष एवं अप्रत्यक्ष रूप में प्रभावित करता है, उदाहरण स्वरूप– मानसून के दौरान वर्षा की अवधि में कमी होने के फलस्वरूप मानसूनी क्षेत्रों की कृषि उत्पादकता में गिरावट आती है। देखा जाए तो जलवायु परिवर्तन सम्पूर्ण विश्व के लिए संकट का विषय है परन्तु भारत, इसके प्रभावों के प्रति अधिक संवेदनशील है क्योंकि भारत का एक बड़ा तबका (लगभग 60 प्रतिशत आबादी) वर्तमान समय में भी कृषि पर निर्भर है और इसके अलावा भारत में कृषि मुख्यतः मौसम पर आधारित है जिसके कारण जलवायु परिवर्तन की वजह से होने वाले मौसमी बदलावों का इस पर अधिक असर पड़ता है। इसलिए कृषि पर जलवायु परितर्वन के प्रभावों को देखना बहुत आवश्यक होता जा रहा है।

ग्लोबल क्लाइमेट रिस्क इंडेक्स, 2021 की रिपोर्ट के तहत यह देखा गया कि जलवायु परिवर्तन से सबसे अधिक प्रभावित दस शीर्ष देशों में भारत भी शामिल है। जलवायु परिवर्तन के कारण बदलती मौसमी परिस्थितियाँ कृषि को अत्यधिक प्रभावित कर रही हैं। अतः इस शोध पत्र में हम यह जानने का प्रयास करेंगे कि जलवायु परिवर्तन कृषि को कैसे प्रभावित करता है, इसके साथ ही इस समस्या के समाधानों की चर्चा भी अत्यावश्यक है।

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कृषि पर जलवायु परिवर्तन का प्रभाव

कृषि उत्पादन में गिरावट

कृषि के लिए जलवायु परिवर्तन एक बड़ी चुनौती बन कर उभरा है। बेमौसम और औसत से कम बारिश होने के कारण 2023.24 के करीब सभी खरीफ फसलों पर असर पड़ा है। इससे उत्पादन में गिरावट आई है। वही रबी फसल में भी पिछले साल के मुकाबले गिरावट आई हैए वहीं रबी फसलों में भी पिछले साल के मुकाबले गिरावट आई है। खराब मौसम के कारण खरीफ उत्पादन में गिरावट के कारण जुलाई–सितंबर तिमाही में देश के कृषि क्षेत्र की विकास दर घटकर 1.2% रह गई है। इसका प्रतिकूल प्रभाव चालू रबी सीजन पर पड़ा है और सामान्य से कम मानसून के कारण कुल बोए क्षेत्र में 3% से अधिक की गिरावट आई है। गेहूँ और दालों के रकबे में क्रमशः 3 और 8% की गिरावट आई है। इससे आगे चलकर खाद्य उत्पादन में गिरावट को लेकर चिंता बढ़ गई है।

औसत तापमान में वृद्धि

औसत तापमान में वष्द्धि होने से फसलों के उत्पादन पर असर पड़ता है। कुछ फसल जैसे गेहूँ सरसों, जौ और आलू जिनको कम तापमान की जरूरत होती है, अगर तापमान में वष्द्धि होती है तो इनके उत्पादन में कमी आ सकती है। इसी प्रकार धान, ज्वार, औ मक्का को भी कम तापमान की आवश्यकता होती है। इस प्रकार औसत तापमान में वष्द्धि से इन फसलों का नुकसान हो सकता है। इंडियन एग्रीकल्चरल रिसर्च इंस्टिट्यूट के अनुसार अगर तापमान 1 डिग्री सेल्सियस तक बढ़ता है तो इससे 5% तक गेहूँ की पैदावार में कमी होगी।

वर्षा के पैटर्न में बदलाव

भारत की लगभग 55% कृषि योग्य भूमि वर्षा पर निर्भर है। वर्षा के पैटर्न में बदलाव भारत की अर्थव्यवस्था, खाद्य प्रणालियों और जनहित से संबन्धित गंभीर परिणाम दे सकता है। दक्षिण–पश्चिम मानसून भारत की कृषि में महत्वपूर्ण भूमिका निभाता है और यह विश्व की अधिकांश जनसंख्या की आजीविका को प्रभावित करता है। भारत में वार्षिक वर्षा की लगभग 80% गर्मी की अवधि के दौरान होती है तथा प्रमुख कृषि मौसम के दौरान फसलों को सिंचाई आदि माध्यमों से जल की आपूर्ति की जाती है। दक्षिण–पश्चिम मानसून के दौरान गन्ना, जूट और धान जैसी जल की अधिक आवश्यकता वाली मानसून के अनुकूल फसलों की खेती आसानी से की जा सकती है। इसलिए बहुत अधिक वर्षा या बहुत कम या अस्थिर मानसून पैटर्न, फसलों को नुकसान पहुँचा सकता है।

कार्बन–डाइऑक्साइड में वृद्धि

जलवायु परिवर्तन से कार्बन डाईऑक्साइड में लगातार वृद्धि हो रही जो कि कृषि के उत्पादन और उत्पादकता को प्रभावित करती है। इसका मुख्य कारण यह है ग्रीनहाउस गैसों के उत्सर्जन में वृद्धि हो रही है और जिसके कारण वैश्विक तापमान में भी वृद्धि हो रही है।

वातावरण में कार्बन की मात्रा बढ़ने से फसलों की पोषण गुणवत्ता में कमी आ रही है, उदाहरण के लिए उच्च कार्बन वातावरण के कारण गेंहूँ की पौष्टिकता में प्रोटीन का 6% से 13% जस्ते का 4% से 7% और लोहे का 5% से 8% तक की कमी आ रही है।

कृषि क्षेत्र की भूमि की गुणवत्ता में कमी

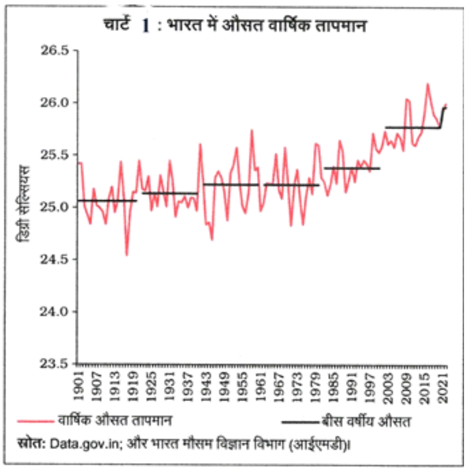
जलस्रोत और भंडार तेजी से सिकुड़ने के कारण किसानों को परम्परागत सिंचाई के तरीके छोड़कर पानी की कम खपत करने वाले आधुनिक तरीके अपनाना होगा। एक रिपोर्ट के अनुसार जलवायु परिवर्तन की वजह से प्रदूषण, भू–क्षरण और सूखा पड़ने से पृथ्वी के तीन चौथाई भूमि क्षेत्र की गुणवत्ता कम हो गई है। ज्यादा अनाज उगाने की हमारी कोशिश में मिट्टी का इस हद तक दुरूपयोग हुआ है कि अब यह हमारी सेहत को प्रभावित करने लगा है। मिट्टी की गुणवत्ता विभिन्न भौतिक, रासायनिक और जैविक प्रक्रियाओं का नतीजा है। बहुत ज्यादा खेती, अत्याधिक दोहन जैविक और अजैविक स्रोतों से सीमित क्षतिपूर्ति के कारण मिट्टी की गुणवत्ता क्षीण हुई है। राष्ट्रीय कृषि विज्ञान अकादमी (एनएएएस) के अनुसार, हमारे देश में मिट्टी के नुकसान की सलाना दर 15.35 टन हेक्टेयर है, जो 53.7 से 84 लाख टन पोषक तत्वों का नुकसान करती है। जलभराव जो खारापन पैदा करके मिट्टी को नुकसान पहूँचाता है और इसके चलते भारत में सालाना 12 से 60 लाख टन अनाज का नुकसान होता है।

कीट एवं रोगों में वृद्धि

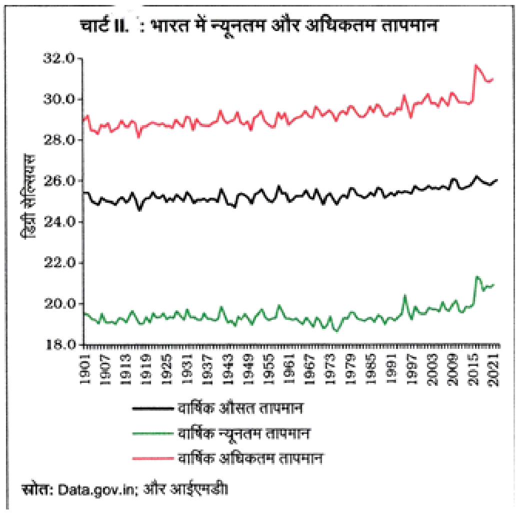
कीट एवं रोगाणुओं में वृद्धि जलवायु परिवर्तन के कारण होती है। जलवायु गर्म होने कीट पतंगों की प्रजनन क्षमता में वृद्धि होने से कीटों की संख्या लगातार बढ़ती रहती है और इसका प्रभाव कृषि उत्पादन पर पड़ता है। जब कीटों को समाप्त करने के लिए कीटनाशक का प्रयोग होता है तो वह कहीं न कहीं फसल के उत्पादन में बाधा डालता है।

भारत में जलवायु परिवर्तन की अभिव्यक्ति

प्रमुख संकेतक जो जलवायु सम्बन्धी दबाव के बारे में संकेत देते हैं, वे विशिष्ट तापमान और वर्षा विसंगतियाँ हैं। भारत ने हाल के वर्षों में इन विसंगतियों को अक्सर को देखा है, जबकि भारत में वार्षिक औसत तापमान धीरे–धीरे बढ़ रहा है, 1901 के बाद से किसी भी अन्य 20–वर्षीय समय अंतराल की तुलना में पिछले बीस वर्षों के दौरान वर्षद्धि काफी तेज रही है (चार्ट–1)।



न्यूनतम और अधिकतम तापमान के दृष्टिकोण से, 1901–2021 के दौरान वार्षिक औसत तापमान में प्रति 100 वर्षों में 0.63 डिग्री सेल्सियस की वृद्धि देखी गयी, जबकि अधिकतम तापमान में प्रति 100 वर्षों में 0.99 डिग्री सेल्सियस की वृद्धि हुई। न्यूनतम तापमान में वृद्धि की प्रवृत्ति अधिकतम तापमान की तुलना में अपेक्षाकृत कम थी, न्यूनतम तापमान में प्रति 100 वर्षों में 0.26 डिग्री सेल्सियस की वृद्धि हुई (आईएमडी, 2021) (चार्ट–II)



कृषि पर जलवायु परिवर्तन का प्रभाव कम करने के उपाय–

जैविक एवं समग्रित खेती

रासायनिक खेती से हरित गैसों के उत्सर्जन में वृद्धि होती है और कीटनाशक, रासायनिक खाद के इस्तेमाल से मृदा की उत्पादकता घटती है और मानव शरीर में पहुँचकर शरीर में बीमारियाँ उत्पन्न करती है। अतः हमें जैविक खेती करने की तकनीकों पर अधिक जोर देना चाहिए।

फसल उत्पादन की नई तकनीक का विकास

हमे फसलों के प्रारूप एवं उनके बीज बोने के के समय में भी परिवर्तन करना होगा, नई तकनीकों को अपनाकर, वर्षा जल संरक्षण, मिश्रित खेती व इन्टरक्रापिंग करके जलवायु परिवर्तन के खतरों से निपटा जा सकता है।

जलवायु स्मार्ट कृषि

देश में जलवायु स्मार्ट कृषि (Climate Smart Agriculture- CSA) विकसित करने की एक मजबूत शुरूआत की गई है। यह एक दृष्टिकोण है जिसमें फसली भूमि, पशुधन, वन और मछली पालन के प्रबंधन का प्रावधान होता है। यह परियोजना खाद्य सुरक्षा और जलवायु परिवर्तन की चुनौतियों का सामना करने के लिए बनाई गई है, जो कि तीन परिणामों पर लक्षित है जैसे कि उत्पादकता में वृद्धि, लचीलेपन में वृद्धि। इसमें सूखा, फसल कीट, बीमारी और अन्य किसी प्रकार के खतरे की चपेट में कमी लाने के साथ अनिश्चित मौसम पैर्टन जैसे खतरों के प्रति अनुकूल क्षमता में सुधार, उत्पादित प्रत्येक कैलोरी भोजन के लिए कम उत्सर्जन, कृषि के लिए वनों की कटाई न करना और वातावरण से कार्बन अवशोषण के तरीके की पहचान करना।

वर्षा जल के उचित प्रबन्धन द्वारा

जलवायु परिवर्तन से तापमान वृद्धि होती है। ऐसे में वर्षा जल को एकत्रित करके सिंचाई हेतु उपयोगी कदम हो सकता है। वाटर शेड प्रबन्धन से हम वर्षा जल को सिंचाई के रूप में प्रयोग कर सकते है वही दूसरी ओर भोजन पुनभरण में भी मदद मिलती है।

मौसम पूर्वानुमान द्वारा

जलवायु परिवर्तन के इस समय में मौसम के पूर्वानुमान के द्वारा आँधी तूफान एवं असमय वर्षा होने से होने वाले नुकसान को कम कर सकते हैं। जिले स्तर पर प्रत्येक कृषि विज्ञान केन्द्र पर जिला कृषि मौसम ईकाई की स्थापना की गयी है।

इसी दिशा में भारत सरकार द्वारा प्रयास किया गया। जलवायु परिवर्तन के लिए 2008 में राष्ट्रीय कार्ययोजना जारी की गई। राष्ट्रीय सतत कृषि मिशन जलवायु परिवर्तन पर निर्मित आठ राष्ट्रीय एक्शन प्लान में से एक है जो कि कृषि क्षेत्र पर केंद्रित है। इस मिशन द्वारा भारतीय कृषि को अधिक

प्रभावी बनाने हेतु योजना बनाई गई है। इस मिशन के कुछ उद्देश्य है जैसे कृषि से अधिक उत्पादन प्राप्त करना, टिकाऊ खेती पर जोर देना, प्राकृतिक जल स्रोतों व मृदा संरक्षण पर ध्यान देना, भूमि जल गुणवत्ता बनाए रखना तथा शुष्क कृषि को बढ़ावा देना। इसके साथ ही वैकल्पिक कृषि पद्धति को भी अपनाया जाएगा और इसके तहत जोखिम प्रबंधन, कृषि संबधी ज्ञान सूचना एवम् प्रौद्योगिकी पर विशेष ध्यान केंद्रित किया जाएगा।

अतः कहा जा सकता है कि जलवायु परिवर्तन वैश्विक और भारतीय कृषि व्यवस्था पर वृहद स्तर पर प्रभाव डालता है। भारतीय कृषि को जलवायु परिवर्तन के प्रति अनुकूल और सक्षम बनाने में भारत सरकार द्वारा किए गए प्रयास सराहनीय है। इस प्रकार कृषि को जलवायु परिवर्तन के दुष्प्रभावों से बचाने के लिए हमें मिल–जुलकर मैत्री तरीकों को अपनाना होगा ताकि हम अपने प्राकृतिक–संसाधन को बचा सके और कृषि व्यवस्था को और सुदृढ़ बना सके।

सन्दर्भ

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अयोध्या क्षेत्र में स्क्रैप आर्ट : पर्यावरण सुरक्षा के विशेष संदर्भ में

श्रीमती रीमा सिंह*

सारांश

भविष्य में अपशिष्ट निवारण संबंधी मुश्किले तीव्रता के साथ पनपने की संभावनाएँ है, अगर भारत के साथ–साथ विश्व के अन्य कलाकार स्क्रैप आर्ट् पर काम करें तो निश्चित ही बड़े पैमाने पर अपशिष्ट निवारण में अपना महत्वपूर्ण योगदान प्रदान कर सकते है। पर्यावरण प्रदूषण की रोकथाम के साथ अपने आस पास के परिवेश को तथा आने वाली पीढ़ियों के लिए सुन्दर एवं स्वच्छ बना सकेंगे तथा उन्हें कलात्मक ढ़ंग से इस दुविधा से निपटने की सीख देते हुए एक मिसाल कायम करने मे सहायक होंगे।

प्रस्तुत शोध का विश्लेषण तीन (03) खण्डों में किया गया है – प्रथम खण्ड में विषय से संबंधित प्रस्तावना अध्ययन का उद्देश्य तथा षोध विधि का समावेष किया गया है। द्वितीय खण्ड में आंकड़ा स्रोत एवं विधितंत्र तथा शोध निराकरण को विश्लेषित किया गया है। तृतीय खण्ड में निष्कर्ष एवं संदर्भसूची को समाहित किया गया है।

प्रथम खण्ड

प्रस्तावना

स्क्रैप आर्ट् का अर्थ होता है– कलाकार द्वारा अनुपयोगी वस्तुओं से कलाकृतियों का निर्माण करना। कला के क्षेत्र में वर्तमान समय में स्क्रैप आर्ट् प्रचलित शब्द हो चुका है परन्तु इसकी शुरुआत 1950 के दशक के United State में जन्मे Assemblage Art कला आंदोलन से संबंध रखती है। सन् 1950 के दशक में कलाकार ने Scrape Art के लिए Dubuttet शब्द का प्रयोग किया। यही वह समय था जब कलाकार ने रोजमर्रा की वस्तुओं को अपने कला में प्रयोग करना शुरु किया। कला क्षेत्र में किया गया यह नवीन प्रयोग समकालीन कलाकारो को एक नई दिशा प्रदान करता है, इन नवीन प्रयोगो ने Assemblage Art, Installation Art, Junk Art, Made Art- Ready जैसे नए कला प्रवषत्तियों को जन्म दिया। कला की इस नई विधाको पारंपरिक चित्रकला और मूर्तिकला से जोड़ कर देखना संभव नहीं है क्योंकि कला की ये पारंपरिक विधाएं कुछ खास तकनीकों पर आधारित है जैसे कि

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अगर चित्र बना है तो कागज, कलम, रंग, तूलिका, मिट्टी, लकड़ी और उससे संबंधित उपकरणों की आवश्यकता होती है जबकि "SCRAP ART" Assemblage Labrication की तकनीको पर आधारित होती है, जिसमें हम त्रिआयामी "Made-Ready" (पहले से ही बनी–बनाई वस्तु) और "Found Objects" को जोड़कर एक नई आकृति तैयार करतें है। कला की यह नयी विधा पुराने सभी पारंपरिक माध्यमों को चुनौति देते हुए नए संभावनाओं को जन्म देने के साथ ही पर्यावरण को शुद्ध बनाने के लिए पुनः उपयोग और रीसायकल की संस्कृति को प्रभावित करता है। कुछ मूर्तिकार अपनी कलाकृति के लिए स्क्रैप धातु का भी प्रयाग करते है कलाकारो के लिए आकर्षण विभिन्न सामग्रीयों, रंगो, आकारों और रुपो में है, जो विभिन्न प्रकार की पुनर्नवीनीकृति धातुओं में आते हैं। पुनर्चक्रित धातुओ से बनी मूर्तिकला विशिष्ट और अद्वितीय है। पुनर्नवीनीकृति धातु की उच्च सांद्रता का उपयोग आटोमोबाइल, विमान, जहाज निर्माण, ट्रेन ट्रैक और पुलो में किया जाता है। विनिर्माण और औद्योगिक–नए उपभोक्ता समान जैसे उपकरण औजार बड़ी मात्रा में पुनर्नवीनीकृति धातु का उपयोग करते हैं। सबसे अधिक बार पुनर्नवीनीकरण की जाने वाली धातुएं– एल्युमीनियम, पीतल, कांस्य, कच्चा लोहा, तांबा, स्टील और टिन है। ऐसी धातुएं जिनका पुनर्चक्रण नहीं किया जा सकता– रेडियोधर्मी धातुएं, पारा, दूषित डिब्बे, घरेलू उपकरण जिनमें हानिकारक विषाक्त पदार्थ होते है और अशुद्ध धातुएं शामिल है। यूरेनियम, प्लूटोनियम और रेडॉन जैसे रेडियोधर्मी धातुओं को पुनर्चक्रित नहीं किया जा सकता क्योंकि इन धातुओं के पुनर्चकक्रण की प्रक्रिया श्रमिकों को विकिरण के संपर्क में ला सकती हैं।

अध्ययन का उददेश

- अपशिष्ट सामग्री का कला के माध्यम से उचित निराकरण हेतु रणनीति प्रस्तुत करना।
- स्क्रैप आर्ट् के बारे मे जागरुकता फैलाना।
- 3 R-Rycycle, Reuse, Reduce की अवधारणा का कला के द्वारा प्रदर्शन।
- स्क्रैप आर्ट् आज के समय में पर्यावरण के लिए किस प्रकार लाभदायक है इसे जनमानस तक पहुँचाना।

अध्ययन क्षेत्र

प्रस्तुत लेख हेतु अयोध्या क्षेत्र के स्क्रैप आर्ट् को चुना गया है षेश अध्ययन हेतु देश, प्रदेश तथा वैश्विक स्तर के अध्ययनों का भी समावेष किया गया।

शोधविधि

यह अध्ययन विषेशत प्राथमिक डाटा विषलेशण एवं द्वितीयक आंकड़ो पर आधारित है। प्रमुख तथ्यों का संकलन विभिन्न प्रकाषित पुस्तकों, समाचार पत्र, पत्रिकाओं, लेखों, सरकारी प्रतिवेदन एवं इण्टरनेट पर उपल्ध सामग्री का उपयोग किया गया है।

द्वितीय खण्ड

आंकडा स्रोत एवं विधितंत्र

विश्व की लगातार बढ़ती जनसंख्याा जिस प्रकार अपने आस पास विभिन्न तरह के उत्पादो। से घिरी है, ये उत्पाद रोजमर्रा की जिंदगी को आसान तो बनाते हैं लेकिन क्या कभी किसी ने ये सोचा कि इनके उपयोग के बाद जब यह अनुपयोगी हो जायेंगें तो इनका निस्तारण कैसे होगा? इन उत्पादों में से कुछ कबाड़ी वाले को बेंच दिया जाता है, कुछ रीसायकल हो जाते है, लेकिन कुछ मटेरियल्स को रीसायकल करना मुश्किल होता है या कहा जा सकता है कि उत्पाद के तादात के अनुपात में रीसायकल करना अत्यंत मुश्किल होता है। विश्व में कई देश कूड़े का ढ़ेर बन चुके है जो की एक बड़ी समस्या के रुप में लोगो के सामने आ रही है। रीसायकल की इन्ही समस्याओ से निपटने के लिए स्क्रैप आर्ट् एक बेहतरीन विकल्प है जो कि अपशिष्ट पदार्थ निस्तारण के साथ ही हमारे आस–पास की जगह को सुंदर एवं आकर्षक बनाता हैं। समकालीन कला के क्षेत्र में कुछ कलाकार स्क्रैप मैटेरियल्स को उपयोग में लाकर कलाकृतियों की रचना का माध्यम बना रहे तथा अपने भावों की अभिव्यक्ति इन कृतियों द्वारा कर रहें हैं। ये कलाकृतियां स्क्रैप मैटेरियल्स की बेहतरीन उपयोगिता की सूचक है तथा पर्यावरण को सुंदर बनाने का काम भी कर रही हैं। स्क्रैप से बनी कलाकृतियां लोगो को सोचने पर मजबूर कर रही है कि जिसे वे अनुपयोगी समझकर निष्कासित कर देते थे वही वस्तु उनके आस–पास के वातावरण को बाग–बगीचों, घरों, चौराहों आदि को सुंदर बनाने का काम कर रहीं हैं। इस प्रयास से लोग न सिर्फ सुंदरता का आनंद उठाते हैं बल्कि अनचाही और बेकार वस्तुओं का महत्व भी समझने लगे हैं तथा इससे सीख लेकर खुद भी उसका संरक्षण करने के साथ उसके उपयोग के बारे में सोचते हैं। जिस तरह पर्यावरणीय चुनौतियों पर व्यापक बहस होती जा रही है इस तरह भारतीय कलाकारों की संख्या बढ़ रही है जो धातु के स्क्रैप की और रुख कर रहे हैं, ये कलाकार अपनी कलाकृतियों के द्वारा पर्यावरण को बचाने के लिए निरंतर प्रयासरत हैं।

विश्व बैंक की एक रिपोर्ट 2016 में ठोस अपशिष्ट प्रबंधन से 1.6 बिलियन टन कार्बन डाई आक्साइड समतुल्य (CO^2 – समतुल्य) ग्रीन हाउस गैस उत्सर्जन का अनुमान लगाया गया है। इस क्षेत्र में सुधार के लिए अपशिष्ट से संबंधित उत्सर्जन 2.6 बिलियन टन CO^2 (2050) तक बढ़ने का अनुमान है।

अपशिष्ट प्रबंधन का स्वर्ण नियम 'R3'

1. Reduce कम करें–कम उपयोग करें
2. Reuse पुनः उपयोग–पुनः उपयोग करें
3. Recycle पुनर्नवीनीकरण–फिर से प्रयोग करें

वाक्यांश– कम करना, पुनः उपयोग करना, रीसायकल करना, सामग्री के बेहतर उपयोग के लिए गतिविधियों के अनुशंसित अनुक्रम को कम नुकसान पहुंचा सकें। हमारे पर्यावरण के लिए प्राथमिक लाभों के अलावा ये 3ट अन्य लाभ भी प्रदान करते है जैसे– वित्तिय बचत।

कचरे को कम करने के तीन नियम हैं

1. Reduce– इसका मतलब है उन संसाधनो का बचत जो भविष्य के लिए अधिक उपयोगी है। उदाहरण– बिजली बचाने के लिए उपयोग न होने पर लाइट स्विच ऑफ करना इत्यादि।
2. Reuse– यह रणनीति उत्पाद की सामग्री को बार–बार उपयोग करने के लिए होता है। उदाहरण– भंडारण कंटेनर के रुप में कार्य करने के लिए पुरानी बोतलों या जार का पुनः उपयोग।
3. Recycle– दैनिक उत्पाद की वस्तुओं को बनाने के लिए नई सामग्री का उपयोग न करके पुरानी ही वस्तुओं को एकत्रित कर उनका प्रयोग करें। उदाहरण– बेकार प्लास्टिक की बोतल से फूलदान बनाना इत्यादि।

'R3' का महत्व बढ़ती आबादी के साथ यह हमारे प्राकृतिक संसाधनों के संरक्षण के लिए महत्वपूर्ण हो गया है जो दीर्घकालिक में अनवीकरणीय है और इसलिए आज उन्हें किफायती तरीके से उपयोग करने की तत्काल आवश्यकता है, संसाधनो के किफायती उपयोग से यह सुनिश्चित होता हैं कि वैश्विक कार्बन फुटप्रिंट कम हो गया है और इसलिए ग्लोबल वार्मिंग को रोका जा सकता हैं।

शोध निराकरण

- भारत की राजधानी नई दिल्ली में सराय काले खान के पड़ोस में स्थानीय कारीगरों ने कचरे और स्क्रैप धातु से ढ़ेर एकत्र किए हैं जिससे दुनियां के सात अजूबों की प्रतिकृतियां बनाई हैं, जिसमें ताजमहल का मॉडल, एफिल टावर, स्टेचू ऑफ लिबर्टी, पीसा की झुकी मीनार, ब्राजील की क्राइस द रिडीमर की प्रतिमा, गीजा के महान पिरामिड और रोम के प्रसिद्ध कोलोसियम का भी निर्माण किया है जिसे लगभग 150–100 टन ठोस अपशिष्ट धातुओं से बनाया गया है जो अनुपयोगी हो चुके थे।
- भोपाल मंडल में अशोक नगर रेलवे स्टेशन पर कलाकारों ने ट्रेन के डिब्बों के स्क्रैप को मोर की आकृति में बनाकर तथा सुंदर रंगो से सजा कर पूरे रेलवे स्टेशन के परिसर में इन मोरों को स्थापित किया है।
- पूर्व मध्य रेल के समस्तीपुर मंडल के सहरसा रेलवे स्टेशन पर पर्यावरण को ध्यान में रखते हुए एक ऑक्सीजन पार्क बनाया गया है इस पार्क में स्क्रैप के जरिय कई कलाकृतियां बनाई गई हैं जिसमें मेक इन इण्डिया का लोगो प्रतीक चिन्ह के तौर पर पहचाना जाने वाला शेर

की आकृति को बनाया गया है जिसे कलाकार ने सुनहरे रंग से पेंट किया है।

- रेल व्हीकल फैक्ट्री ट्रेनों की खराब हो चुकी पहियों और उसमें लगे एक्सेल तथा अन्य पुर्जो के इस्तेमाल से खूबसूरत कलाकृतियों का निर्माण किया है इन कलाकृतियों को बेंगलुरु स्थित रेल व्हील फैक्ट्री के परिसर में सजाया गया है खराब हो चुके ट्रेन के पहियों को जोड़कर और उन्हें खूबसूरत रंगो से पेंट करके उन पर पानी की बचत करने ऊर्जा की बचत करने सहित कई अन्य संदेश लिखे गए है।
- 21 जुलाई को 2023 को खान मंत्रालय और इस्पात मंत्रालय आजादी का अमृत महोत्सव मनाया गया, जो आजादी के 75 वर्ष पूरे होने का जश्न मनाने का सरकार की पहल है आजादी का अमष्त महोत्सव के उत्सव को चिन्हित करने के लिए मटेरियल रीसायकलिंग एसोसिएशन ऑफ इण्डिया (MRAI) और जवाहरलाल नेहरु एल्युमीनियम रिसर्च डेवलपमेंट एण्ड डिजाइन सेंटर (JNARDDC) ने 11वें स्क्रैप रीसायकलिंग (लौह और गैर–लौह) और अपशिष्ट उपयोग अभियान का आयोजन किया गया।
- अयोध्या में स्थित डॉ0 राममनोहर लोहिया अवध विश्वविद्यालय में लगभग प्रत्येक वर्ष 10 टन के करीब ठोस व अपशिष्ट सामग्री निकलती है विश्वविद्यालय परिसर में स्थित ललित कला विभाग विगत 7 वर्षों से इन अपशिष्ट धातुओं का उपयोग कलाकृतियों को बनाने में कर रहें है , विभागीय शिक्षकों के सहयोग से छात्र–छात्राएं नई कलाकृतियों का निर्माण कर रहें है, छात्र–छात्राएं स्क्रैप धातुओं का उपयोग कर प्रतिदिन नई–नई जिसमें प्रमुख रुप से नवग्रह वाटिका का निर्माण किया गया है जिसमें अपशिष्ट धातु के प्रयोग से एक विशाल वटवृक्ष की संरचना की गई है और नौ ग्रहों को उनके निश्चित आकार, मान एवं दरों के अनुसार वेल्डिंग के द्वारा वटवृक्ष पर सजाया गया है। इसके अलावा अन्य कलाकृतियों में स्क्रैप धातु से– Peacock, Seacow, Dr. Lohia's portrait, Maternity, The Sheephead, Cockroch, The family of Mosquitos, Hippopotamus, The swiper, Trees, Dog, Baffalo इत्यादि अनेकों सुंदर कलाकषतियों की रचना की गई है। डॉ0 राममनोहर लोहिया अवध विश्वविद्यालय परिसर में स्थित ललित कला विभाग (मूर्तिकला विभाग) के समस्त शिक्षकों एवं छात्र–छात्राओं को इस शोधपत्र में सहयोग करने के लिए मैं आभार व्यक्त करती हूँ।

तृतीय खण्ड

निष्कर्ष

स्क्रैप आर्ट् के द्वारा हम अपना पर्यावरण इको फ्रेंडली बनाने के साथ–साथ बहुत सुंदर बना सकते है तथा आने वाली पीढ़ीयों को अपशिष्ट कचरे से निजात दिला सकतें है। स्क्रैप आर्ट् के द्वारा अपशिष्ट निवारण के साथ ही कलाकार अपनी कला को एक नवीन स्वरुप प्रदान करने के साथ अपनी कला को एक नए आयाम तक पहुंचा सकते है। विगत आने वाले वर्षों में अगर भारत के

साथ–साथ विश्व के अन्य कलाकार स्क्रैप आर्ट् पर काम करें तो सुनिश्चित ही बड़े पैमाने पर अपशिष्ट निवारण में अपना महत्वपूर्ण योगदान प्रदान कर सकते है तथा पर्यावरण को शुद्ध करने के साथ कलाकार अपनी सृजनात्मकता में वृद्धि कर सकेंगे।

चित्र संख्या–1

चित्र संख्या–2

चित्र संख्या–3

चित्र संख्या–4

चित्र संख्या–5

चित्र संख्या–6

चित्र संख्या–7

चित्र संख्या–8

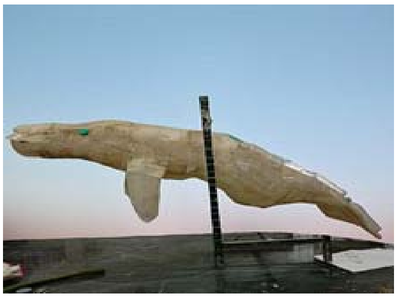
चित्र संख्या–9

चित्र संख्या–10

संख्या–11

चित्र संख्या–12

चित्र संख्या–13



चित्र संख्या–14

चित्र संख्या–15

चित्र संख्या–16

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तकनीकी शब्द

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2. Assemblege Art- संयोजन कला
3. Ready Made Art- पहले से तैयार कलाकषति
4. Installation Art- स्थापना कला
5. Lubrication- लुब्रिकेशन सिद्धांत

चित्र सूची

पर्यावरणीय चुनौतियाँ एवं समाधान : उत्तराखंड में पहाड़ी क्षेत्रों के विशेष संदर्भ में

राकेश सिंह[1] एवं वी०बी० चौरसिया[2]

सार

पर्यावरण प्राणियों, जीव–जंतु एवं पादपों का आवरण है, जो प्रत्यक्ष एवं अप्रत्यक्ष रूप से सभी को प्रभावित करता है। हमारे चारों ओर के आवरण को पर्यावरण कहा जाता है। पर्यावरण के अंतर्गत विभिन्न पारिस्थितिकियों में पाए जाने वाले पादप एवं जीव जंतु आते हैं। पर्यावरण का स्वस्थ होना मानव जाति के लिए वरदान है तथा पर्यावरण के दूशित होने पर यह अभिशाप का रूप भी धारण कर लेता है। पर्वतीय राज्य उत्तराखंड के कुल भौगोलिक क्षेत्रफल के 86 प्रतिषत पर पहाड़ तथा 71 प्रतिशत क्षेत्रफल पर वन पाए जाते हैं। राज्य के 13 जिलों में से 3 जिले मैदानी तथा षेश 10 जिले पर्वतीय भौगोलिक पारिस्थितिकी के अंतर्गत आते हैं। उत्तराखंड के सामाजिक आर्थिक ढांचे में कृशि को इस तथ्य से महसूस किया जा सकता है कि प्रदेश के अधिकांश जनसंख्या की आजीविका कृषि एवं वनों पर निर्भर है। पहाड़ी क्षेत्रों में पर्यावरण पर विभिन्न प्राकृतिक, अप्राकृतिक तथा दूषित आर्थिक गतिविधियों का नकारात्मक प्रभाव पड़ रहा है। इसके अंतर्गत अनियोजित विनिर्माण, वृक्षों का कटान, भू–स्खलन, भूक्षरण, हिमस्खलन, जैव–विविधता का क्षरण, पारिस्थितिकीय पतन, भू–धंसाव, मानव और वन्यजीव संघर्श, पहाड़ी क्षेत्रों में स्टोन क्रेशर प्लांट, कृषि में रासायनिक तत्वों का अत्यधिक प्रयोग आदि प्रमुख चुनौतियां हैं। यह कारक पर्यावरण को प्रत्यक्ष एवं अप्रत्यक्ष रूप से प्रभावित कर रहे हैं। वर्तमान अध्ययन में पर्यावरण को प्रभावित करने वाली प्रमुख चुनौतियों का अध्ययन किया गया है तथा इन चुनौतियों के समाधान हेतु सुझाव दिए गए हैं। यह वर्णनात्मक अध्ययन द्वितीयक आंकड़ों पर आधारित है। पर्यावरण को सुरक्षित करने हेतु सभी को संगठित होकर कार्य करने की आवश्यकता है। पर्यावरण के संरक्षण से वर्तमान एवं भविष्य की पीढ़ीयों को सुरक्षित, स्वस्थ एवं स्वच्छ पारिस्थितिकी में जीवन यापन करना संभव हो पाएगा।

मुख्य शब्द : पर्यावरण, पादप, जीव–जंतु, प्रदूषण, भौगोलिक पारिस्थितिकी, सामाजिक–आर्थिक गतिविधियां

1 शोध छात्र, अर्थशास्त्र विभाग, डी0ए0वी0 (पी.जी.) कालेज, देहरादून।

2 प्रोफेसर, अर्थशास्त्र विभाग, डी0ए0वी0 (पी.जी.) कालेज, देहरादून।

प्रस्तावना

उत्तराखंड राज्य (पूर्व में उत्तरांचल) भारत के उत्तरी भाग में स्थित अपने हिमालयी एवं पहाड़ी क्षेत्रों के लिए प्रसिद्ध है। उत्तर प्रदेश राज्य से अलग होकर 9 नवंबर 2000 को अधिकांश यूपी के पहाड़ी जिलों से उत्तराखंड राज्य अस्तित्व में आया था। राज्य के उत्तर में हिमाचल प्रदेष, उत्तर–पूर्व में चीन, पूर्व में नेपाल के साथ अंतरराश्ट्रीय सीमा, तथा दक्षिण में उत्तर प्रदेश और पष्चिमी में हिमाचल प्रदेष एवं हरियाणा के साथ अंतरराज्यीय सीमा रेखा बनाते हैं। उत्तराखंड का विस्तार 28° 43′ उत्तर से 31°27′ उत्तर देशांतर और 77°34′ पूर्व से 81°02′ पूर्व अक्षांश तक है। उत्तराखंड राज्य का कुल भौगोलिक क्षेत्रफल 53483 वर्ग किलोमीटर है, जिसमें से 86.07 प्रतिशत क्षेत्र (46035 वर्ग किलोमीटर) में पहाड़ी क्षेत्र षामिल हैं, जबकि शेष 13.93 प्रतिषत में मैदानी क्षेत्र शामिल हैं। इन स्थलाकृतिक और भौगोलिक विविधताओं के कारण राज्य की कृषि में विशिष्ट भिन्नताएँ प्रदर्शित होती हैं। राज्य में पहाड़ी क्षेत्रों कि अधिकता के कारण अनेक प्राकृतिक संसाधन जैसे– ग्लेषियर, वन, नदियां तथा खनिज संसाधनों का प्रचुर भंडार है। प्राकृतिक संसाधन राष्ट्रीय एवं राज्य सम्पदा का अभिन्न अंग है जो राज्य के बाहर भी बड़ी आबादी तक इकोसिस्टम सेवाएं तथा वस्तुएं प्रदान करता है। वन सर्वेक्षण रिपोर्ट 2021 के अनुसार उत्तराखंड में कुल 378.16 मिलियन टन कार्बन भंडार (कार्बन स्टॉक) मौजूद है तथा प्रति हेक्टेयर कार्बन स्टॉक 155.59 टन/हे० है। राज्य में 38,000 वर्ग किलोमीटर वन क्षेत्र जो राज्य के कुल क्षेत्रफल का लगभग 71 प्रतिषत है। इसमें विभिन्न प्रकार की जड़ी बूटियों के अतिरिक्त विभिन्न प्रकार की वनस्पतियां जैसे– साल, चीड़, देवदार, एवं बाँझ आदि के वन आते हैं। इसमें विभिन्न प्रकार के वन्यजीव निवास करते हैं। इन महत्वपूर्ण वन्यजीवों में बाघ, तेंदुआ, हाथी, कस्तूरी मृग, स्नो लैपर्ड एवं विभिन्न प्रकार के पक्षी, वनस्पति, कीट पतंगे आदि विद्यमान हैं। राज्य में वन्यजीव पर्यटन हेतु छः राष्ट्रीय उद्यान, सात वन्यजीव अभयारण्य, चार संरक्षण रिजर्व और एक बायोस्फीयर रिजर्व क्षेत्र हैं जो उत्तराखंड के कुल भौगोलिक क्षेत्रफल का 12 प्रतिशत संरक्षित क्षेत्र के अंतर्गत आता है। उत्तराखंड राज्य के पहाड़ी क्षेत्रों में निवास कर रही आबादी का पर्यावरण से गहरा सांस्कृतिक लगाव है। ऊंचे पहाड़ों में वनों के मध्य अनेक देवी देवताओं के मंदिर स्थापित है और वहां वनों की पूजा की जाती है। सांस्कृतिक संरक्षण तथा संस्कृति के प्रति प्रतिबद्धता के स्वरूप उत्तराखंड भारत का एकमात्र राज्य है जिसकी आधिकारिक भाषाओं में से एक संस्कृत है। प्रकृति के अत्यधिक समीप होने के कारण यहाँ निवास कर रही आबादी को प्राकृतिक तथा मानवीकृत विपदाओं का सामना करना पड़ता है। जिससे हिमालयी क्षेत्र अत्यधिक संवेदनशील और अनेक पर्यावरणीय चुनौतियों से घिर गया है। हाल ही में सिलक्यारा टनल (उत्तरकाशी), जोशीमठ भू–धंसाव, हिमस्खलन (चमोली) जैसी घटनाएं पर्यावरण के साथ हुए मानवीय छेडछाड का ही दुष्परिणाम है। वैश्विक तापमान, जलवायु परिवर्तन पर भारतीय दूर संवेदी संस्थान, भारतीय भूगर्भ सर्वेक्षण विभाग, इंटरनेशनल पैनल फॉर क्लाइमेंट चेंज, नेचर कम्यूनिकेशन जर्नल, बुलेटिन आंफ एटॉमिक साइंटिस्ट्स जैसे प्रसिद्ध संस्थाओं के वैज्ञानिक सर्वे रिपोर्ट एवं आंकलन बताते है की हिमालयी क्षेत्रों में पर्यावरणीय संकट गंभीर स्थिति में है तथा इसके शीघ्र समाधान की चेतावनी दी

है। जिससे पृथ्वी की जीवनदायिनी क्षमताओं को नुकसान पहुँच रहा है। पहाड़ी क्षेत्रों में पर्यावरण पर विभिन्न प्राकृतिक, अप्राकृतिक तथा दूषित आर्थिक गतिविधियों का नकारात्मक प्रभाव पड़ रहा है। इसके अंतर्गत जलवायु परिवर्तन, वनाग्नि, हिमालयी झरनें/नदियों (बारामासी गाड) का विलुप्तीकरण, प्रमुख नदियों में जल प्रदूषण, अनियोजित विनिर्माण प्रकियाएं, वृक्षों का कटान, भू–स्खलन, भूक्षरण, बादल फटना, हिमस्खलन, हिमनद झीलों के टूटने का खतरा, जैव–विविधता का क्षरण, पारिस्थितिकीय पतन, अवैध खनन, भू–धंसाव, मानव और वन्यजीव संघर्ष, पहाड़ी क्षेत्रों में स्टोन क्रेशर प्लांट, तथा कृशि में रासायनिक तत्वों का प्रयोग आदि प्रमुख चुनौतियां हैं। यह कारक पर्यावरण को प्रत्यक्ष एवं अप्रत्यक्ष रूप से प्रभावित कर रहे हैं। वर्तमान अध्ययन के उद्देश्य इस प्रकार है–

(1) उत्तराखंड के पहाड़ी क्षेत्रों में पर्यावरणीय चुनौतियों का अध्ययन करना तथा

(2) पर्यावरणीय चुनौतियों के समाधान हेतु सुझाव देना हैं।

यह वर्णनात्मक अध्ययन द्वितीयक आंकड़ों पर आधारित है। पर्यावरण को सुरक्षित करने हेतु सभी के संगठित प्रयास एवं एक मत होकर कार्य करने की आवश्यकता है। यह पर्यावरण को संरक्षित करने हेतु ठोस प्रयास होगा। पर्यावरण के संरक्षण से ही वर्तमान एवं भविष्य की पीढ़ीयों के लिए सुरक्षित पारिस्थितिकीयों में जीवन यापन करना संभव हो पाएगा।

साहित्य की समीक्षा

जांन एनटोन वान जांनटेन आदि (2020) : इस अध्ययन में बताया गया कि सतत विकास लक्ष्यों की सफलता प्रत्येक संसाधनों को विवेकपूर्ण एवं उचित प्रतिबंधन के साथ हासिल किया जा सकता है। व्यक्तिगत आर्थिक गतिविधियों और सतत विकास की आर्थिक, सामाजिक एवं पर्यावरणीय आयामों के मध्य सुव्यवस्थित मूल्यांकन की आवष्यकता है। इस शोध पत्र में व्यक्तिगत आर्थिक गतिविधियों एवं सामान्यत सतत विकास के मध्य संबंध को व्यक्त करने हेतु वर्ष 2005 से 2019 के मध्य प्रकाशित 876 शोध पत्रों की सुव्यवस्थित व्याख्या की गई है। इन शोध पत्रों से ज्ञात हुआ कि कृषि, औद्योगिकीकरण और विनिर्माण गतिविधियों का पर्यावरण पर नकारात्मक प्रभाव पड़ा है इसके साथ ही कुछ आर्थिक गतिविधियों जैसे– नवाचार, सेवा गतिविधियों एवं कुछ आर्थिक उत्पादन का पर्यावरण पर सकारात्मक प्रयास भी पड़ा है। पारिस्थितिकी तंत्र, जलवायु परिवर्तन एवं मानव स्वास्थ्य को कुछ आर्थिक गतिविधियां प्रभावित कर रही हैं। शोध पत्र में 2030 तक 17 एसडीजी हासिल करने की प्रति चिंता व्यक्त की गई है। आर्थिक विकास पर अधिक ध्यान देने से पर्यावरणीय चुनौतियां उत्पन्न हुई हैं। आर्थिक गतिविधियां कुछ स्तंभों को मजबूत करती है परंतु इसके पर्यावरणीय ह्रास एवं मानव जीवन पर पढ़ने वाले नकारात्मक प्रभावों को कम करने की आवश्यकता महसूस की जा सकती है।

सिंह, पी. डी, आदि (2019) के अनुसार यह अध्ययन सतत विकास को प्रोत्साहित करने में संस्थानों की महत्वपूर्ण भूमिका पर प्रकाष डालता है। पर्यावरणीय क्षति को अस्थिर वन प्रबंधन,

मरुस्थलीकरण, उपजाऊ मिट्टी की कमी, मीठे पानी की उपलब्धता में कमी और अत्यधिक जैव विविधता हानि के रूप में व्यक्त किया जाता है। आर्थिक विकास, ग्रामीण विकास और पर्यावरणीय स्थिरता के मध्य उच्च सहसंबंध की आवश्यकता है। अधिकांश वैज्ञानिकों का मत हैं कि पर्यावरणीय ह्रास के कारण ग्लोबल वार्मिंग और जलवायु परिवर्तन भावी पीढ़ी के लिए एक गंभीर खतरा है और इसके लिए मनुष्य बहुत अधिक जिम्मेदार हैं, लेकिन फिर भी इस पर उतना ध्यान नहीं दिया जा रहा हैं जितना की आवश्यक है। विश्व में बढ़ता कार्बन उत्सर्जन हमारी लापरवाही का उदाहरण है। उत्तराखंड का हिमालयी पारिस्थितिकी तंत्र आर्थिक रूप से अविकसित है तथा घनी आबादी के कारण पर्वतीय पारिस्थितिकी तंत्र पर्यावरणीय समस्याओं के प्रति अत्यधिक संवेदनशील है। इन क्षेत्रों में पर्यावरणीय आपदाएं अत्यधिक होती हैं। पर्यावरणीय क्षति को कम करने के लिए समय रहते उपयुक्त पर्यावरण नीति की आवश्यकता है।

शोध प्रविधि

इस शोध पत्र में द्वितीयक आंकड़ों का विवरणात्मक विश्लेषण किया गया है। द्वितीयक समंकों का एकत्रीकरण उद्देश्यपूर्ण सुविधाजनक तकनीक से विभिन्न शोध पत्र, पत्रिकाओं, समाचार पत्रों के आलेख, विभिन्न संस्थाओं की आधिकारिक वेबसाइट्स, उत्तराखण्ड सरकार के आधिकारिक विभागों की वेबसाइट्स तथा इंटरनेट आर्टिकल्स के माध्यम से किया गया है।

पर्यावरणीय चुनौतियाँ एवं समाधान

जलवायु परिवर्तन : वर्तमान समय में जलवायु परिवर्तन प्रमुख वैश्विक चुनौती है। पहाड़ी एवं हिमालयी क्षेत्रों में यह चुनौती और भी अधिक गंभीर समस्याएं उत्पन्न करती है। इसके कारण धरती की जीवनदायिनी क्षमताओं पर बुरा प्रभाव पड़ रहा है। 'बुलेटिन ऑफ एटॉमिक साइंटिस्ट्स' नामक वैज्ञानिक संस्था द्वारा हाल ही में 'डूम्स्डे क्लॉक' चेतावनी जारी की गयी है। जिसके अनुसार जलवायु परिवर्तन मानव जाति के लिए गंभीर संकट उत्पन्न कर रहा है। इस संस्था के परामर्शदाताओं में 15 नोबेल पुरस्कार विजेता सम्मिलित है। जिससे इस संस्था के द्वारा संज्ञान में ली गई चुनौतियों की गंभीरता को समझा जा सकता है। इनके अनुसार जलवायु परिवर्तन को नियंत्रित करने की संभावनाएँ समग्र रूप से धूमिल हुई है। हाल के वर्षों में यह निरंतर स्पष्ट होता रहा है कि अब तो धरती के जीवनदायिनी क्षमता खतरे में है जिन कारणों से हजारों वर्षों तक धरती पर विविधतापूर्ण जीवन यापन पनप सका उसका आधार ही संकटग्रस्त हो चुका है। जलवायु परिवर्तन से हिमालय के ग्लेशियर, नदियाँ, पर्यावरण, कृषि, अनिश्चित मौसम, वन्य जीवन और सतत् कृषि उत्पादन पर नकारात्मक प्रभाव पड़ रहा है। इस चुनौती के समाधान हेतु समय रहते धरती के तापमान को नियंत्रित करना समय की मांग है। तापमान एक बार तय सीमा के पार हो गया तो स्थितियां नियंत्रण से बाहर निकल सकती है। पहाड़ी क्षेत्रों में जलवायु परिवर्तन की समझ अधिक लोगों तक पहुंचाने की आवश्यकता है। यह समझ सही परिपेक्ष्य में अधिक लोगों तक पहुंचेगी तभी

लोग अधिक संख्या में आगे आएंगे। जलवायु परिवर्तन के प्रमुख कारकों को चिन्हित कर सम्मिलित रूप से क्षेत्रीय स्तर से वैश्विक स्तर तक इन कारकों के समाधान एवं पर्यावरण अनुकूल व्यवहार को प्राथमिकता देने की आवष्यकता है।

वनाग्नि : प्राकृतिक रूप से वनों की बहुलता वाले इस प्रदेश में वनाग्नि प्रमुख चिंता का विशय है। वनाग्नि से वन संपदा, वन्य जीव जंतुओं तथा आसपास के वातावरण पर बुरा प्रभाव पडता है। वनाग्नि से वातावरण में कार्बन डाइऑक्साइड की मात्रा तथा वातावरण के तापमान में वष्द्धि होती है। कई घटनाओं में यह देखा गया है कि वनाग्नि की चपेट में मवेषियों तथा उनके निवास स्थान (छानियां) आग की चपेट में आ जाते हैं जिससे उनके स्वामियों को आर्थिक क्षति भी उठानी पड़ती है। पहाड़ी क्षेत्रों में यह देखा गया है कि लोग इस दृष्टिकोण से जंगलों में आग लगाते हैं ताकि वर्शा ऋतु के पश्चात् नई घास एवं चारा उग पाएगा। वन्य अधिकारियों के अनुसार उत्तराखंड में 90 प्रतिशत से अधिक की वनाग्नि की घटनाएं मानव जनित है। इस धारणा को बदलने की आवश्यकता है। इन घटनाओं के समाधान हेतु ग्राम पंचायत स्तर पर जागरूकता की आवश्यकता है तथा उचित जागरूकता के पश्चात् भी मानव जनित आग की घटनाओं में कमी नहीं आने पर सख्त कार्यवाई की आवश्यकता है। जिससे वन्यजीव, वन्य संपत्तियों तथा पर्यावरणीय संतुलन के साथ छेड़छाड़ ना हो। इसमें क्षेत्रीय लोगों का सहयोग भी आवश्यक है जो वनाग्नि की सूचना को शीघ्रता से संबंधित अधिकारियों तक देने के लिए मजबूत सूचना तंत्र का कार्य कर सकते है। वनाग्नि पर नियंत्रण हेतु बड़े कार्य बल की आवश्यकता महसूस की जा सकती है।

हिमालयी झरनें/नदियों (बारामासी गाड) का विलुप्तीकरण : हिमालयी क्षेत्र नदियों, झरनों एवं नैसर्गिक सुन्दरता के लिए जाने जाते हैं। वर्तमान समय में बदलती पारिस्थितिकी असंतुलन से इन क्षेत्रों में तापमान में वृद्धि, वनस्पतियो की कमी, सड़क निर्माण तथा कम वर्षा के कारण यहाँ की नदियाँ (गाड), हिमालयी झरने, गदेरे, प्राकृतिक जल स्रोत विलुप्त एवं सूख रहे हैं। नीति आयोग कार्य समूह की रिपोर्ट (2017) में बताया गया है कि, हिमालय के आधे से ज्यादा झरने सूखने की कगार पर है। इनके द्वारा पहाड़ी क्षेत्रों में जल आपूर्ति, कृषि सिंचाई एवं मवेशियों के लिए पीने का पानी उपलब्ध होता है। पारिस्थितिकियों के असंतुलन को गंभीरता से समझने की आवश्यकता है। इनके संरक्षण हेतु ऐसे क्षेत्रों का चिन्हीकरण किया जाए जहाँ पर ये झरने एवं नदियाँ विद्यमान हैं तथा उन क्षेत्रों में वनीकरण, वर्षा जल संरक्षण, पर्यावरण अनुकूल गतिविधियों को प्रोत्साहन देकर संरक्षित किया जा सकता है।

प्रमुख नदियों में जल प्रदूशण : राज्य की प्रमुख नदियों का उद्गम हिमालयी क्षेत्रों से होता है। यह प्रमुख नदियां जिन क्षेत्रों से होकर गुजरती हैं उन क्षेत्रों के तटों पर बसे पहाड़ी लघु बाजार अब बड़े शहरों का आकार ले रहे हैं। जिससे नदियों में अपशिष्ट पदार्थ एवं कचरा प्रबंधन की उचित व्यवस्था न होने के कारण नदियों में दूषित अपशिष्टों को सीधा डाला जा रहा है। नदियों के महत्त्व को समझते हुए उत्तराखंड उच्च न्यायालय ने मार्च, 2017 को गंगा और यमुना नदियों को जीवित

इकाई के रूप में परिभाशित किया और इन्हें एक व्यक्ति के समान कानूनी अधिकार दिए गए हैं। गंगा का विशेष धार्मिक महत्त्व है जो 2525 किलोमीटर लंबे प्रवाह के साथ 'गंगा रिवर डाल्फिन' तथा सैकड़ों जीवों का जलीय आवास भी है। नदियों के जल की स्वच्छता को बनाए रखने हेतु नदियों के आसपास बसे आवासों, होटल, लघु बाजारों में उचित कूड़ा प्रबंधन, सीवरेज प्रबंधन तथा लघु उद्योगों के अवशिष्टों को प्रवाह तंत्र में नही डालने दिया जाए। लोगों को जागरूक और पर्यावरण के प्रति अपनी जिम्मेदारी समझनी चाहिए।

अनियोजित विनिर्माण प्रकियाएं : पहाड़ी क्षेत्रों में अनियोजित एवं पहाड़ी संरचना को समझे बिना प्रकृति की मूल संरचना के साथ किए गए मानव निर्मित बदलाव पर्यावरणीय चुनौती के साथ–साथ सामाजिक–आर्थिक चुनौती भी खड़ी करते है। पहाड़ी क्षेत्रों में अनियोजित निर्माण कार्य पारिस्थितिकीय चुनौती पैदा करते है। हाल ही की 'ऑपरेशन सिलक्यारा' टनल की घटना ने राष्ट्रीय एवं अंतर्राष्ट्रीय मीडिया का ध्यान आकर्षित किया। उत्तरकाशी जिले के धरासू बैंड के पास यमुनोत्री हाईवे पर बन रही 4.531 किलोमीटर लंबी सुरंग में 41 श्रमिकों को सुरंग में भूस्खलन होने के कारण 18 दिनों तक जीवन के लिए संघर्ष करना पड़ा। राज्य और राष्ट्रीय एजेंसियों ने एक साथ मिलकर इस घटना में फसे लोगों को सकुशल बाहर निकाला था। हिमालयी क्षेत्रों में लंबी और सड़कों के चौड़ीकरण के बाद मलबे का उचित डंपिंग जोन निर्धारित न किए जाने के कारण मलबा इधर–उधर फेंक दिया जाता है। जिसके कारण आसपास के क्षेत्रों में निवास कर रहे जीव–जन्तुओं को अपना मूल क्षेत्र छोड़ कर दूसरे स्थानों पर जाने के लिए विवष होना पड़ता है। पहाड़ी क्षेत्रों में बड़े निर्माण कार्यों के कार्यान्वयन से पूर्व पर्यावरण विशेषज्ञों से गहन विचार विमर्श के पश्चात क्षेत्रीय और पर्यावरणीय पारिस्थितिकी के अनुसार कार्य करना चाहिए। सशक्त भू–कानून के माध्यम से बाहरी लोगों के द्वारा पर्वतीय क्षेत्रों में अनियोजित विनिर्माण गतिविधियों पर अंकुश लगाया जा सकता है।

बादल फटना : ग्लोबल वार्मिंग जैसी घटनाओं के कारण पहाड़ी क्षेत्रों में बादल फटने की घटनाएं प्रायः होती रहती है। इसका अन्य कारण जलवायु परिवर्तन भी है। बादल फटने पर तीव्र बारिश होती है जिससे बाढ़ जैसी स्थिति उत्पन्न हो जाती है तथा भू–स्खलन और भूक्षरण तीव्र गति से होता है। इससे लोगों के भवन, मवेशियों तथा कृषि भूमि को भारी क्षति पहुंचती हैं। ऐसी घटनाओं से बचाव के लिए अग्रिम चेतावनी ही विकल्प हैं। जिसके लिए उन क्षेत्रों का चुनाव किया जाए जहाँ पर ऐसी घटनाएं होने की आशंकाए अधिक होती है। चयनित क्षेत्रों में डॉप्लर रडार एवं वेदर स्टेशन स्थापित कर अग्रिम चेतावनियां समय–समय पर जारी की जानी चाहिए।

वृक्षों का कटान : पहाड़ी क्षेत्रों में सड़क निर्माण, ईंधन, पशुचारा, बड़े भवन निर्माण तथा अवैध व्यापार हेतु वृक्षों का कटान किया जाता है। वृक्षों के अवैध कटान से वन भूमि बंजर तथा भू–स्खलन और भूक्षरण होने की आशंकाएं बढ़ जाती है। आर्थिक लाभ के लिए वृक्षों की तस्करी एवं अवैध कटान सामाजिक समस्याएँ उत्पन्न करता है। वृक्षों के अवैध कटान पर रोकथाम की सख्त आवश्यकता है जिससे पर्यावरणीय संतुलन बना रहेगा। वन विभाग को संबंधित क्षेत्रों में निरंतर वृक्षों का आंकलन

कर ऐसी घटनाओं को अंजाम देने वालों के विरुद्ध नियमानुसार कार्रवाई करनी चाहिए। साथ ही लोगों से पर्यावरण अनुकूल व्यवहार अपनाने की अपील भी करनी चाहिए।

भू–स्खलन : तापमान तथा नमी के प्रभाव से मिट्टी के बंधन का ढीला पड़ जाने से भूस्खलन की प्रक्रिया को होती है। पहाड़ी क्षेत्रों में वनस्पति विहीन भूमि, राजमार्गों के किनारों पर तथा अधिक वर्शा से भू–स्खलन होता है। सड़कों से आवागमन की दौरान भू–स्खलन की समस्या प्रायः यात्रीगणों को परेशान करती है। इससे कई बार जान माल की क्षति भी उठानी पड़ती है। भू–स्खलन से बचाव के लिए राज्य में जापान के विषेशज्ञों से सुझाव लिया जा रहा है। बंजर एवं खाली पड़ी भूमि पर वृक्षारोपण से इस पर्यावरणीय चुनौती से बचाव किया जा सकता है।

भूक्षरण : मिट्टी का तीव्र कटाव भूक्षरण कहलाता होता है। यह प्रक्रिया तीव्र वर्षा एवं ढलान युक्त भूमि पर अधिक तीव्र गति से मिट्टी का कटाव करता है। पहाड़ी क्षेत्रों में भूक्षरण के कारण कृषि योग्य भूमि का कटाव तथा मवेशियों के लिए चारा युक्त भूमि ह्रास होता है। इस चुनौती के समाधान हेतु ढलान युक्त भूमि पर चेक डैम, सुरक्षा दीवार बनाकर तथा उचित वृक्षारोपण से भूक्षरण की प्रक्रिया को कम किया जा सकता है।

भू–धंसाव : भूमि की धारणा क्षमता से अधिक का दबाव पड़ने पर भू–धंसाव की स्थिति उत्पन्न होती है। भू–धंसाव के लिए पहाड़ी क्षेत्रों में ब्लास्टिंग से उत्पन्न कंपन, सुरंग निर्माण तथा बड़े निर्माण कार्य उत्तरदायी हैं। चमोली जिले के जोषीमठ बाजार में 600 घरों में दरारें देखी गई जिसका कारण भू–धंसाव पाया गया। भू–धंसाव एक गंभीर समस्या है इसके कारण कई पीढ़ियों से किसी स्थान विषेश पर निवास कर रहे लोगों को पलायन हेतु मजबूर होना पड़ता है। जिससे उनका मानवीय एवं सांस्कृतिक लगाव भी जुड़ा होता है। इस समस्या से बचाव के लिए संवेदनशील क्षेत्रों का आंकलन कर उन क्षेत्रों में सीमीत आवासीय संख्या सुनिश्चित की जाए। पहाड़ी क्षेत्रों में निर्माण कार्यों पर हेवी मशीनरी का प्रयोग प्रतिबंधित किया जाना चाहिए। ढलान युक्त भूमि पर वृक्षारोपण एवं जल निकासी की उचित व्यवस्था की जानी चाहिए।

हिमनद झीलों के टूटने का खतरा : तापमान में वृद्धि से हिमालयी झीलों की संख्या लगातार बढ़ रही है और इन झीलों के टूटने से मानव जीवन पर खतरा बढ़ता जा रहा है। वर्ष 2013 में चौराबाड़ी झील (चमोली) के फटने से केदारनाथ की आपदा आई थी जिसमें लगभग 5000 लोगों की मृत्यु और अरबों रुपयों की क्षति हुई थी। भारतीय दूर संवेदी संस्थान, देहरादून के वैज्ञानिकों के अनुसार 2011 में हिमालयी झीलों की संख्या 93 थी तथा वर्तमान में उत्तराखंड में सात झीलें सबसे अधिक संवेदनशील हैं। भारतीय भूगर्भ सर्वेक्षण विभाग द्वारा उत्तराखंड हिमालय की 13 झीलों कों संवेदनशील पाया है। झीलें के फटने से अचानक पानी बाहर निकलने से घाटी के निचले हिस्सों में ग्लेशियर लेक आउटब्र्स्ट फ्लड होगा जिससे बुनियादी ढांचे, प्राकृतिक संसाधनों और मानव जीवन को भारी नुकसान हो सकता है। वैज्ञानिकों ने हिमनद टूटने को प्रमुख हाइड्रो मेट्रोलॉजिकल खतरों में से एक माना है। इस खतरे से निपटने के लिए जरूरी है कि उच्च जोखिम वाले क्षेत्रों का चिन्हीकरण कर वहाँ पहले ही चेतावनी प्रणाली स्थापित की जाए और संवेदनशील क्षेत्र में सुरक्षात्मक

निर्माण किए जाये तथा आम लोगों को जागरूक किया जाए। संवेदनषील झीलों का समय–समय पर आंकलन करना भी आवश्यक है।

हिमस्खलन (एवलांच) : जलवायु परिवर्तन और तापमान में वषद्धि का दुश्परिणाम ही हिमस्खलन जैसी प्राकृतिक घटनाएँ है। 7 फरवरी 2021 को चमोली जिले में हिमस्खलन की घटना से 200 लोग मारे गए तथा बहुत से लोग लापता हुए थे। विष्णुगाड परियोजना सहित दो जलविद्युत परियोजनाएं नष्ट हो गई थी। वैज्ञानिकों का आकलन था कि रोंती पर्वत से 2.7 करोड़ क्यूबिक मीटर चट्टान और हिमनद टूटकर रोंति गाड, ऋषि गंगा और धौली गंगा नदियों में गिरी और भीषण बाढ़ का रूप ले लिया था। हिमस्खलन की घटनाओं से सीमा पर तैनात सुरक्षा बलों को भी हताहत होना पड़ता है। हिमस्खलन वाले क्षेत्रों में वेदर स्टेशन और जियोमैपिंग के द्वारा क्षेत्रों का निरंतर आंकलन किया जाना चाहिए। पर्यावरण अनुकूल गतिविधियों के माध्यम से वैष्विक तापमान को नियंत्रण पर लाने हेतु सकारात्मक कदम उठाने की आवष्यकता है।

जैव–विविधता का क्षरण : हिमालयी क्षेत्र जैव विविधता के लिए प्रसिद्ध हैं तथा यह विविधताएँ मानव एवं वन्य जीवों के लिए जीवन का आधार है। बदलते पर्यावरण परिदृश्य ने इन विविधताओं को नष्ट किया है। इन क्षेत्रों में पहले पायी जाने वाली वनस्पतियां, वन्य जीव–जंतु एवं कृषि उपजों में भी बदलाव आ रहा है। जैव विविधता के संरक्षण हेतु संवेदनशील क्षेत्रों में मानवीय हस्तक्षेप को कम करना तथा दूशित आर्थिक गतिविधियों पर नियंत्रण करने की आवश्यकता है।

पारिस्थितिकीय पतन : पर्वतीय क्षेत्र विशेष पारस्थितिकीय गुण रखते है। विशेष पारिस्थितिकीय गुण के कारण ही यह क्षेत्र देश विदेश के लोगों को अपनी ओर आकर्षित करता है। परन्तु जलवायु में आए बदलाव के कारण इन क्षेत्रों की पारिस्थितिकी में पहले जैसी विशेषताएं नहीं रह गई है। सभी उच्च, मध्यम एवं निम्न पारिस्थितिकीयां जलवायु परिवर्तन का शिकार हुई है। सभी में अपने क्षेत्र की विषेश परिस्थितिकी, जलवायु, मौसम एवं ऋतुओं में बदलाव देखा गया है। इन क्षेत्रों में पारिस्थितिकी के संरक्षण हेतु पारिस्थितिकी अनुकूल व्यवहार एवं गतिविधियों को बढ़ावा दिया जाना चाहिए। पर्यटन को स्थानीय पारिस्थितिकी के साथ संतुलित करना चाहिए।

मानव और वन्यजीव संघर्ष : प्राकृतिक एवं मानव जनित घटनाएँ तथा जंगलों में मानवीय हस्तक्षेप के कारण मानव और वन्यजीव संघर्ष राज्य में प्रमुख चुनौती है। पलायन आयोग की पहली रिपोर्ट में जंगली जानवरों के भय से पलायन का एक कारण माना गया है। जंगलों में मानव जनित आग, मानवीय हस्तक्षेप तथा खाली होते जंगल मानव वन्यजीव संघर्ष में प्रमुख कारण है। इन क्षेत्रों में गुलदार, भालू के हमले की घटनाएं सबसे ज्यादा होती है। सर्दी और बरसात के मौसम में गुलदार के हमले की घटनाएं अधिक होती है। जिसमे गुलदार कोहरे के कारण झाड़ियों में छिपा हुआ रहता है और मौका देखकर हमला करता है। वनों में आग नियंत्रण तथा मानवीय हस्तक्षेप को कम करके इस संघर्ष को कम किया जा सकता है। घने जंगलों में तारबाड़, सुरक्षा दीवारें लगाकर जंगली जानवरों को मानवीय बस्तियों में आने से रोका जा सकता है।

अवैध खनन : पहाड़ी क्षेत्रों में नदियों एवं जंगलों में आर्थिक लाभ हेतु अवैध खनन किया जा रहा है। खनन की अवैध गतिविधियों के कारण बरसात के समय पानी तीव्र बहाव से विस्तृत क्षेत्र का कटाव करता है। जिससे नदियों के आसपास स्थित कृषि भूमि (सेरा) का क्षेत्र भी कम हो रहा है। इससे मृदा अपरदन एवं भूक्षरण की घटनाओं को बढ़ती हैं। खनन वाले क्षेत्र से गर्मी के मौसम में अत्यधिक गर्म हवा और लू चलती है। इससे पर्यावरण असंतुलन पैदा होता है। इन घटनाओं के रोकथाम के लिए स्थानीय प्रशासन को नियमानुसार कार्रवाई करने की आवश्यकता है।

पहाड़ी क्षेत्रों में स्टोन क्रेशर प्लांट : पर्यावरणीय पारिस्थितिकी तथा वन्य जीवों के लिए पहाड़ी क्षेत्रों में स्टोन क्रेशर प्लांट हानिकारक है। इससे वन्य पारिस्थितिकी और वन्य जीवों का शांत वातावरण भंग होता है। स्टोन क्रेशर प्लांट से निकलने वाली तीव्र ध्वनि तथा धूल कण आसपास निवास कर रहे लोगों लिए स्वास्थ्य समस्या का भी कारण बनता है। स्टोन क्रेशर प्लांट को संवेदनषील क्षेत्रों में लगाने की अनुमति नहीं मिलनी चाहिए जिससे मानवीय एवं वन्य पर्यावरण को नुकसान होता हो। ऐसे प्लांट एकांत स्थान पर होने चाहिए।

कृषि में रासायनिक तत्वों का प्रयोग : मृदा स्वास्थ्य के लिए आवश्यक है कि कृषि गतिविधियों में जैविक खाद का प्रयोग किया जाए। जलवायु परिवर्तन एवं अनिश्चित मौसमी चक्रण के कारण कृषक उच्च उत्पादन हेतु रासायनिक तत्वों का प्रयोग कर रहे हैं। जिससे मिट्टी की उर्वरक क्षमता कुछ समय के पश्चात क्षिण हो रही है। कृषि में रासायनिक तत्व मानव स्वास्थ्य के लिए हानिकारक है। इस चुनौती से समाधान के लिए कृषकों को जैविक खाद के लिए प्रोत्साहित किया जाए तथा रासायनिक खाद का स्वास्थ्य और पर्यावरण पर पड़ने वाले बुरे प्रभाव के प्रति जागरूक किया जाए।

हिमालयी एवं पहाड़ी क्षेत्र पारिस्थितिकियों के अनुसार अत्यधिक संवेदनषील श्रेणी में आते हैं। इन्हे उपरोक्त सभी कारकों के द्वारा प्रभावित होना पड़ रहा है। साथ ही कई अन्य कारकों में प्राकृतिक एवं मानव जनित घटनाएँ, मानवीय हस्तक्षेप और कुप्रबन्धन, पर्यावरण के प्रतिकूल व्यवहार संवेदनषील क्षेत्रों को नुकसान पहुंचा रहा है जिसे रोकना अति आवष्यक है।

निष्कर्ष एवं सुझाव

पर्यावरण में निहित जीवनदायिनी क्षमताएं मानव, वन्य जीवों तथा वनस्पतियो के जीवन का आधार है। जलवायु परिवर्तन एवं वैश्विक तापमान जैसी चुनौतियों के प्रति हिमालयी पर्वतीय क्षेत्र अतिरिक्त संवेदनशील है। पहाड़ी क्षेत्रों में पर्यावरण पर विभिन्न प्राकृतिक, अप्राकृतिक तथा दूषित आर्थिक गतिविधियों का नकारात्मक प्रभाव पड़ रहा है। वर्तमान अध्ययन में पहाड़ी क्षेत्रों में पर्यावरणीय चुनौतियों के अंतर्गत जलवायु परिवर्तन, वनाग्नि, हिमालयी झरनें/नदियों (बारामासी गाड) का विलुप्तीकरण, प्रमुख नदियों में जल प्रदूषण, अनियोजित विनिर्माण प्रकियाएं, वृक्षों का कटान, भू–स्खलन, भूक्षरण, बादल फटना, हिमस्खलन, हिमनद झीलों के टूटने का खतरा, जैव–विविधता का क्षरण, पारिस्थितिकीय पतन, अवैध खनन, भू–धंसाव, मानव और वन्यजीव संघर्ष,

पहाड़ी क्षेत्रों में स्टोन क्रेशर प्लांट, तथा कृषि में रासायनिक तत्वों का प्रयोग आदि प्रमुख चुनौतियां हैं। उपरोक्त चुनौतियों के समाधान हेतु पर्यावरण के प्रति सही समझ समाज के अधिक लोगों तक पहुंचाने तथा सभी के सम्मिलित प्रयास से समाधान तलाशने चाहिए। पर्वतीय पारिस्थितिकी में स्थानीय समुदायों की भागीदारी तथा उनके अनुभवों का भी जलवायु परिवर्तन की अनुकूल नीतियों में प्रयोग किया जाना चाहिए। प्राकृतिक एवं अप्राकृतिक पर्यावरणीय चुनौतियों के समय अग्रिम चेतावनी तथा आपदा के पश्चात तत्काल बचाव एवं राहत कार्यों हेतु स्थानीय लोगों को भी प्रशिक्षित किया जाना चाहिए। सुरक्षित पर्यावरण से ही मानव जीवन हजारों वर्षों से धरती पर विद्यमान रहा हैं। लोगों को पर्यावरण अनुकूल गतिविधियाँ एवं पर्यावरण की प्रति नैतिक एवं सामाजिक जिम्मेदारी को समझना चाहिए। भविष्य की पीढ़ियों के लिए पर्यावरण का संरक्षण एवं संवर्धन आवश्यक है।

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