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Ecological Sustainability



Uttar Pradesh - Uttarakhand Economic Association (UPUEA)

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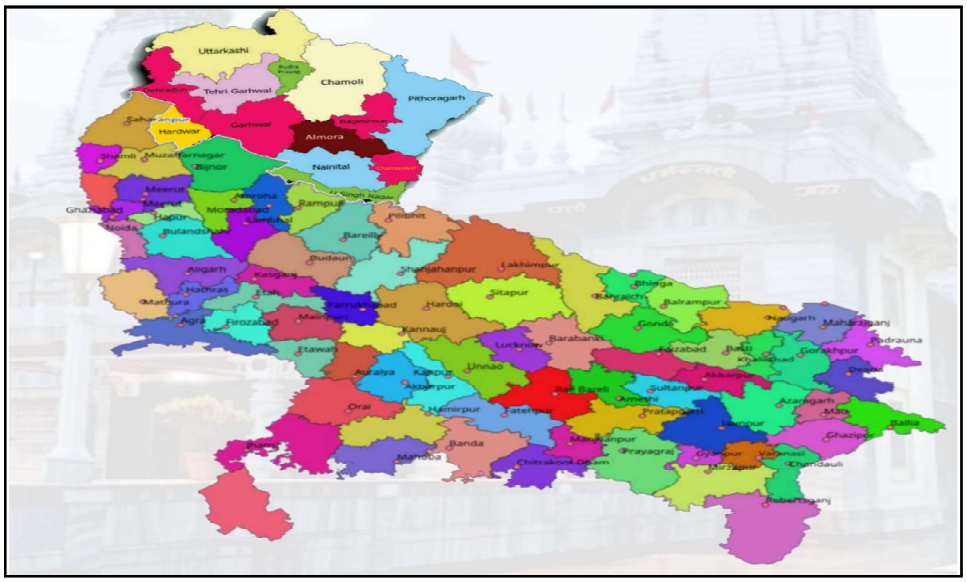
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From Secretary's Desk

Established in 2005, the Uttar Pradesh-Uttarakhand Economic Association (UPUEA) has achieved remarkable growth, flourishing into a premier society of economists. In less than two decades, it has garnered an impressive 3500 life members, a testament to its widespread recognition and influence. Dedicated to advancing economic research across both states, UPUEA actively enriches the field through its publication of research findings, solidifying its role as a pivotal intellectual hub. The UPUEA organizes enriching annual conferences, creating vibrant forums where economists converge to present their latest research, forge valuable collaborations, and engage in stimulating intellectual discourse. Through its unwavering commitment to curating high-quality gatherings and nurturing research collaboration, the UPUEA plays a truly significant role in enriching and advancing economic understanding across both Uttar Pradesh and Uttarakhand.

The Uttar Pradesh-Uttarakhand Economic Association (UPUEA) is gearing up for its 21st Annual National Conference, a three-day event scheduled in the last week of June 2025 (27th-29th June 2025). We have received more than Two Hundred Sixty (260) Research papers under the broad theme of the conference: **"Strengthening Socio-Economic Security for a Resilient India: Challenges and Policy Framework".** This framework must strategically balance continued economic growth with equity and environmental sustainability to ensure a prosperous and inclusive future for all Indians. Researchers and economists have a great opportunity to contribute their expertise by submitting papers on five key sub-themes: *Ecological Sustainability, Fostering Livelihood Security, Fiscal and Financial Stability, and the Indian Knowledge System and Economy and Sustainable Development of Uttar Pradesh and Uttarakhand*While getting papers accepted for publication in our conference proceedings is a major accomplishment, we consistently face the persistent challenge of delayed submissions. This recurring issue of last-minute entries unfortunately disrupts our carefully planned conference schedule and can impact the overall quality of the proceedings. A timely submission is absolutely

crucial for ensuring a smooth and efficient conference experience for everyone involved. To guarantee a seamless conference experience and the prompt publication of all full papers in the proceedings, we kindly urge all interested members to reach out to the General Secretary for any clarifications or the latest updates. Your adherence to the specified page limits will be instrumental in ensuring a truly well-organized and informative conference.

The theme of the UPUEA Conference 2025 serves as a beacon for addressing the socio-economic and environmental challenges of Uttar Pradesh and Uttarakhand. The UPUEA extends its sincere thanks to the numerous funding agencies and institutions whose generous support has been instrumental in facilitating conferences, journal publications, and the printing of conference proceedings. The association is also indebted to *Right Way Publication & Distribution,* New Delhi, for their efficient and timely printing services.



(Vinod Kumar Srivastava)
General Secretary

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Inter-District Disparities in Agricultural Development of Uttar Pradesh (India)

Adarsh Pandey[1] & Dr Anamika Choudhary[2]

ABSTRACT

This study explores the uneven pace of agricultural development across the districts of Uttar Pradesh during the year 2022–2023. Recognizing agriculture as the backbone of the state's economy and rural livelihoods, the research focuses on measuring and understanding regional imbalances in this critical sector. To capture a comprehensive picture, seven key indicators were selected—ranging from crop yields and irrigation coverage to input usage and access to credit. These variables were combined using a composite index approach, with values standardized through min-max normalization to enable fair comparison among districts. The findings clearly reflect a wide gap in agricultural advancement across different parts of the state. Western Uttar Pradesh, with its stronger infrastructure and higher use of agricultural inputs, has emerged as more developed in comparison to the eastern and southern districts, where development remains relatively sluggish. This pattern highlights not only differences in resource availability but also the disparities in institutional support and investment over time. By presenting a district-wise breakdown of agricultural development levels, the study sheds light on areas that require immediate attention and targeted policy measures. It argues for region-specific strategies to bridge these gaps—such as expanding irrigation networks, improving access to farm technologies, and strengthening local support systems. Addressing these disparities is essential not just for agricultural growth but also for fostering more inclusive and balanced development throughout the state. Ultimately, this research aims to provide useful insights for policymakers, planners, and researchers seeking to promote equity in agricultural progress across Uttar Pradesh. It underscores the importance of recognizing regional diversity when designing development strategies, and calls for a more nuanced, data-driven approach to agricultural planning.

Introduction

Uttar Pradesh, located in northern India, is the country's most populous state and a key contributor to its cultural, political, and economic landscape. It shares borders with nine Indian states and has the largest share of the fertile Indo-Gangetic plain. It is one of the largest contributors to India's economy, accounting for around 8% of the national GDP. Agricultural development remains a major driver of the economy of the state given that a sizable portion of the population relies on farming and related industries for their living. Despite this centrality, several difficulties remain for the

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industry including uneven access to infrastructure, low mechanization, unequal fertilizer use, limited irrigation coverage, and productivity inequities. These problems differ greatly from district to district, mirroring the different agro-climatic, socio-economic, and infrastructural circumstances throughout UP. Understanding the requirement for a more data-driven and comparative method of agricultural development, this study presents an Agriculture Index that assesses and ranks every district of Uttar Pradesh using a series of thoughtfully chosen agricultural criteria. Gross cropped area per square km, gross irrigated area, fertilizer consumption, per capita milk output, fish production per square km, forest cover, and road length per square km—all of these reflect a key element of agricultural output and rural support systems. By combining these measures into a composite index, the research provides a whole view of agricultural strengths and deficits statewide.

Further examination of the Agriculture Index using rankings and quartile-based groupings helps to identify low-, medium-, and high-performing municipalities. This categorization helps to reveal patterns of excellence and underachievement as well as assist to grasp the spatial spread of agricultural development. This method not only helps to compare states but also gives policymakers, planners, and researchers a useful instrument to create focused interventions adapted to district particular requirements.This study aims ultimately to advance evidence-based planning for Uttar Pradesh's sustainable and inclusive agricultural development. The study intends to help stakeholders develop regional plans that would raise agricultural productivity, improve resource efficiency, and enhance rural livelihoods by identifying areas of untapped potential and ongoing problems. By doing this, the Agriculture Index becomes an essential first step to close regional disparities and speed up the general growth trend of the state's agricultural industry.

Review of Literature

The examination of regional disparities in agricultural development has long occupied a central place in development economics. Seminal theoretical contributions by scholars such as *Arthur Lewis (1954)* and *John W. Mellor (1976)* emphasized the importance of agricultural productivity in stimulating overall economic growth and poverty alleviation in agrarian economies like India. Mellor, in particular, noted that increased agricultural incomes catalyse demand for industrial goods, thereby triggering a multiplier effect across the economy. Empirical studies have further reinforced the pivotal role of agriculture in reducing inequality and fostering rural development. *Bhalla and Singh (2001)* demonstrated that states investing in irrigation, rural infrastructure, and agricultural research experienced faster economic growth. Chand et al. (2018) confirmed that a 1% increase in agricultural GDP could reduce rural poverty more effectively than similar growth in non-agricultural sectors. These findings are especially pertinent to states like Uttar Pradesh, where over 60% of the population still depends on agriculture for their livelihood.The World Bank's (2008) *World Development Report* echoed this emphasis, highlighting agriculture's disproportionate role in raising the incomes of the rural poor. *Birthal et al. (2015)* also underlined the need for climate-resilient farming and crop diversification to mitigate risk and improve incomes, particularly in drought-prone areas like Bundelkhand.Intra-state disparities within Uttar Pradesh have attracted increasing scholarly attention. *Raman and Kumari (2012)* found that agricultural development in Uttar Pradesh has been highly uneven, with the Western region benefiting from superior infrastructure and irrigation, while Central and Bundelkhand regions remained underdeveloped from 1990–91 to 2008–09. *Diwakar (2018)* added that disparities are not only economic but extend to access to education, healthcare, and other

public services. *Singh and Singh (2016)* highlighted irrigation coverage and infrastructure as key differentiators in agricultural productivity across districts, while *Srivastava and Dubey (2019)* pointed out the higher mechanization and better market access in Western districts compared to Eastern Uttar Pradesh.

Recent studies consistently reveal widening inter-district development disparities across India, including Uttar Pradesh (*Sharma et al., 2021*), West Bengal (*Saha & Dutta, 2024*), and Bihar (*Alam & Shankar, 2024)*. Earlier work by *Shastri (1988) and Shaban (2006)* noted similar patterns in Rajasthan and Maharashtra, with *Tripathi and Awasthi (2013)* confirming these inequalities even in industrialized states. These disparities are rooted in factors like irrigation, infrastructure, and institutional support, underscoring the limitations of uniform policies and the need for localized planning. Building on this, the current research analyzes Uttar Pradesh's agricultural development disparities for 2022–23 using a composite index to identify backward regions and inform targeted policy.

Methodology

This section will provide a detailed discussion about the indicators and data sources along with the tools techniques and software used for the analysis.

Indicators and Data Sources

For calculating the composite index of agricultural development to analyse the inter-district regional disparities among the 75 districts of Uttar Pradesh, the seven indicators were extracted from the 'Directorate of Economics and Statistics (DES),Department of Planning and Development, Government of Uttar Pradesh'. The selection of indicators has been influenced by the above-explored literature dealing with inter-district regional disparities and some indicators were removed as data related to them was not available on the websites and publications. To remove the bias of scale, the selected indicators were divided by the geographical area of the district measured in square kilometres and then normalized by the z-score. The absence of the latest demographic data due to the postponement of the 2021 national census compelled us to use the district's geographical area instead of the district-wise population. The detailed description of selected indicators is given in the Tables 1.

Table 1: Description of the agricultural development indicators used for the study.

GCA/KM^2	It stands for the gross cropped area per unit of geographical area which equals the percentage of total agricultural land in each district. The size of the agricultural land is one of the major determinants on which the level of crop cultivation depends.	UPDES
GIA/KM^2	It stands for the gross irrigated area per unit of geographical area which equals the percentage of total irrigated land in each district. Irrigation is one of the major determinants on which the level of agricultural productivity depends.	UPDES
FC/KM^2	It stands for the total NPK fertilizer consumption in tonnes per square kilometre of the geographical area of the district. Fertilizer consumption is one of the major determinants on which the level of agricultural productivity depends.	UPDES
TMP/KM^2	It stands for the total amount of milk production by cows, buffaloes, and goats in tonnes per square kilometre of geographical area of the district. As livestock is one of the significant sub-sectors of agriculture, the level of milk production is one of the major determinants that represents livestock wealth.	UPDES

FP/KM^2	It stands for the total amount of fish production (tonnes) per square kilometre of the district departmental area of fisheries. As fisheries and aquaculture is one of the significant sub-sectors of agriculture, the level of fish production is one of the major determinants that represents the fisheries and aquaculture wealth.	UPDES
FA/KM^2	It stands for the forest area per unit of geographical area which equals the percentage of total forest land in each district. Forestry and logging are some of the significant sub-sectors of agriculture, which not only provide fruits, timber, and other byproducts but also help in biodiversity and soil conservation. Thus, the size of the forest cover represents the agroecological balance.	UPDES
LR/KM^2	It stands for the length of road(pucca road) per square kilometre of geographical area which represents the rural road density of the district. The presence of rural road infrastructure is significant for the smooth transportation of agricultural goods. *Non PWD Roads are taken into account which are basically improves local connectivity and smooth's the agriculture logistics.	UPDES

Tools and Techniques

This study constructs an Agricultural Development Index (ADI) for 75 districts based on seven key indicators reflecting various aspects of agricultural performance. Tried and tested software "MS Excel' has been used for the calculation and tabulation of data while online software's have been used for software have been used for plot, graph, and data visualization.

The methodological steps adopted are outlined below:

1. Data Normalization

To enable meaningful comparison across variables measured on different scales, all seven indicators were normalized using the **Min-Max normalization technique**. This method transforms the original data into a standardized scale ranging from 0 to 1, according to the formula:

$$X2 = (X \text{ “ } X\tilde{} \text{ b”™ }) / (X\tilde{} \text{ “ “ } X\tilde{} \text{ b”™ })$$

2. Construction of Composite Index

The Agricultural Development Index (ADI) for each district was computed as the **arithmetic mean** of the normalized values of all seven variables. This unweighted approach assumes equal importance of each indicator. Alternatively, a weighted average can be employed if prior knowledge or expert judgment suggests differing significance among the variables.

3. Ranking of Districts

Upon calculating the ADI, districts were ranked in descending order using the RANK.EQ function in Microsoft Excel. Higher index values correspond to higher ranks, indicating relatively greater agricultural development.

4. Quartile-Classification

To facilitate comparative analysis and policy targeting, the ranked index values were categorized into **four quartiles** using the QUARTILE.INC function in Excel. These quartiles represent:

- **Q1**: Districts in the lowest 25% of the ADI distribution (Very Low degree of development)
- **Q2**: Districts in the second quartile (Low degree of development)

- **Q3**: Districts in the third quartile (High degree of development)
- **Q4**:Districts in the highest 25% (most developed)

Each district was assigned to its corresponding quartile through conditional logic functions.(Very High degree of development)

Findings of the Study

The index values reflect a considerable variation, ranging from a low of 0.168 in Sonbhadra to a high of 0.532 in Rampur, which reflects serious differences in agricultural growth. The average value of the Agriculture Index in the state is around 0.350, reflecting that although some districts are close to the optimal level of agricultural performance, many of them are far behind. This wide range highlights the unevenness of agricultural progress and calls for region-specific policies that can improve the performance of backward districts without slowing down the progress of the more developed ones.

A number of districts stand out as the best performers in the state. Rampur, with the highest Agriculture Index of 0.532, is followed closely by Agra (0.513), Chandauli (0.493), Bulandshahar (0.490), Mau (0.488), and Hapur (0.485). These districts have large cropping and irrigation intensities, which reflect effective use of land and water resources. They also demonstrate strong infrastructure development, specifically road density, that enhances better market and input connection. The high fertilizer use in these districts further reflects intensive farm practices adoption. Additional outputs like fish and milk production are also comparatively much greater in these areas, adding to overall agricultural prosperity there. Moderate to considerable forest cover in areas such as Chandauli and Rampur also serves to add a positive contribution through supporting biodiversity and ecological balance but needs to be managed to avoid conflict with requirements of arable land.

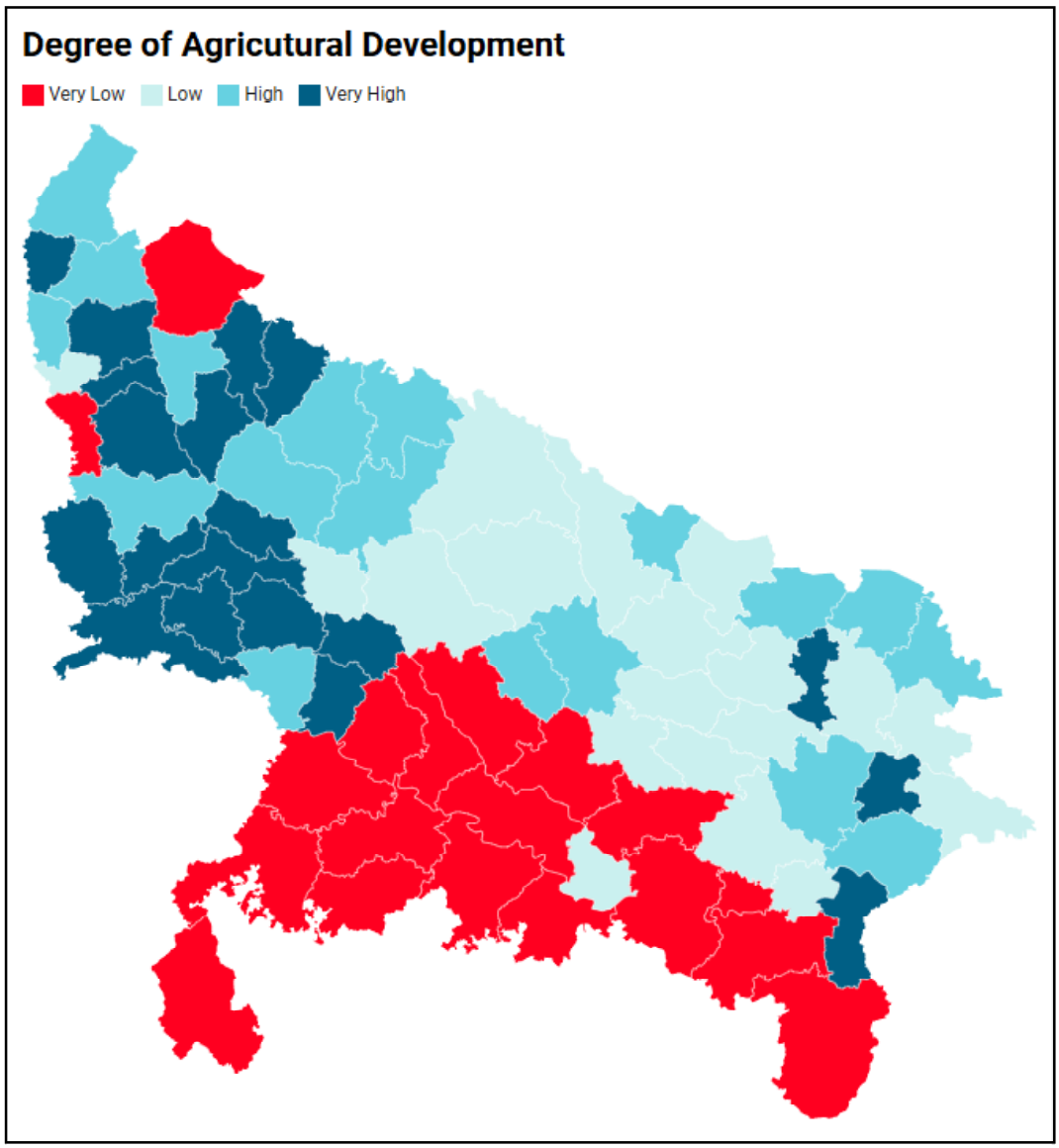
Table 2: Agriculture Index of Various Districts

District	Agriculture Index	Ranking	Degree of Development
Agra	0.513	2	Very High
Aligarh	0.384	31	High
Prayagraj	0.253	66	Very Low
Ambedkarnagar	0.342	46	Low
Amethi	0.346	41	Low
Amroha	0.401	23	High
Auraiya	0.454	10	Very High
Azamgarh	0.351	37	High
Baghpat	0.409	20	High
Bahraich	0.323	54	Low
Ballia	0.344	44	Low
Balrampur	0.307	56	Low
Banda	0.246	68	Very Low
Barabanki	0.372	33	High
Bareilly	0.398	24	High
Basti	0.338	49	Low
Bijnor	0.258	64	Very Low
Budaun	0.397	25	High
Bulandshahr	0.490	4	Very High
Chandauli	0.493	3	Very High
Chitrakoot	0.228	70	Very Low

Deoria	**0.335**	**51**	**Low**
Etah	0.420	18	Very High
Etawah	0.386	29	High
Ayodhya	0.348	39	Low
Farrukhabad	0.344	43	Low
Fatehpur	0.307	57	Very Low
Firozabad	0.422	17	Very High
Gautam Buddha Nagar	0.225	71	Very Low
Ghaziabad	0.339	47	Low
Ghazipur	0.373	32	High
Gonda	0.342	45	Low
Gorakhpur	0.351	38	Low
Hamirpur	0.179	74	Very Low
Hapur	0.485	6	Very High
Hardoi	0.334	52	Low
Hathras	0.466	8	Very High
Jalaun	0.253	65	Very Low
Jaunpur	0.337	50	Low
Jhansi	0.205	72	Very Low
Kannauj	0.414	19	Very High
Kanpur Dehat	0.233	69	Very Low
Kanpur Nagar	0.251	67	Very Low
Kasganj	0.426	14	Very High
Kaushambi	0.338	48	Low
Kheri	0.324	53	Low
Kushinagar	0.359	35	High
Lalitpur	0.264	63	Very Low
Lucknow	0.386	30	High
Maharajganj	0.394	26	High
Mahoba	0.193	73	Very Low
Mainpuri	0.468	7	Very High
Mathura	0.439	11	Very High
Mau	0.488	5	Very High
Meerut	0.431	13	Very High
Mirzapur	0.304	58	Very Low
Moradabad	0.437	12	Very High
Muzaffarnagar	0.359	34	High
Pilibhit	0.406	21	High
Pratapgarh	0.286	61	Very Low
Rae bareli	0.288	60	Very Low
Rampur	0.532	1	Very High
Saharanpur	0.357	36	High
Sambhal	0.423	15	Very High
Sant Kabeer Nagar	0.462	9	Very High
Bhadohi	0.265	62	Very Low
Shahjahanpur	0.404	22	High
Shamli	0.422	16	Very High
Shravasti	0.388	28	High
Siddharthnagar	0.389	27	High
Sitapur	0.346	42	Low
Sonbhadra	0.168	75	Very Low
Sultanpur	0.348	40	Low
Unnao	0.294	59	Very Low
Varanasi	0.311	55	Low

Source : Authors calculations using MS Excel.

Figure 1. Map Shows Degree of Development across Districts



Source: Author's conceptualization. Created with the help of OnlneDatawrapper software. Maps are not to scale. Colour print required

The prosperity of these districts is due to a confluence of various factors. Western Uttar Pradesh, where most of High development districts are situated, is served by a wide network of canals that provide irrigation and high levels of groundwater availability, allowing farming all year round. The districts are also relatively near big towns, improving accessibility to farming markets, credit outlets, and modern farming technology. In addition, a record of agrarian reform and investment in

infrastructure has reinforced the development of these districts, allowing them to sustain high productivity levels in the long term. Their performance indicates that under the right combination of natural resources, infrastructure, and institutional support, agricultural development can thrive even in a difficult environment.

Table 3: Top Five and Bottom Five Districts

Top Five Districts	Agri Index	Bottom Five Districts	Agri Index
Rampur	0.532	**Sonbhadra**	0.168
Agra	0.513	**Hamirpur**	0.179
Chandauli	0.493	**Mahoba**	0.193
Bulandshahr	0.490	**Jhansi**	0.205
Mau	0.488	**Gautam Buddha Nagar**	0.225

Source: Author's Calculations using MS Excel

Conversely, several districts lag significantly behind on the Agriculture Index, coping with substantial developmental challenges. These include Sonbhadra (0.168), Hamirpur (0.179), Mahoba (0.194), Jhansi (0.205), Gautam Buddha Nagar (0.225), and Chitrakoot (0.228), which consistently rank among the lowest. These districts typically exhibit low cropping and irrigation intensities, inefficient fertilizer use, and poor infrastructure connectivity. Furthermore, their limited milk and fish production hinders agricultural diversification and restricts potential income sources for farmers. In certain areas, such as Sonbhadra, the extensive forest cover, while ecologically beneficial, reduces the amount of land available for cultivation, presenting an obstacle to agricultural expansion. Additionally, the lack of access to agricultural credit and extension services in these districts further constrains their productivity.

Discussions and Policy Implications

Geographic and climatic factors significantly hinder agricultural performance in some districts. Areas with rocky terrain, poor soil, and erratic rainfall face challenges for traditional farming, necessitating drought-resistant crops and efficient water management. In districts like Gautam Buddha Nagar, urbanization has shifted labor from agriculture to other sectors, impacting farming's emphasis and index value. Special attention is needed for districts with high forest cover, such as Sonbhadra. Here, the focus should pivot from conventional crop production to sustainable agroforestry and diversified livelihoods. This approach supports conservation while empowering local communities. Promoting animal husbandry, beekeeping, and fisheries can also provide alternative income, reducing reliance on traditional agriculture.

The Agricultural Index also reveals crucial policy implications. High-performing districts like Rampur and Chandauli offer best practices in irrigation, crop diversification, and allied industry investment that can be replicated. Low-performing regions require targeted interventions, including micro-irrigation (sprinklers, drip systems), improved rural roads, and better access to quality seeds and fertilizers. Additionally, strengthening agricultural extension services and farmer training can boost the adoption of modern farming methods, driving future growth.

Conclusion

In essence, the Agriculture Index serves as a valuable analytical tool for understanding the multifaceted dynamics of agricultural development across Uttar Pradesh. The glaring disparities revealed between districts underscore the critical need for nuanced and region-specific interventions. While some districts have successfully capitalized on robust infrastructure, abundant natural resources, and favourable policy environments to achieve significant agricultural productivity, others are confronted with considerable environmental limitations, institutional weaknesses, and infrastructural deficits. Addressing the unique challenges faced by these less developed agricultural regions through strategically targeted investments and inclusive planning will be instrumental in transforming Uttar Pradesh into a truly resilient and prosperous agricultural state. Consequently, the Agriculture Index transcends its function as a mere diagnostic instrument; it serves as a vital roadmap guiding the path towards inclusive growth in both the agricultural sector and broader rural development initiatives within the state. By carefully considering the index's findings, policymakers can formulate more effective and equitable strategies to uplift all agricultural communities in Uttar Pradesh.

Data References

1. Directorate of Economics and Statistics, Department of Planning and Development, Government of Uttar Pradesh, Lucknow https://updes.up.nic.in/

References

- Alam, S., & Shankar, R. (2024). Regional disparity in Bihar: A district-level study of agricultural and social indicators. *Journal of Rural Development Studies, 38*(1), 55–72.
- Arthur, L. (1954). Economic development with unlimited supplies of labour. *The Manchester School, 22*(2), 139–191.
- Bhalla, G. S., & Singh, G. (2001). *Indian agriculture: Four decades of development*. New Delhi: Sage Publications.
- Birthal, P. S., Roy, D., Joshi, P. K., &Thorat, A. (2015). Farm diversification and climate resilience in Indian agriculture. *Agricultural Economics Research Review, 28*(2), 1–12.
- Chand, R., Saxena, R., & Rana, S. (2018). Estimates and analysis of farm income in India, 1983–84 to 2011–12. *Economic & Political Weekly, 53*(4), 45–53.
- Diwakar, D. M. (2018). District-level development disparities in Uttar Pradesh: A composite index analysis. *Indian Journal of Regional Studies, 34*(2), 70–85.
- John W. Mellor. (1976). *The new economics of growth: A strategy for India and the developing world*. Ithaca, NY: Cornell University Press.
- Raman, R., &Kumari, R. (2012). Regional disparity in agricultural development: A district-level analysis for Uttar Pradesh. *Journal of Rural Development, 31*(4), 435–448.
- Saha, S., & Dutta, A. (2024). Growing regional disparity in West Bengal: A district-level composite index approach. *Economic Affairs, 69*(1), 25–39.
- Shaban, A. (2006). Regional development and disparities in Maharashtra: A district-level analysis using PCA. *Indian Journal of Regional Science, 38*(1), 15–30.
- Sharma, R., Yadav, V., & Mishra, P. (2021). Composite development index of Uttar Pradesh districts: A principal component approach. *Social Science Probe, 18*(2), 101–117.

- Shastri, C. (1988). Regional disparities in Rajasthan: A district-level perspective, 1961–1984. *Journal of Development Geography, 7*(2), 42–57.
- Singh, R., & Singh, A. (2016). Spatial disparities in agricultural productivity in Uttar Pradesh: An infrastructure-based study. *Indian Journal of Agriculture and Economics, 71*(3), 360–374.
- Srivastava, A., & Dubey, S. (2019). Disparities in rural infrastructure and agricultural mechanization in Uttar Pradesh. *Journal of Land and Rural Studies, 7*(1), 24–39.
- Tripathi, S., &Awasthi, I. C. (2013). Socio-economic development across Indian districts: A multivariate Wroclaw approach. *Indian Economic Journal, 60*(4), 91–112.
- World Bank. (2008). *World development report 2008: Agriculture for development*. Washington, DC: World Bank.
- Uttar Pradesh Directorate of Economics and Statistics. (2024). *Statistical diary of Uttar Pradesh 2023–2024*. Lucknow: UP Directorate of Economics and Statistics.
- Uttar Pradesh Directorate of Economics and Statistics. (2024). *District wise development indicators, Uttar Pradesh 2024*. Lucknow: UP Directorate of Economics and Statistics.

Nutrition Security in States of Uttar Pradesh and Uttrakhand: A Challenge for Achieving Vision 2047

Dr. Arundhati Sharma[1] & Dr Dalip Kumar[2]

ABSTRACT

This paper presents the status of food and nutrition security in India. The issue of nutrition & food security has been cropping up as one of the serious challenges faced by the 21 St. century. Nutrition security is defined as a state when a person has a nutritionally adequate diet, the food consumed is "bioavailable" for the body to perform adequately in maintaining various physiological processes including growth, resisting or recovering from disease, pregnancy, breastfeeding, and physical activities. Nutritional security largely depends of the quality of health of the population, especially of the children, adolescents and women. The purpose of this paper is to gather information on infant and child mortality, nutrition, anemia, wasting, stunning, utilization and quality of health and planning services etc. Nutrition & food security in India is facing major challenge due to growing population, climate change, water management, water scarcity, urbanization, rising energy costs, new technologies, marketing of agricultural products and markets etc. Household food security and nutrition have worsened during the reforms, the reason for which seems to be higher inflation and costly food items. The Government of India has given clarion call to the citizens, planners and all to work for making India the developed nation by year 2047. According to Food and Agricultural Organization (FAO-2023) that 74.1 per cent population in India is unable to afford healthy diet whereas it is just 1.4 per cent in North American and European countries. The condition in other developing and underdeveloped countries are precarious. Percentage of population unable to have healthy diet are 10.9per cent in China, upper middle-income countries 14.1 per cent, lower income countries 70.2 per cent, low-income countries 86. 1 per cent, South Asia 54.9 per cent, Asia 44.2 and Africa 77.5 per cent.

Keywords: *Food Security, Nutritional Security, Vision 2047, Consumption Pattern, Shree Anna recipes.*

Introduction

The food & nutritional insecurity doesn't auger well for India which is passing through the 'Amrit kaal' and aiming at being the third largest in just few years. The PM Modi has given clarion call to the citizens, planners and all to work for making India the developed nation by year 2047. This dichotomy in the fastest growing economy persists despite several government initiatives to address the issues related to health of the people which is basic component contributes for human

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capital formation in the long term. Food& nutritional security has always been one of the serious challenges faced by mankind as it is related to the issue of survival and quality of life. The 1995 World Food Summit declared, "Food security at the individual, household, regional, national and global levels exist when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996, p.3). The declaration further recognizes that "poverty eradication is essential to improve access to food. Nutrition security is defined as a state when a person has a nutritionally adequate diet, the food consumed is "bioavailable" for the body to perform adequately in maintaining various physiological processes including growth, resisting or recovering from disease, pregnancy, breastfeeding, and physical activities (Kalkuhl,2016).

Nutritional security depends on food security. The categorical dimension of food security most commonly has 4 pillars: availability, access, utilization, and stability. (UN,1975).1990s that the concept of nutrition security was included in the definition of food security. For food security availability, accessibility, utilization& stability, are the important issues to be taken into consideration. For availability, there is need to scale up food production which needs the modern farming tools & techniques, better irrigation infrastructure, use of chemical fertilizers, pesticides and other inputs. As a result, the sustainability issue arises and threatens the food security in future. For food and nutritional security farmers, agro-scientist policy makers, planners and governments need to take steps commensurate to future sustainability. It requires to bridge the gap between demand and supply as well as to strengthen the distribution network so that food is available to the people in every part at affordable price. Access of food depends on income and financial stability also. If economists continue to treat food and other agricultural products just as any other goods and give priority to volume and structure of domestic production & distribution as well as it's subordination to market regulations as well as the competitive price rule, the goal of food security to all, at all times can't be achieved. The global crisis of 2007 has renewed the debate on food security from the households, national, regional and global perspectives. Food security requires its linkage with the production, socio-economic security as well as maintain domestic market in a manner that ensures the availability of food to all, at lower costs. It also requires managing foreign trade, storage &reserves and correct functioning of processing and distribution.

The National Food Security Act 2013 aims to provide for food and nutritional security by ensuring access to adequate quantities of quality food at affordable prices. It is strategically designed to link sustainability with a clear framework for strategic alignment with global priorities. It became imperative in the paradoxical situation when food security is threatened despite tremendous technological development, economic growth, rise in per capita income and expansion of global market. The issue of nutrition & food security has been cropping up as one of the serious challenges faced by the 21st. century world because of the mad race for injudicious exploitation of natural resources that promotes "mass production instead of production for the masses", there has been unbalanced and unsustainable growth. As a result, simultaneously there exists both the 'plenty & prosperity' on the one side as well as 'poverty, hunger, starvation, deprivation and malnutrition' on the other. These are the early symptoms of unsustainable development. It requires balance food to all the people, all the time at individual, national, regional and global level all through the year. In 2022, the Global Food Security Index (GFSI) ranked India at 68th out of the 113 major countries in terms of food security. In 2022, the Global Hunger Index (GHI) ranked India at 107th out of 121

countries. According to the Global Food Security Index 2022, India has a prevalence of undernutrition of 16.3 per cent. Further, 30.9 per cent of children in India are stunted, 33.4 per cent are underweight, and 3.8 per cent are obese. Global hunger, measured by the prevalence of undernourishment (Sustainable Development Goal Indicator 2.1.1), but is still far above pre-COVID-19-pandemic levels, affecting around 9.2 per cent of the world population in 2022 compared with 7.9 per cent in 2019(FAO,2023)

Objectives and Methodology

Main objective of this paper to gather information on child mortality, nutrition, anemia, wasting, stunning, utilization and quality of health etc.. Secondly, to find the food consumption pattern and trends in consumer expenditure on food and non- food items. This paper is based on secondary data which collected from several agencies, including FAO, NSSO, MOSPI, NABARD and NFHS various rounds. FAO provided data related to Proportion of the Population Unable to Afford a Healthy Diet National Family Health Survey (NFHS) provide data related to nutritional label among children, adolescent and women.

Literature Review

As per American Heart Association the Nutrition security refers to an individual or household condition of having equitable and stable availability, access, affordability, and utilization of foods and beverages that promote well-being, prevent disease, and if needed, treat disease. (Thorndike AN, CD Gardner, KB Kendrick et.al, 2022). As per Ayala & Meier study Nutrition security and food security are interconnected and must be dealt with simultaneously to address associated health challenges. Food and nutrition security is expected to increase as a result of new challenges. (Ayala & Meier,2017),The original definition of food security arose in 1974 at the World Food Conference to focus on the "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (FAO, 2017).

The World Food Summit 1996 focused on the need for nutrition as a basis of health: "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" The World Health Organization has emphasized that micronutrient malnutrition contributes substantially to the global burden of disease and Iron deficiency is the most common form of micronutrient malnutrition globally (Tulchinsky,2010). Food utilization is defined as the ability of a person's body to assimilate nutrients in consumed food. Optimum calorie and nutrient consumption by a person are an outcome of good care and dietary habits, food preparation, variety of the diet, and intra household distribution of food. Combined with good biological utilization of food consumed, all of these factors determine the nutritional status of individuals (FAO,2008).

The changing pattern of population agglomerations across a rural–urban continuum and its interface as a place of exchange and socioeconomic interactions, is reshaping and being reshaped by agrifood systems, with implications for the availability and affordability of healthy diets, and in turn, for food security and nutrition.(FAO,2023). Laborde's paper on 'COVID-19 risks to global food security' say that the recent economic crisis caused by COVID-19 may lead to a scenario of food insecurity related to a decrease in the economic income of families derived from the increase

in unemployment (Laborde,2020) 'Food Security and Nutrition: Vision 2020' written by R. Radhakrishna and K. Venkata Reddy mentioned that while India achieved success in combating transient food insecurity caused by droughts or floods, it miserably failed to make much dent in chronic food insecurity as reflected in the low energy intake and high incidences of malnutrition. The overall improvement in nutritional status has also been very slow.

Kumar, Rajesh and Bagaria, Nidhi and Santra, Swarup (2014) paper on *Food security: status and concerns of India* focuses on status of food security, reduction of hunger and undernourishment has remained sluggish and well below the developed countries. Surabhi Mittal (2006) paper on '*Structural Shift in Demand for Food: Projections for 2020'*analyzed of food consumption patterns and how they are likely to shift with changes in income and relative price is required to assess the food security-related policy issues in the agricultural sector.

Consumer Expenditure on Food and Non-food Items

Dietary pattern or the nutritional pattern is based on the quantities, proportion, variety or the combination of different foods, drinks and nutrients in diets as well as the frequency with which they are habitually consumed by the population at large. Dietary patterns with nutrients in required proportion indicate the nutritional status which determines the gastrointestinal microbial and diversity and regulation of mucosal immune system. Long term dietary patterns affect the diversity of microbiota,whereas the short-term changes in the diet that influences the mechanism of immune system in the human body. It is not wrong to say that nutritional deficiencies are hidden hunger, most of the developing countries suffer from.

Table 1: Composition and Growth of NAS Household Consumption Expenditure (%)

	Current Prices		At Constant Prices (2011-12)	
Years	Food and Non-alcoholic Beverages	Other Goods and Services*	Food and Non-alcoholic Beverages	Other Goods and Services*
	Percentage		Percentage	
2011-12	30.4	69.6	30.4	69.6
2012-13	31.0	69.0	30.5	69.5
2013-14	31.6	68.4	30.5	69.5
2014-15	30.9	69.1	29.0	71.0
2015-16	29.2	70.8	27.4	72.6
2016-17	30.4	69.6	28.2	71.8
2017-18	29.5	70.5	27.5	72.5
2018-19	28.4	71.6	27.1	72.9
2019-20	28.9	71.1	27.2	72.8
2020-21	32.5	67.5	30.3	69.7

Sources: Computed from National Statistics Organisation (2023), National Accounts Statistics, MOSPI, Government of India
Notes:- *Included health, education, transportation, communication, recreation, hotels etc,

Table -1 depicts the trends in consumer expenditure on food and non-food items in percentage terms. The expenditure on food items for urban people has declined from 56 per cent in 1987-88 to 38 per cent in 2011-12 during the same period non-food expenditure rose from 44 to 62 per cent. In

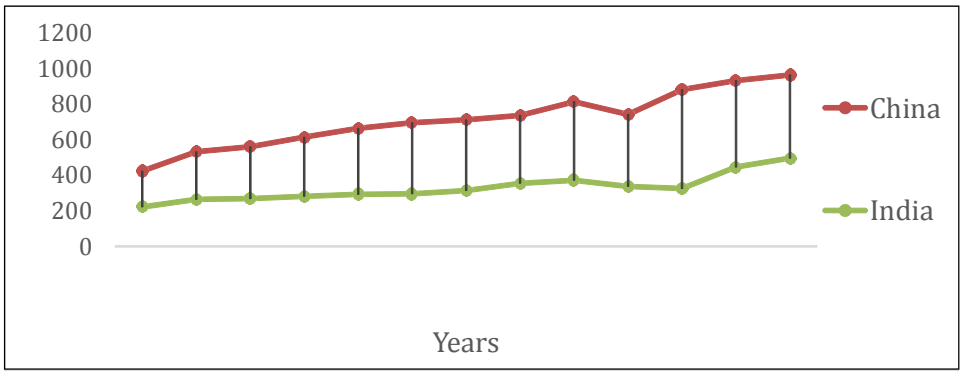
urban area people gave more importance to non- food items like health, education, housing, transport, luxuries and fashion. As per 'Engel Law'- household income increases, the percentage that is spent on food decreases, but the absolute amount spent on food increases. Spending less money on food means people have more disposable income for other items like education, housing and health. Per capita expenditure on food of India increased 281.9 US$ in 2013 to 496.7 US$ in year 2022. This is an average annual growth rate is around 7.16 per cent.

The percentage consumer expenditure in food items decreased in urban as well rural sectors. Before reform the expenditure was 56 and 64 per cent respectively in urban and rural areas. But after reform these expenditures are 41 and 54 per cent respectively in urban and rural areas. The share of food has fallen by about15 and 10 percentage points respectively in urban and rural India. The decline in expenditure on food items (both rural and urban areas) being offset by commensurate increase in expenditure on non-food items may be due to increase in the level of income and changes in the life style of the people. However, if this decline in consumption of food items is witnessed without a similar increase in consumption of non-food items, it is a cause of serious concern particularly for the socially and economically weaker sections of the society (Dev and Sharma: 2010).

Per capita Expenditures on Food items in India and China

Expenditures depend on income. Per capita income of country increases, its food consumption pattern has changed. They use high value foods like as variety of fruits and non-veg items. Food intake pattern of youth specially in urban areas has changed. Now home-made meals have been replaced by processed and packed fast foods. An urban area, food consumption pattern, food habit and life style changed rapidly. Food expenditure included food items bought for consumption at home. Out- of- home food purchases, alcohol, tobacco is not included in food items. As per Chart - 2 rich countries people trend to spend more money on food in absolute terms. Food trends to account for a smaller percentage of their total expenditure. But low-income people trend to use cheaper staple food such as cereals and vegetables for most of found calories. Other side richer people can afford other food such as fruits, vegetables, meats and other deary products. This food provides wider range of protein, fats and micro nutrients. Details of India and China Household Consumption Expenditure on Food can be seen on Chart-1.

Chart-1: Trends of Per capita Expenditure on Food items Among India and China (US$)



Sources:- *Computed from- USDA Economic Research Services,2023*

In compression of India and China, per capita expenditure on Food items is just double in China than India. India changes in urbanization, per capita income, education, health awareness etc., actually in last one decade. India's food consumption per capita has increased in terms of quantity and quality. Per- capita expenditure on food for China was 965.6 US$ in year 2022, whereas India was only 496.7US$ in same period. Per- capita expenditure on food for China increased from 424.0 US$ in 2010 to 965.6 US$ in 2022. This is growing an average annual rate of 5.37 per cent. In the same period Per- capita expenditure on food for India increased from 222 US$ to 496.7 US$. The trends of average annual growth rates of this period were 7.16 per cent. Clearly, looking at calorie intake independently of activity could be quite misleading when the former varies so much with the latter. (Deaton and Dreze 2008). Per capita calorie consumption also appears to have declined in contemporary China in the 1980s and 1990s (a period of rapid improvement in nutrition indicators such as height and weight), see Du, Lu, Zhai and Popkin. The decline in per capita calorie consumption has been previously noted in the Indian literature including, without any attempt to be exhaustive, National Sample Survey Organization (2001&2012), Rao (2000, 2005), Meenakshi and Viswanathan (2005), Ray and Lancaster (2005), Palmer-Jones and Sen (2001), Patnaik (2004, 2007), Radhakrishna, Rao, Ravi, and Reddy (2004), Radhakrishna (2005), Sharma (2006) and Kumar, Mruthyunjava, and Dey (2007).

Nutritional Status Evidence from NFHS Data

Nutritional security largely depends of the quality of health of the population, especially of the children, adolescents and women. To know the health status, multi round of National Family Health Surveys (NFHS) being conducted on periodic basis since 1992-93. The purpose is to gather information on fertility, infant and child mortality, family planning practices, reproduction, nutrition, anemia,wasting,stunning,utilization and quality of health and planning services etc. No doubt,in last three decades, due to economic development and several welfare schemes launched by governments there are significant improvement but some indicators are still cause of concern for India despite moving on fast track of economic growth in the world. This is due to inequality in wealth and income as well as large scale poverty and unemployment prevailing in the country. The FAO defines malnutrition as "an abnormal physiological condition caused by inadequate, unbalanced or excessive consumption of the macronutrients that provide dietary energy (carbohydrates, protein and fats) and the micronutrients (vitamins and minerals) that are essential for physical and cognitive growth and development" (FAO,2003).

National average of anemic children in 6-59 months 67.1 per cent according to NFHS-5 (2019-21). From NFHS-4 to NFHS- 5 here has been some noticeable declines in indicators like nutritional deficiency (38.4 to 35.5%), wasting(21 -19.4%), underweight(35.8- 32.1 %) and anemic children (6-59 months) from 67.1 to 58.6 per cent. Percentage of anemic women (15-59 years of age) shows slight fall from NFHS - 4(2015-16) to NFHS- 5 th. Round. Malnourishment in children (stunting, wasting and underweight) under 5 years has reduced as per NHFS-5 (2019-21) from 38.4 per cent to 35.5 per cent, 21.0 per cent per cent to 19.3 per cent and 35.8 per cent to 32.1 per cent respectively as compared to NHFS-4 (2015-16). Malnutrition among women aged 15-49 years has also reduced from 22.9 per cent to 18.7 per cent.

Table 2 presents the Nutritional status of Children, Non-pregnant women(15-49 years), Pregnant women(15-49 years), all men and women, adolescents' girls and boys revealed by latest round (NFHS-5) rounds conducted in states of Indie.

Table 2: Nutritional Status of Children and Adults in India (2019-21)

Sr. No.	Descriptions	India			
		NFHS Vth Round (2019-21)			NFHS IV (2015-16)
		Urban %	Rural %	Total %	Total %
1	Children (6-59 months) Anemic	64.2	68.3	67.1	68.6
2	Non-pregnant women (15-49 years) Anemic	54.1	58.7	57.2	53.2
3	Pregnant women (15-49 years) Anemic	45.7	54.3	52.2	50.4
4	All women (15-49 years) Anemic	53.8	58.5	57.0	53.1
5	All women(15-19years) Anemic	56.5	68.2	59.1	54.1
6	All men (15-49 years) Anemic	20.4	27.4	25.0	22.7
7	All men(15-19years) Anemic	25.0	33.9	31.1	29.2
8	Women (overweight)	33.2	19.7	24.0	20.6
9	Men (Overweight)	29.8	19.3	22.9	18.9

Sources: National Family Health Survey, 5th Round

As per above table 2 shows the Nutritional deficiencies in children as shown by NFHS 4 (2015-16) and NFHS 5 (2019-21). Above data gives the all-India picture of stunting, wasting and underweight children. percentage of stunting children in NFHS 4 was 38.4 per cent. That came down to 35.5 per cent in NFHS 5.Percentage of wasting children also came down from 21 per cent in NFHS -4 to 19.4 per cent in NFHS-5. NFHS 4 found 35.8 per cent underweight children in the country which dropped down to 32.1 per cent by 2019-22 (NFHS- 5). Percentage of stunting children in NFHS 4 was 38.4 which declined to 35.5 in NFHS 5. There were 21.0 per cent Wasting children in NFHS 4 and that came down to 19.4 per cent in NFHS 5. Similarly, 35.8 per cent children were found underweight in NFHS 5 but the figure declined to 32.1 per cent by NFHS in 2019-21. These improvements could become possible due to more awareness as well as other programmes launched by the government at massive scale. Adolescents age (15-19 years) is very crucial in the physical and mental health of population and hence in the human capital formation. Data related to anemic girls and boys in India. National Family Health Surveys found 54.1 per cent girls and 29.2 per cent boys as anemic in 2015-16 as well as 59.1 per cent and 31.1 per cent respectively in 2019-21. The difference in the number of anemic girls and boys indicates remnants of gender difference in India's patriarchal society that still cares more for male child in majority of families. The percentage of all anemic (pregnant) women (in 15-59 years age group) increased from 50.4 per cent in NFHS 4 (2015-16) to 52.2 per cent in NFHS 5 (2019-21). The overall figure of all women in last two surveys are 53.1 per cent in 2015-16 and 57 per cent in 2019-21.

Nutritional Status in UP and Uttarakhand

Nutritional Status of UP

Uttar Pradesh (UP) is a state in northern India. More than 24 crores inhabitants, it is the highest populated state in India. Children's nutritional status in Uttar Pradesh has been decline little since NFHS-4.The infant mortality rate in Uttar Pradesh was 50 deaths (before the age of one year) per 1,000 live births. The under-five mortality rate, on the other hand, was estimated to be 60 deaths (before five years of age) per 1,000 live births (NFHS-V). Around 40 per cent of the children under the age of five years were stunted (too short for their age) in Uttar Pradesh. The level of undernutrition is the highest among children belonging to Scheduled Tribes. Around 50 per cent of women in the state had anemia compared to the 21 per cent of men who suffered from anemia. The percentage of children who are underweight decline from 40 percent to 32 percent in the 4 years betweenNFHS-4 and NFHS-5. The percentage of children who are wasted has not changed since NFHS4 (18% in NFHS-4 and 17% in NFHS5). However, the continuing high levels of undernutrition are still a major problem in Uttar Pradesh. This state is a significant burden of malnutrition, particularly among children. While there's been some progress in reducing stunting and underweight, the state still faces high levels of malnutrition. Stunting affects 46.2 per cent of children, wasting is 17.9 per cent, and underweight is 39.5 per cent, with a very high prevalence of child anemia at 63.3 per cent

Table 3: Nutritional Status of Children and Adults in UP and Uttarakhand

Sr. No.	Descriptions	Uttar Pradesh			Uttarakhand				
		NFHS Vth Round			NFHS IV	NFHS Vth Round			NFHS IV
		(2019-21) %			(2015-16) %	(2019-21) %			(2015-16) %
		Urban	Rural	Total	Total	Urban	Rural	Total	Total
1	Children (6-59 months) Anemic	65.3	66.7	66.4	63.2	63.8	56.6	58.5	59.8
2	Non-pregnant women (15-49 years) Anemic	50.5	50.7	50.6	52.5	45.6	41.0	42.4	45.1
3	Pregnant women (15-49 years) Anemic	37.1	47.9	45.9	51.0	51.9	44.3	46.4	46.5
4	All women (15-49 years) Anemic	50.1	50.5	50.4	52.4	45.8	41.1	42.6	45.2
5	All women(15-19years) Anemic	53.4	52.8	52.9	53.7	41.0	40.9	40.9	46.4
6	All men (15-49 years) Anemic	18.0	22.7	21.5	23.7	14.2	15.6	15.1	15.6
7	All men(15-19years) Anemic	22.5	29.9	28.2	31.5	31.2	26.3	27.6	22.2
8	Women (overweight)	30.6	18.3	21.3	16.5	31.9	25.4	29.7	20.4
9	Men (Overweight)	24.9	16.2	18.5	12.5	31.4	25.0	27.1	17.7

Sources: National Family Health Survey, 5th Round

As per Table3, two-fifths (40%) of women and 36 per cent of men are either too thin or overweight or obese. Among women age 15-49, the proportion overweight or obese is 21 per cent, which is the higher than in NFHS-4 (17%). Men are almost equally likely to be thin or overweight or obese (18-

19%), which is different from the pattern observed in NFHS-4 with men being much more likely to be thin (26%) than overweight or obese (13%).Two-thirds (66%) of children age 6-59 months are anemic. This includes 28 per cent who are mildly anemic, 36 percent who are moderately anemic, and 2 per cent who have severe anemia. The overall prevalence of anemia in children increased from 63 percent in NFHS-4 to 66 per cent in NFHS-5.Half (50%) of women in Uttar Pradesh have anemia, including 24 per cent each with mild and moderate anemia, and 2 per cent with severe anemia.

Chart-2: Comparative Study of Nutritional Status in India, UP and Uttarakhand (2019- 2021)

Chart 2A

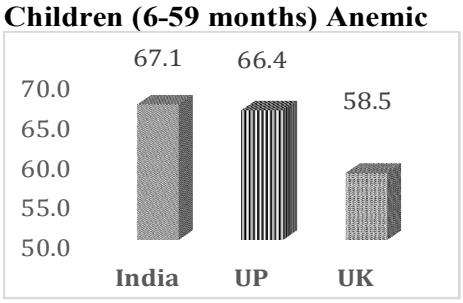


Chart 2B

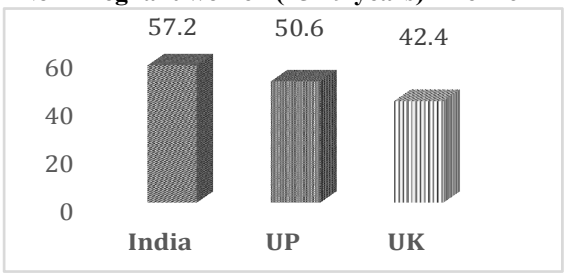


Chart 2C

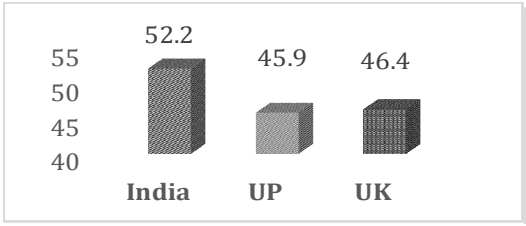


Chart 2D

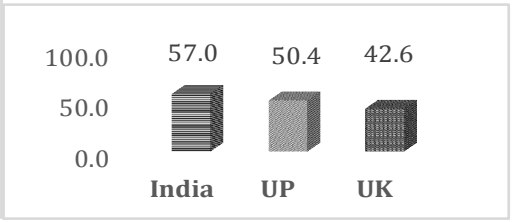


Chart 2E

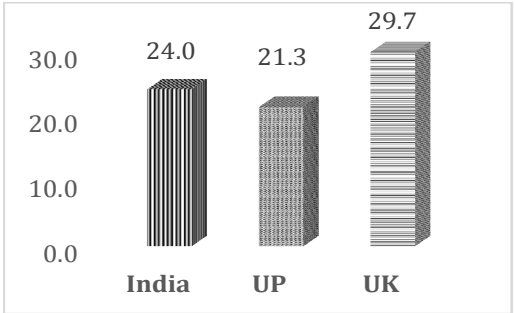
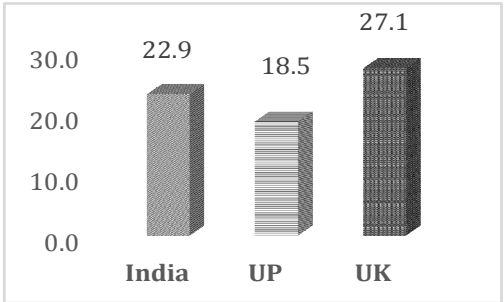


Chart 2F



Nutritional Status of Uttarakhand

Uttarakhand(UK) formerly known as Uttaranchal is a state in northern India. It is divided into regions, Garhwal and Kumaon, which further break into 13 districts. The literacy rate of Uttarakhand is 79.63 per cent with 88.33 per cent literacy for males and 70.70 per cent literacy for females as per the Census in 2011.Uttarakhand has a significant problem with undernutrition, particularly among children. Data from the NFHS-5 indicates that 58.5 per cent Children (6-59 months) Anemic,44.2 per cent non-pregnant women (15-49 years) are Anemic. 46.4 per cent of Pregnant women (15-49 years) are Anemic and 42.6 per cent All women (15-49 years) Anemic. The state has also been identified as an area with iodine deficiency. Twenty-seven percent of children under age five years are stunted, or too short for their age, which indicates that they have been undernourished for some time. Thirteen percent are wasted, or too thin for their height, which may result from inadequate recent food intake ora recent illness causing weight loss, and five percent are severely wasted. Twenty-one percent are underweight, which takes into account both chronic and acute undernutrition. Even during the first six months of life when almost all babies are breastfed, 17 per cent of children are stunted, 26percent are wasted, and 20 percent are underweight.

Nearly three-fifths (59%) of children age 6-59 months are anemic in UK. This The Overall prevalence of anemia in children increased from 53 per cent in NFHS-4 to59 per cent in NFHS-5. Boys are slightly more likely than girls to have any anemia in NFHS-5. Children of mothers who have anemia are much more likely to be anemic. As per Chart 2A,B,C and 2D we can see the comparison between India, UP and UK. Rehan et al. (2020) studied the prevalence of underweight and stunting in children under five years in urban and rural areas of Uttarakhand reported that the prevalence of underweight was 37.3 per cent, stunting 43.3 per cent and wasting 24.5 per cent. Obesity/Overweight is increasing rapidly due to increased sedentary lifestyles, physical inactivity, and unhealthy diet in India. Uttarakhand among the states with the highest prevalence of overweight and obesity in India. The NFHS Vth round data noted that the prevalence of overweight and obesity was higher among both males and females in Uttarakhand. Details compression of India, UP and UK can be seen in Chart No 2E and 2F.

Population Unable to Afford a Healthy Diet

A healthy diet provides not only adequate calories but also adequate levels of all essential nutrients and food groups needed for an active and healthy life. The cost of a healthy diet is defined as the cost of the least expensive, locally available foods that meet the food-based dietary guidelines (FBDGs) requirements, with an energy intake of 2 330 kcal/day(Herforth, Holleman, ed.el.2023)

Table 4 shows the proportion of population unable to afford healthy diet in India, China and the average World at the minimum cost of living. In the year 2017 at the cost of living at $ 2.8 per person /day in India 78.8 per cent population couldn't afford healthy diet whereas it was 16.6 per cent and 43.8 per cent in the world where cost of living was $ 2.5 and $ 3.3 respectively. Till 2018 cost of living being almost stagnant, 73.2 per cent,71.4 per cent and 76. 2 per cent population couldn't afford healthy diet during same years. In 2021 there has been very little changes in the cost of living in the world ($ 3.3 in 2017 to $ 3.7 per person per day). In the same period of 5 years affected by COVID pandemic and international wars, the population affected by unhealthy diet fluctuated between 43.8per cent in 2017 to 42.2 per cent in 2021.

Table 4: Proportion of the Population Unable to Afford a Healthy Diet (%)

Sr. N	Years	Cost of Healthy Diet US$/Person/day					
		India		China		World	
		US $	%	US $	%	US $	%
1	2017	2.8	78.8	2.5	16.6	3.3	43.8
2	2018	2.8	73.2	2.6	13.6	3.4	41.8
3	2019	2.8	71.4	2.7	12.2	3.4	41.2
4	2020	2.9	76.2	2.9	15.9	3.5	43.3
5	2021	3.0	74.1	2.9	10.9	3.7	42.2

Sources: Computed data from FAO, 2023, FAOSTAT: Cost and Affordability of a Healthy Diet (CoAHD),

Conclusion

So many initiatives have been taken by previous as well as by present government to provide food and nutritional security to the masses. Increased agricultural production and rising income have enabled the country, to a large extent, in facing the challenge even during the most critical period of pandemic, international wars and other unforeseen calamities that led to problem of food security. But still the challenges of food & nutritional security remain to be addressed. It is the period of 'Amrit Kaal' and India is fast marching towards the destination of becoming developed by the centenary year of India's independence in 2047. The success of green revolution led to surplus production of food grains like wheat and rice. Due to it intake in daily diet and production of coarse grains *Shree Anna* remained neglected for long after the success of green revolution. It is good that production and consumption of *Shree Anna* are being emphasized and popularized by the Government of India as well as UNO. In the recently held G -20 Summit, *Shree Anna* recipe was served to the world dignitaries so that attention of the people at large, could be attracted towards these grains which have more nutritional values and affordable to the low-income group. To conclude, it is imperative for the government and civil society to make concerted efforts for food & nutritional security to vast 1400 million as it is necessary not only for survival but also for quality of life, well-being of the people, efficiency& productivity of workforce, human resource development and overall development of the country.

References

- Ayala A, Meier BM. A human rights approach to the health implications of food and nutrition insecurity, *Public Health Reviews* (2017) 38:10
- Deaton Angus and Jean Drèze (2008), Nutrition in India: Facts and Interpretations.
- Dev, S. Mahendra and Sharma, Alakh N. (2010), Food Security in India- Performance, Challenges and Policies-Oxfam India,Working Papers Series September 2010, OIWPS-VII
- Dorin, Bruno, (1999), "Food policy and nutritional security: the unequal access to lipids in India, *Economic and Political Weekly*, 34(26), June, 1709–17.
- Du, S., B. Lu, F. Zhai, and B. M. Popkin, (2002), "A new stage of the nutrition transition in
- China", *Public Health Nutrition*, 5(1A), 169–74.

- Das Gupta, Monica, (1985), "Informal Security Systems and Population Retention in Rural India", *NCAER Working Paper No.2*, National Council of Applied Economic Research, New Delhi
- FAO (1996), Food and Agriculture Organization of the United Nations. Report of the World Food Summit. 13–17 November 1996. FAO. 1996. http://www.fao.org/docrep/003/w3548e/w3548e00.htm
- FAO (2003), Food and Agriculture Organization of the United Nations. Trade reforms and food security: conceptualizing the linkages. FAO. 2003. http://www.fao.org/3/a-y4671e.pdf.
- FAO (2008), Food and Agriculture Organization. Food Security Information for Action-Practical Guideline: An Introduction to the Basic Concepts of Food Security. Published 2008. http://www.fao.org/3/al936e/al936e00.pdf
- FAO (2023), *The State of Food Security and Nutrition in the World 2023*, Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development | United Nations Children's Fund, World Food Programme | World Health Organization, Rome, 2023
- Herforth Anna, Cindy Holleman, Yan Bai and William A. Masters (2023), The cost and affordability of a healthy diet (CoAHD) indicators: methods and data sources, online at https://www.fao.org/faostat/en/#data/CAHD
- Jodha, N.S., (1986), "Common Property Resources and Rural Poor in Dry Regions of India",
- *Economic and Political Weekly*, 21(27), 5 July, 1169–81.
- Kalkuhl M, Braun JV, Torero M. Food Price Volatility and Its Implications for Food Security and Policy. Springer International Publishing AG; 2016
- Kumar Dalip and Bharat Singh (2014), Changing Food Consumption, Public Distribution System and Food Security in India, Bihar *Economic Journal*, volume-3, No-1 August, PP 42-56
- Kumar, Praduman, Mruthyunjaya, and Madan M. Dey, (2007), "Long-term changes in Indian Food Basket and Nutrition," *Economic and Political Weekly*, 42(35), September 1st, 3567–72.
- Kumar, Rajesh and Bagaria, Nidhi and Santra, Swarup (2014), *Food security: status and concerns of India.* Published in: The International Journal of Humanities & Social Studies, Vol. 2, No. 1 (January 2014): pp. 108-116.
- Laborde, D.; Martin, W.; Swinnen, J.; Vos, R.(2020), COVID-19 risks to global food security. *Science* **2020**, *369*, 500–502
- Meenakshi, J.V. and B Vishwanathan (2003),'Calorie Deprivation in Rural India', *Economic and Political Weekly*, 38(4), 369-375.
- Meenakshi, J. V. and Brinda Viswanathan, (2005), "Calorie Deprivation in Rural India between 1983 and 1999/2000," in Angus Deaton and Valerie Kozel, eds., The Great Indian Poverty Debate, New Delhi. Macmillan, 570–83
- Mittal Surabhi (2006), '*Structural Shift in Demand for Food: Projections for 2020'* Working Paper No. 184,Indian Council for Research on International Economic Relations, New Delhi
- NABARD (2022), Food and Nutritional Security in India, Changing the Way to Robust Agri-Food System, Department of Economic Analysis and Research, National Bank for Agriculture and Rural Development NABARD Research Study -35. Page 37.
- NFHS (2021), National Family Health Survey (NFHS-5),2019-2021, International Institute for Population Sciences Deonar, Mumbai, Ministry of Health and Family Welfare, Govt. of India, New Delhi
- National Sample Survey Organization, (2001), Nutritional Intake in India 1999–2000, Ministry of Statistics and Program Implementation, Government of India, New Delhi
- National Sample Survey Organization, (2012), Nutritional Intake in India 2009–2010, Ministry of Statistics and Program Implementation, Government of India, New Delhi

- NSSO (2013). "Key Indicators of Household expenditures in India, 2011-2012, NSS 62nd Round, National Sample Survey Organization, Central Statistical Organization, Ministry of Statistics and program Implementation, Government of India, New Delhi.
- Palmer-Jones, Richard, and Kunal Sen, (2001), "On Indian poverty puzzles and statistics of
- Poverty," *Economic and Political Weekly*, 36(3), January 20, 211–7.
- Patnaik, Utsa, (2004), "The republic of hunger," *Social Scientist*, 32(9–10), Sep–Oct, 9–35.
- Patnaik, Utsa, (2007), "Neoliberalism and Rural Poverty in India," *Economic and Political Weekly,* 42(30), July 28, 3132–50.
- Radhakrishna, R. (2005), 'Food and Nutrition Security of the Poor: Emerging Perspectives and Policy Issues', *Economic and Political Weekly*, 40(18), April30, 1817-1823.
- Radhakrishna R and K. Venkata Reddy (2004), 'Food Security and Nutrition: Vision 2020', Indira Gandhi Institute of Development research, Mumbai.
- Radhakrishna, R., K. Hanumantha Rao, C. Ravi, and B. Sambi Reddy. (2004), "Chronic Poverty and Malnutrition in 1990s," *Economic and Political Weekly*, 39(28), July 10, 3121–30.
- Ray, R. and G. Lancaster (2005), "On Setting the Poverty Line Based on Estimated Nutrient Prices: Condition of Socially Disadvantaged Groups during the Reform period', *Economic and Political Weekly*, 40(1), 46-56.
- Rao, C. H. Hanumantha, (2000), "Declining Demand for Foodgrains in Rural India: Causes and Implications," *Economic and Political Weekly*, 35(4), January 22, 201–6.
- Rao, C. H. Hanumantha, (2005), Agriculture, Food Security, Poverty and Environment: Essays on Post-reform India, New Delhi. Oxford University Press.
- Rehan, A., Kishore, S., Singh, M., Jain, B., Reddy, N. K.K., Kumar, D., Usha, P. and Parveen, R. (2020).A study to assess undernutrition and its socio-demographic correlates in under-five children in urban and rural areas of Rishikesh, Uttarakhand. *Journal of Family Medicine and Primary Care*, 9: 4980-4984.
- Suryanarayan, M.H. (1997), 'Food Security in India: Measures, Norms and Issues', *Development and Change*, 28(4), 771-789.
- ThorndikeAN, CD Gardner, KB Kendrick, HK Seligman, AL Yaroch, AV Gomes, KN Ivy…
- Circulation, (2022),Strengthening US Food Policies and Programs to Promote Equity in Nutrition Security: A Policy Statement From the American Heart Association.ahajournals.org.
- Tulchinsky TH. (2010), Micronutrient deficiency conditions: global health issues. Public Health Rev;32:243–55.
- UN,(1975), United Nations. Report of the World Food Conference: Rome, 5-16 November 1974. United Nations; 1975, Public Health Rev. 2017;38(1):10
- Uauy, R., Hoffman, D.R., Peirano, P., Birch, and Birch, E.E. (2001), "Essential fatty acids in
- Visual and brain development", *Lipids*, 36(9), 2962S–72S

Organic Farming towards a Sustainable Future: Climate Resilience, Health and Employability

Anjali Chaudhari[1] & Dr. Anugrah Rohini Lall[2]

ABSTRACT

Agriculture sector is the backbone of the economy as it provides the necessary raw materials and inputs to the other sectors of the economy in order to carry out other production activities and services. Moreover, it occupies a pivotal space in the economy by encouraging inclusive growth, promoting rural income and ensuring food security. As per the NSSO Periodic Labor Force Survey (2022-23) 45.76% of working population is engaged in the agricultural and allied activities. The study suggests that there has been an extensive use of chemical fertilizers and pesticides which has made the economy self sufficient in terms of food grain production but deteriorated the environment and health in the long run. In this scenario, organic farming can present to be a good alternative. This paper aims to present a mixed study on, how it helps in mitigation of climate change. It further analyzes the harmful effects of pesticidal exposure to the farmers and how organic agriculture can help in income stability and profitability. The study examined the impact of organic farming on climate mitigation, human health and also assessed the role of organic farming in employment generation of rural women. The study brings out the role of SHG linkages and government interventions that lead to income generation and women empowerment. It also concludes that organic farming help significant positive impact on human health and natural farming methods like crop rotation, cover cropping and use of organic compost and manure helps in climate change mitigation.

*(**Keywords:** Organic Farming, Climate Change, Pesticidal exposure, Sustainability, SHGs)*

Introduction

"Organic agriculture is a holistic production management system that avoids use of synthetic fertilizers, pesticides, and genetically modified organisms, minimizes pollution of air, soil and water, and optimizes the health and productivity of interdependent communities of plants, animals and people." (Codex Alimentarius Commission, FAO, 2013). It does not only include certified organic farms and products but includes all agricultural systems that make use of natural processes to enhance agricultural productivity (IFOAM). Moreover, agriculture is a major contributor to climate change through anthropogenic global warming and carbon emissions. Agricultural activities release methane (CH_4) nitrous oxide (N_2O) and Carbon dioxide (CO_2). The global greenhouse emission is estimated to be around 23% (IPCC report). (*SDG13*). In addition to this, agriculture's role is vital in providing

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food and nutrition rather than just being a source of food. The fruits, vegetable, whole grains, legumes are the source of various nutrients like vitamins, minerals, proteins and good fats which can help in boosting immunity and prevent various chronic diseases and deficiencies (*SDG 3*). Moreover, the organic farming may possibly help in employment and income generation of the women as they make up a large sharing of small landholdings in the developing nations like India *(SDG5)*.

Review of Literature

According to Lenka et al, (2015) Agriculture sector is a potential contributor to the green house gas emissions through the energy use and management of agricultural land. Mathukia et al, (2016) contends that Organic farming practices can mitigate climate change, build resilient farming systems, reduce poverty and improve food security. Mie et al (2017) evaluates that the consumers of organic food tend to have healthier lifestyle in comparison to conventional food production. Tomar et al, (2023) examines the positive impact of Organic Farming on human health, environment and food production system. Kumar et al, (2024) analyses the pre and post farm knowledge of women farmers in organic farming practices; it showed a positive effect of training and the knowledge gained. Bodapati et al, (2014) highlights with the subsequent govt. interventions the participation of women in agriculture increased promoting gender equality.

Objectives

- To study the impact of agriculture on climate change and its role in climate change mitigation.
- To examine the impact of organic farming on human health.
- To assess the role of organic farming in employment generation of rural women.

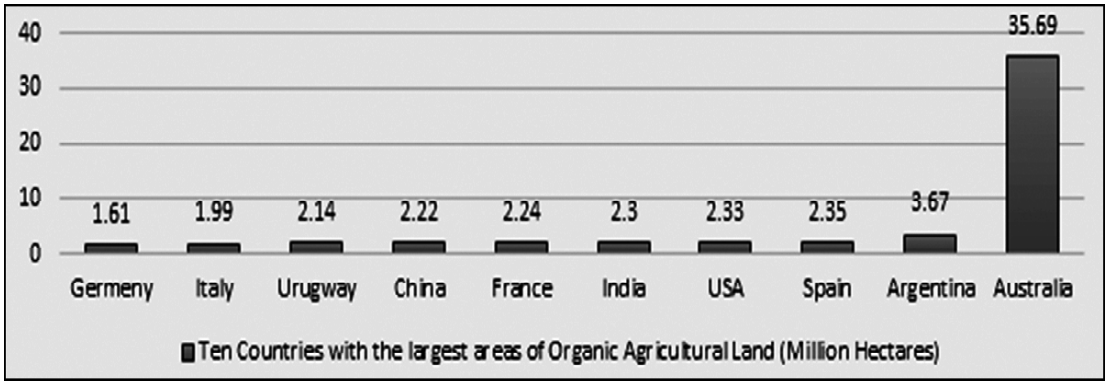
Research Methodology

The paper consists of both quantitative and qualitative methods of research. It is based on the secondary data set collected from authentic international organizations, government and non government websites.

Discussions and Analysis

"Organic agriculture is a holistic production management system that avoids use of synthetic fertilizers, pesticides, and genetically modified organisms, minimizes pollution of air, soil and water, and optimizes the health and productivity of interdependent communities of plants, animals and people." (Codex Alimentarius Commission, FAO, 2013).Organic agriculture is practiced in about 187 countries and on 72.3 million hectares of agricultural and managed by 3.1 million farmers. Australia (35.69 m hectares) tops the list followed by Argentina (3.63 m hectares) and Spain (2.35 m hectares). As per the latest FiBL survey on organic agriculture globally, organic farms increased by 1.1 million hectares and the organic retail sales continued to grow. Besides the non- agricultural

areas consists of aquaculture, forest and grazing areas totally it is around 35 million hectares (FiBL Survey, 2021).



Source: FiBL Survey 2021

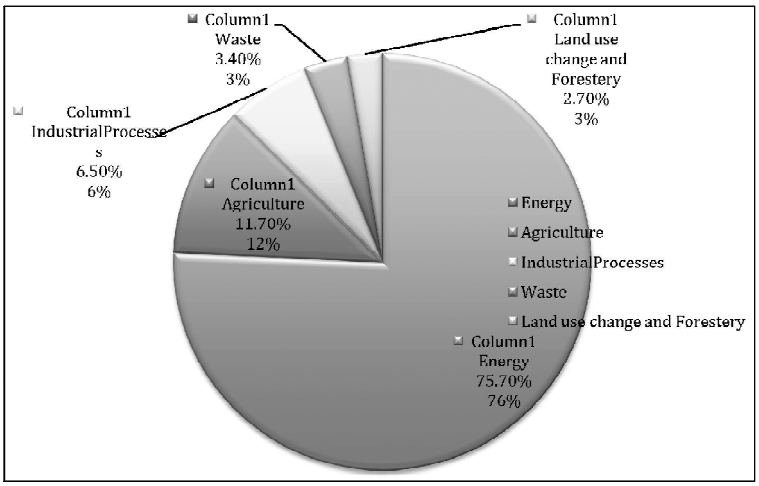
Present Scenario of Organic Farming in India

Organic farming is in an infant stage in India. Under the Paramparagat Krishi vikas Yojana (PKVY) and mission Organic value Chain Development for North Eastern Region (MOVCDNER), the total agricultural land under organic farming is 59.75 lakh Ha in India. Under the Bhartiya Prakritik Krishi Paddhati (BPKP), a sub scheme of PKVY 4.09 lakh hectare was allocated to eight states. Both these schemes provide aid to the farmers in training, capacity building, production, processing, certification and marketing (Ministry of agriculture & Farmers Welfare, 2024).

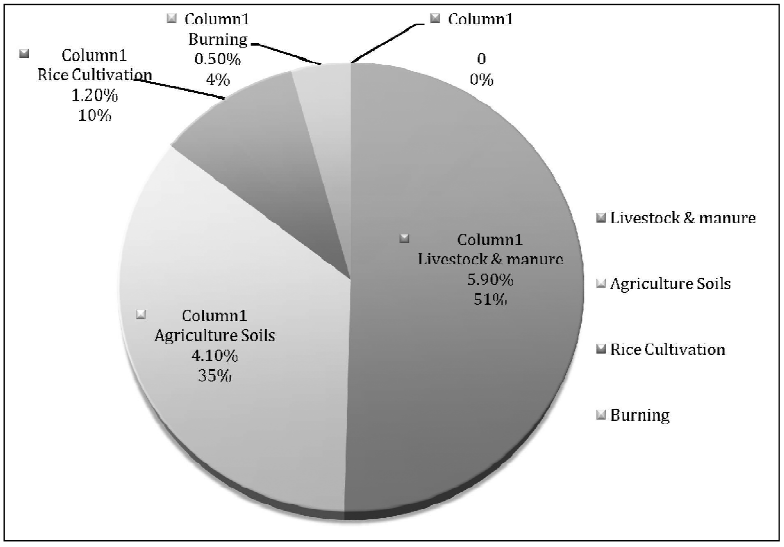
Contribution of Agriculture sector to climate change

The continuous rise in the amount of GHGs has led to an enhanced green- house effect resulting major contributors CO2 contributes the most around 76%; followed by CHGs (16%) , N2O (6%). With the growing population, the demand for food is also growing so is the amount of agricultural land and the emissions pertaining to it. The management practices of the agricultural land, land-use, change, forestry has a great influence on atmospheric GHG concentration. The two broad anthropogenic sources of GHG emission from agriculture are- energy used in agriculture that is manufacture and use of agricultural inputs and farm machinery) and the management of agricultural land. Besides, the CO2 emissions due to burning of crop and animal waste, the livestock population and rice fields are significant contributors to CH4 emissions.

The Global greenhouse gas (GHG) emissions grew by 51% from 1990- 2021, these emissions are leading to unnatural sudden increase in the temperature of the earth resulting in devastating floods, storms and fires and heat waves. WRI's Climate Watch platform publishes comprehensive emissions data for all countries, sectors and gases offering insight into the underlying causes of the climate crisis.



Global GHG emissions by different sectors and end use, 2021 (*Source: Climate watch, 2021)*



GHG emissions by agricultural sector, 2021 (*Source: Climate Watch* , 2021) Agriculture being the second highest GHG emitting sector, accounts to 11.7% of the global emissions. Under this, the major emitters include livestock farming and agricultural soils, such as methane from manure besides land use change and energy use.

Findings

Organic Farming as a tool for Climate resilience-(SDG 13- Climate Action)

Agriculture being one of the major contributors to the emissions of greenhouse gases since 1990's but it also has the potential to mitigate the climate change. Organic farming is one of the

approaches that are based on ecological principle, encourages environmental sustainability and bio diversity conservation. Natural farming methods consist of crop rotation, cover cropping and use of organic compost and manure which helps to improve the soil health and its content. Organic Farming is beneficial in sequestering carbon, potentially reducing a significant amount of global green house gas emissions. Several food crops particularly legumes and perennial crops contribute to carbon sequestration like chickpea, lentil and pigeon pea etc. Perennial crops specifically have deep root systems that help in absorbing the excess amount of carbon from the atmosphere. Organic agriculture also helps in encouraging soil's water retaining capacity and its natural nutrients, as per research perennials can sequester up to 1.9 tons of CO_2 per acre a year. Besides it also improves its water percolation by 15-20% replenishing groundwater making crops resistant in harsh conditions like drought (NRDC org, 2022).

Moreover, it also reduces dependence on fossils fuels and synthetic chemicals. Rather, it makes use of natural inputs, biological pest controls, integrated pest management and water conservation methods further minimizing the carbon footprints. A forty year study, conducted by the Rodale Institute showed that Organic fields use 45% less energy as compared to the conventional farms while maintaining or even exceeding the yields after a 5 year transition period. Besides, Organic farms sustain 30% more biodiversity than conventional farms as compared to the conventional ones, as shown by a meta-analysis of 94 studies from the past 30 years (IFOAM, EU group). As per many researches there are around 30% more wildlife and plants near ecological farming as compared to conventional farms the reason being is less or no use of chemicals and pesticides in those fields (NCONF, India,2025).Hence, organic agriculture shows a great potential in contributing climate change mitigation.

Natural Farming as way of healthy lifestyle (SDG 3- Ensure healthy live and promote well being for all at all ages)

The agricultural sector is an important pillar of an economy; it not only combats the issue of food insecurity but also provides the necessary nutrients required for a healthy population. The COVID 19 pandemic has changes the perception of people towards safety and health. People have become more about what they are consuming, as nutritious and good quality of food is very important for building a strong immune system. As, a result organic food products witnessed an up thrust since the onset of pandemic. There are higher level of antioxidants, micronutrients and better taste in organically grown food crops.

Agricultural systems have an overall impact on the sustainability of food systems as it impacts both the human and animal health; additionally it is also linked with the aspect occupational hazard that includes the farmers and workers involved into it. The conventional agriculture makes use of intensive synthetic pesticides and fertilizers which are mainly chemically manufactured; as per some epidemiological studies there are effects of certain pesticides on children's cognitive development at current levels of exposure. The exposure while production of conventional particularly from spraying chemicals have shown to increased risk to diseases like Parkinson's disease, non-Hodgkin lymphoma(type of cancer) and type 2 diabetes (Moisan F et.al, 2013); exposure during pregnancy can affect the brain development and can lead to diseases like leukemia/ lymphomas in the infant(Starling AP et.al, 2014).

Cadmium (Cd) is naturally present in the soils and is often added up by P fertilizers and atmospheric deposition, is toxic to kidneys (Akesson A; 2014), (Grant CA; 2015).Its availability also depends upon factors like soil structure, humus content and pH. Low soil organic matter further increases its concentration in the soil. The organically grown fields tend to have higher soil organic matter as compared to the ones that are chemically managed; two long term experiments indicate a higher Cd concentration over time for chemically managed farms as compared to organically managed farms (Jones K, Johnston; 1989),(Christensen BT, Elsgaard L; 2013). It is also been observed that consumers who have preference towards organic food tend to have healthier dietary patterns overall, this includes higher consumption of fruit, vegetables, whole grains and legumes. These patterns in diet are also shown to have lower risk of chronic diseases, including diabetes and other cardio vascular disease (Li F et.al; 2015) (Schwingschackl L et.al 2015), (Zong G et.al; 2016).

Table. Comparison of organic and conventional farming in terms of nutritional quality

Vegetables & Cereals	Chemical Constituent	Analysis	References
Cauliflower	Lipo soluble antioxidant	Organic cauliflower contained more antioxidants as compared to conventional	Maggio et al; 2013
Zucchini	Potassium	Potassium was found to be more in organic zucchini as compared to compared to conventional	Maggio et al; 2013
Apple	Phenolic components	Higher amount of polyphenols was detected in organic apple	Veberic et al; 2005
Eggplants	Phenolic compound	In the millionaire cultivar organic content was found more	Luthria et al; 2010
Carrots	Cartenoids	B- Carotene was found to be in higher amounts in organic farming	Huber et al; 2011
Cereals	Proteins and essential amino acids	Organic grain was found to be more nutritious as compared to conventional	Huber et al; 2011
Tomatoes	Phenolic content, Vitamin C, Cartenoid	No difference was found in cartenoid but phenol but found to be in higher amount in organic as compared to conventional one	Caris Veyrat et al; 2004

Hence, Organic produce provides a healthy and sustainable alternative as it is free from harmful chemicals and pesticides, eliminating the associated health risks and giving way to a healthy life.

Organic agriculture and Women Empowerment (SDG 5 Achieving gender equality and empowering all women and girls)

Gender relations across the globe are important in order to analyze the distribution of workload in the farms, the management of assets like land, labour, inputs and machinery and decisions related to farm management. Indigenous communities across the world are known to have great knowledge about the nature, they have been playing a key role in sustainable management of the local resources and biodiversity but these studies about the local communities had not been gender sensitive. “Half

or more of indigenous ecological science has been obscured by the prevailing invisibility of women, their work, their interests and especially their knowledge" (Rocheleau, 1991). The marginalization of indigenous women's skills, needs and knowledge in agriculture is directly related to the unequal power relations inherent within the ideologies of colonization, capitalism and globalization. As a consequence sustainable agriculture loses out (Awa, 1989; Badri and Badri 1994; Rocheleau, 1991).Given these situations the gender issues in the realm of sustainability and organic farming movements need to studied.

Role of SHGs in Income generation through Organic Farming

Despite being an agrarian economy, Indian farmers are often neglected and when it comes to woman farmers this disparity further widens. As per the studies around 73% of rural women are engaged into farm activities but only 12.8% own hardly own any land (GOI, 2019) hence, not categorized as a farmer. The work they do is often is dismissed as an extension of their household duties and hence their work goes undermined. Women play a significant role in the development of organic farming and related sectors such as horticulture, livestock, agro/social forestry and fisheries. Farmizen currently present in Bengaluru, Hyderabad and Surat with about 1,500 subscribers and 24 farms across these cities and around 40 acres of land is under cultivation. Men usually migrate to the cities in search of better livelihood. Women who were left behind organized themselves into a self help group with the support of an NGO started practicing sustainable agricultural practices. Another instance from the hill state of Uttarakhand named Adbhora, with the help of an NGO named Sanjeevani, 51 women farmers with marginal and fragmented land holdings trained on the natural methods of farming like vermi- composting, bio-dynamic compost using farm waste and cow dung. Within a year they got their earning increased from Rs. 47000 per season to Rs. 86000. A study was done by NABARD under the LEDP project on the empowerment of women through organic farming in the Phalodi block of Jodhpur district (2022-23). The Sample size was 150 farm women; the analysis compares the farm knowledge levels of women prior and post training programmes; the results showed a significant positive outcome of the intensive training programs and practical exposure on the female participants.

Conclusion

This paper concludes that organic agriculture provides a good alternative in achieving the SDGs in the agricultural sector. Organic farming can help in climate change resilience as it is beneficial in carbon sequestering. Natural farming methods like crop rotation, cover cropping and use of organic compost and manure helps in improving soil health and its content. In addition to it, agriculture is also an important tool for ensuring food and nutrition security to the population. Consumption of chemically grown food is shown to have adverse health impacts including diabetes and other cardio vascular disease. The exposure particularly from spraying chemicals has shown to increased risk to various disorders. Organically grown food tend to have better taste, more vitamins, anti- oxidants and nutrients as compared to the conventional one. Apart from this, Women in the realm of agricultural studies are often neglected though they play an important role in organic agriculture, horticulture and forestry.

Suggestions

To combat greenhouse gas (GHG) emissions, farmers should be incentivized and supported to grow carbon-sequestering crops like legumes (chickpea, lentil, pigeon pea) and perennials, which have deep root systems.

Furthermore, given that organic food consumers often exhibit healthier diets with higher intake of fruits, vegetables, and whole grains, and a lower risk of chronic diseases, grassroots health campaigns through Gram Panchayats are crucial. These campaigns should educate people on the nutritional benefits of organically grown pr

Finally, recognizing the invaluable traditional knowledge of women in indigenous communities regarding sustainable farming, they should be integrated into Self-Help Groups (SHGs) via NGOs and government agencies. This will facilitate training in organic farming techniques like vermicomposting and bio-composting, significantly boosting their income. Policies tailored to local community needs within organic farming are also essential.

References

1. Bodapati, S., & Chander, M. (2011, October 1). *Organic Agriculture: A way forward to achieve gender equality in India*. Organic Eprints. https://orgprints.org/id/eprint/24252/
2. Brook, L. (2022, June 9). Organic Agriculture helps solve climate change. nrdc. org.https://www.nrdc.org/bio/lena-brook/organic-agriculture-helps-solve-climate-change
3. Das, S., Pal, T. K., & Chatterjee, A. (2020, June 23). Organic farming in India: A Vision towardsa healthy nation | food quality and safety | oxford academic. www.academic.oup.com. https://academic.oup.com/fqs/article/4/2/69/5861338
4. Farnworth, C., & Hutchings, J. (2009, April). Organic Agriculture and Womens' Empowerment. grist org. https://grist.files.wordpress.com/2011/02/gender-study-090421.pdf
5. Ge, M., Friedrich, J., & Vigna, L. (2024a, December 5). Where do emissions come from? 4charts explain greenhouse gas emissions by sector. World Resources Institute.https://www.wri.org/insights/4-charts-explain-greenhouse-gas-emissions-countries-and-sectors
6. In: Sejian, V., Gaughan, J., Baumgard, L., Prasad, C. (eds) Climate Change Impact on Livestock: Adaptation and Mitigation.Springer, New Delhi. https://doi.org/10.1007/978-81-322-2265-1_3
7. Kumar, S., Nagal, G., Kar, P., & Lal, B. (2024). Impact of Organic Farming Training on the Knowledge of Farm Women: A Pre-Post Analysis. Indian Research Journal of Extension Education, 24. https://doi.org/10.54986/irjee
8. Lenka, S., Lenka, N.K., Sejian, V., Mohanty, M. (2015). Contribution of Agriculture Sector to Climate Change.
9. Lynch, J., Cain, M., Frame, D., & Pierrehumbert, R. (2025, April 20). Agriculture's contribution to climate change and role in mitigation is distinct from predominantly fossil CO2-emitting sectors. Frontiers. https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2020.518039/full
10. Mathukia, Ratilal & Ponkia, Harkishan & Mathukia, Parth & savalia, n. (2016). Organic farming: Climate resilient agriculture. Journal of Natural Fibers.
11. Mie, A., Andersen, H. R., Gunnarsson, S., Kahl, J., Kesse-Guyot, E., Rembia , E., Quaglio, G., &Grandjean, P. (2017, October 27). Human health implications of organic food and organicagriculture: A comprehensive review - environmental health. BioMedCentral.https://ehjournal.biomedcentral.com/articles/10.1186/s12940-017-0315-4

12. Org, F. (2001b). Chapter 1. Environment and Natural Resouces Series No. 4. https://www.fao.org/4/y4137e/y4137e01.htm

13. Rani, M., Kaushik, P., Bhayana, S., & Kapoor, S. (2023a, July 26). *Impact of organic f arming on soil health and nutritional quality of crops*. Journal of the Saudi Society of AgriculturalSciences.https://www.sciencedirect.com/science/article/pii/S1658077X2300070X

14. Team, W. (2024, October 19). The invisible labourers: Why women farmers in India rarely receive recognition for their work - welcome to WOTR!. Welcome to WOTR! -WatershedOrganisation Trust (WOTR). https://wotr.org/blog/the-invisible-labourers-whywomenfarmersinindiararelyreceiverecognitionfortheirwork/#:~:text=Agriculture%20is%20a%20cornerstone%20of,landholdings%20are%20owned%20by%20women

15. Thomas, R. R., & Singh, Dr. G. (2024, November 6). Organic farming and climate changemitigation. IJSRET. https://ijsret.com/2024/11/06/organic-farming-and-climate-change-mitigation/

16. Tomar, S. S., Tomar, B., & Patle, T. (2023, December). Impact of organic farming on human and environmental research gate. https://www.researchgate.net/publication/378697500_Impact_of_Organic_Farming_on_Humanand_Environmental_Health

17. USDA, G. (1977a). Sustainable Agriculture. Sustainable Agriculture | National AgriculturalLibrary.https://www.nal.usda.gov/farms-and-agricultural-production-systems/sustainable-agriculture

18. Wrinkler, H. (2024, July 2). Climate change. IFOAM Organics Europe. https://www.organicseurope.bio/what-we-do/climate-change/

Renewable Energy for Sustainable Development in India

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ABSTRACT

This research, "Renewable Energy for Sustainable Development in India," analyzes India's renewable energy growth from FY 2014-15 to 2023-24, focusing on solar, wind, bio-power, and small hydro. It highlights how these sources drive sustainable development by reducing fossil fuel dependence and environmental impact, driven by effective policies, technology, and investment.

Using secondary data from MNRE and CEA, the study reveals significant expansion. Total installed power capacity hit 441.97 GW by March 2024, with renewables surging 134.63% to 190.57 GW. Solar, wind, bio-power, and small hydro alone grew 259.55%.

By 2023-24, renewables constituted 43.12% and non-fossil fuels 44.97% of total installed capacity, positioning India among the top 5 globally. Renewable energy generation contributed 20.75% in 2023-24, up 265.89% since 2014-15, consistently outpacing non-renewable growth. Gujarat, Rajasthan, Tamil Nadu, Karnataka, and Maharashtra lead in renewable capacity (61%). The paper concludes India's renewable sector is undergoing a transformative journey due to strong policy, boosting capacity and green energy output.

Keywords: *Renewable Energy, Solar Power, Wind Power, Growth Trends, Sustainable Development.*

INTRODUCTION

Energy is the heartbeat of our planet, intricately linked to the climate challenge we face today. The rapid growth of the global population and advances in civilization have resulted in an exponential growth in energy demand. Despite the well-known environmental and health risks posed by fossil fuels, our dependence on them persists.

Installed Capacity

As on 31st March 2024, India's total installed power capacity reached 441.97 GW, an increase from 275.90 GW of 2014-15, reflecting a growth of 60.19% over the past nine years. Total installed capacity under Renewable Energy sector, including large Hydro was increased from 81.22 GW of

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2014-15 to 190.57 GW by 2023-24 with a growth of 134.63% during the period. Installed capacity under Solar, Wind, Bio Power and Small Hydro Power was 143.64 GW as on 31st March 2024 which was enhanced from 39.95 GW of 2014-15, having a remarkable growth of 259.55%. India witnessed an amazing capacity installation of 18.56 GW in RE sector during 2023-24, significantly higher than that of 7.35 GW in non-RE sector.

Annual growth rate for Renewable Energy installations has consistently surpassed 6% whereas growth rate of non-renewable energy has not been more than 3.01% from 2017-18. By the end of 2023-24, Renewable Energy and non-fossil fuel sectors accounted for 43.12% and 44.97% of the total installed capacity, respectively[1].

According to the Renewable Energy Statistics 2024 published by International Renewable Energy Agency (IRENA), India ranks 4th position globally in overall renewable energy installed capacity. Specifically, India holds 4th position in both wind power and Bio power installations and 5th position in both Solar power and Hydro Power installations.

Energy Generation:

Renewable energy sources contributed 359.89 BU, representing 20.75% of the total energy generation during 2023-24. Since 2014-15, energy generation from Solar Power, Wind Power, Bio-Power, and Small Hydro Power has surged by 265.89%, highlighting significant progress in India's renewable energy sector[2].

According to the Renewable Energy Statistics 2024 published by the International Renewable Energy Agency (IRENA), India ranks 5th globally in overall renewable energy generation. Specifically, India holds 4th position in Solar power energy generation.

Ministry's effective policy implementation has translated into noticeable gains, marked by increased renewable energy capacity installations and enhanced green energy generation. This publication outlines transformative journey of renewable energy sector at the national, state and international levels.

LITERATURE REVIEW

Recent research consistently highlights solar energy's crucial role in sustainable development and environmental quality. **Novas et al. (2021)**, analyzing 4260 publications, identified key trends in solar research, emphasizing sustainability assessment and the need for continued R&D to meet future energy challenges.

Focusing on India, **Lal and Singh (2023)** explored solar energy's potential as a cost-effective, reliable, and environmentally beneficial solution. They underscored the government's ambitious targets and the role of solar parks in mitigating energy crises and climate change, fostering socio-economic development.

Similarly, **Adebayo et al. (2024)**, using advanced methodologies, investigated solar energy's impact on environmental quality in the United States from 2000-2020. Their findings revealed that solar innovation, renewable energy, digitalization, and economic globalization negatively affect the ecological footprint, advocating for a paradigm shift towards renewables to achieve SDG-7 and SDG-13.

OBJECTIVES

1. To evaluate the growth and trends in the overall installed renewable energy capacity in India.
2. To analyze the current situation of renewable energy of states in India.

RESEARCH METHODOLOGY

This paper is based on secondary data. The paper aims to find out current level of Solar Energy Investment in India. Secondary data analysis involves the systematic collection, review, and synthesis of existing data from various sources to address the research objectives. The data has been collected from various government agencies, organizations, various ministries, government reports and publications i.e., Ministry of New and Renewable Energy (MNRE) and Central Electricity Authority (CEA) & Ministry of Power (MoP), Published Research Articles, Journals, or Conference Proceedings.

DATA INTERPRETATION

TABLE 1: Cumulative Installed Capacity in Renewable Energy sector in India since 2014-15 to 2023-24 (in GW)

YEAR	HYDRO POWER	RES*	TOTAL RENEWABLE ENERGY	PERCENTAGE GROWTH IN TOTAL R.E.
2014-15	41.27	39.95	81.22	6%
2015-16	42.78	47.09	89.87	7%
2016-17	44.48	58.56	103.04	8%
2017-18	45.29	70.65	115.94	9%
2018-19	45.40	79.41	124.81	10%
2019-20	45.70	88.26	133.96	10%
2020-21	46.21	95.80	142.01	11%
2021-22	46.72	109.89	156.61	12%
2022-23	46.85	125.16	172.01	13%
2023-24	46.93	143.64	190.57	15%
TOTAL			1310.04	

RES*- Comprising of Solar, Wind, Bio-Power and Small Hydro Power

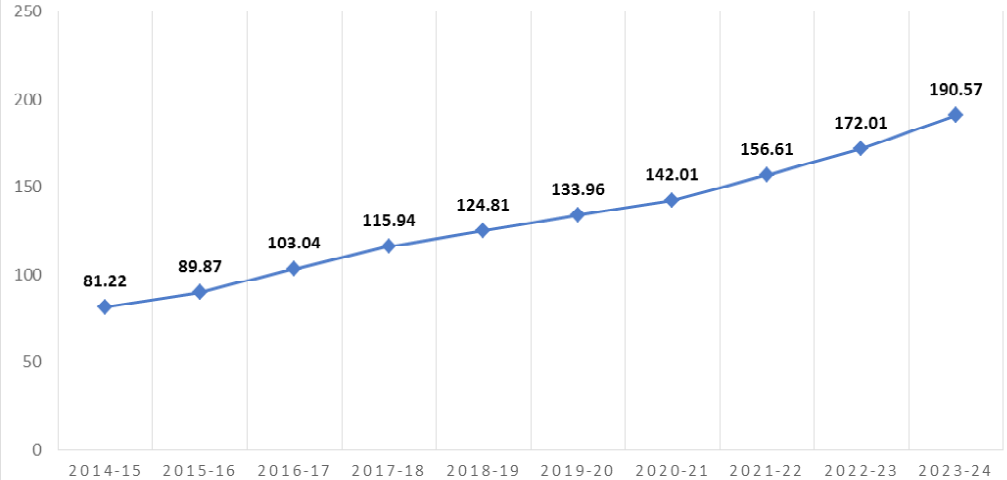
Source: Ministry of New and Renewable Energy (MNRE) and Central Electricity Authority (CEA)

Table 1 presents the **cumulative installed capacity** of renewable energy sources in India in gigawatts (GW) for each fiscal year from 2014-15 to 2023-24. The table breaks down the total capacity into **Hydro Power** and **RES***, where RES* comprises Solar, Wind, Bio-Power, and Small Hydro Power. It also shows the **Total Renewable Energy** capacity, which is the sum of Hydro Power and RES*, and the **Percentage Growth in Total R.E.**, indicating the year-on-year percentage increase in the total renewable energy installed capacity. For instance, in 2014-15, the Total Renewable Energy capacity was 81.22 GW with a 6% growth, while in 2023-24, it reached 190.57 GW with a 15% growth. ***The major reasons for this continuous growth include: Strong policy support, including subsidies, tax benefits, and regulatory frameworks encouraging renewable energy adoption. Improvements in solar, wind, and bio-energy technologies have made RES more efficient and cost-effective.***

The installed capacity under the "RES" category has seen a substantial rise over the years, growing from 39.95 GW in 2014-15 to 143.64 GW in 2023-24. From 2017-18 to 2019-20, the growth rate of Hydro Power capacity in India displayed a gradual yet low upward trend, reflecting the maturity of the sector. In 2017-18, Hydro Power capacity grew by 0.81 GW, translating to a 1.79% growth rate. This modest increase was primarily driven by limited new installations and optimization efforts in existing plants. In 2018-19, growth slowed further, with an addition of only 0.11 GW, representing a mere 0.24% growth rate. This stagnation can be attributed to challenges such as environmental clearance hurdles and socio-political constraints surrounding large hydro projects. By 2019-20, Hydro Power capacity increased slightly by 0.3 GW, marking a 0.66% growth rate. This incremental rise highlights the sector's focus on modernization and efficiency improvements of operational hydro plants rather than substantial capacity additions. These steady yet low growth rates reflect Hydro Power's pivotal but stable role within India's renewable energy portfolio. **This indicates a strong push and successful implementation of projects in solar, wind, bio-power, and small hydro sectors.** Government policies, including subsidies and tax incentives, have created a favorable environment for investment, leading to increased adoption of clean energy technologies.

Improved grid infrastructure and integration have also enabled higher renewable energy adoption. These factors collectively led to a continuous increase in total renewable energy capacity, driving India's energy transition forward.

Figure 1: Trend in cumulative installed capacity in Renewable Energy (GW)



Source: *Based on Table 1.*

Figure 1 represents the trend in **cumulative installed capacity in India's renewable energy** sector from 2014-15 to 2023-24, reflecting continuous growth driven by key factors. One of the primary reasons for this expansion is government support through policy measures such as subsidies, tax incentives, and ambitious renewable energy targets. The steady decline in technology costs, particularly in solar and wind energy, has also facilitated large-scale adoption.

A major change evident in Figure 1 is the sharp rise in installed capacity of Renewable Energy Sources (RES), particularly from 2016-17 onward, driven by accelerated solar and wind energy projects. The annual percentage growth in total renewable energy capacity has progressively increased, reaching 15% in 2023-24, the highest recorded in the dataset. This continuous upward trend indicates India's commitment to energy transition, fostering sustainability and energy security while reducing dependence on fossil fuels.

Table 2: Year-wise Renewable Energy Generation since 2014-15 to 2023-24 (in BU)

YEAR	WIND	% change	SOLAR	% change	BIO-POWER	% change	HYDRO	% change	GRAND TOTAL	GROWTH %
2014-15	33.77	54.71	4.60	7.45	15.29	24.77	8.06	13.05	61.72	5%
2015-16	33.03	50.21	7.45	11.32	16.95	25.76	8.35	12.69	65.78	4.97%
2016-17	46.00	56.40	13.50	16.55	14.37	17.62	7.67	9.40	81.55	6.16%
2017-18	52.70	51.74	25.80	25.33	15.64	15.35	7.70	7.56	101.84	7.69%
2018-19	62.04	48.94	39.27	30.97	16.75	13.21	8.70	6.86	126.76	9.58%
2019-20	64.65	46.73	50.13	36.23	14.11	10.19	9.45	6.83	138.34	10.45%
2020-21	60.15	40.84	60.40	41.01	16.43	11.15	10.26	6.96	147.25	11.12%
2021-22	68.64	40.16	73.48	42.9	18.32	10.71	10.46	6.12	170.91	12.91%
2022-23	71.81	35.27	102.01	50.11	18.55	9.11	11.17	5.48	203.55	15.38%
2023-24	83.39	36.92	115.98	51.35	17.00	7.52	9.49	4.20	225.83	17.07%
TOTAL	**576.18**		**492.62**		**163.41**		**91.31**		**1323.52**	

Source: Central Electricity Authority (CEA), Ministry of Power (MoP)

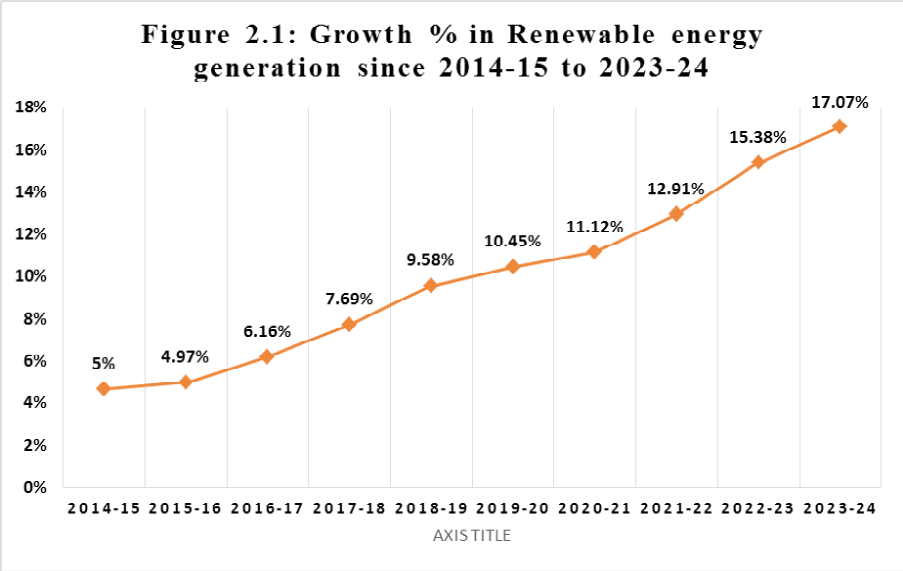
Table 2 represents the **year-wise renewable energy generation** in India in billion units (BU) for each fiscal year from 2014-15 to 2023-24. This table provides a breakdown of the generation from different renewable sources: wind, solar, bio-power, and hydro. A major contributor to this upward trend is the increasing deployment of solar and wind energy, enabled by policy support, declining technology costs, and improved grid infrastructure. Government incentives, such as feed-in tariffs and subsidies, have encouraged large-scale investments, leading to sustained expansion of renewable energy capacity.

India's renewable energy generation witnessed a dramatic shift and growth from 2014-15 to 2023-24, increasing from **61.72 BU to 225.83 BU**. In 2014-15, **wind dominated with 54.71% (33.77 BU)**, followed by bio-power (24.77%, 15.29 BU), small hydro (13.06%, 8.06 BU), and solar (7.45%, 4.6 BU).

By 2023-24, **solar became the leading source (51.35%, 115.98 BU)**, growing over 2500% due to falling costs, large solar parks, and incentives. Wind followed with 36.92% (83.39 BU), showing consistent growth from turbine efficiency and favorable policies, with notable jumps in 2016-17 and 2017-18. Growth briefly slowed (2019-2021) due to land and transmission issues, before recovering.

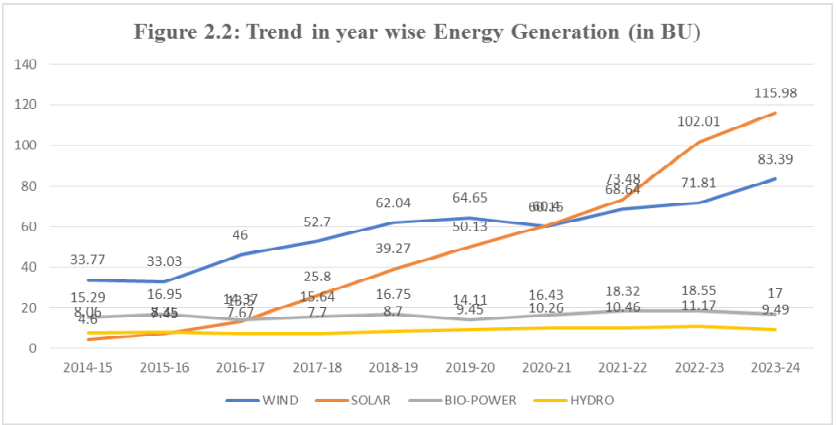
Bio-power saw moderate growth to 17 BU (7.53%), influenced by feedstock availability and policy. Small hydro increased modestly to 9.49 BU (4.20%), constrained by environmental concerns and long project gestation.

These fluctuations reflect the dynamic interplay of policy shifts, technological advancements, investment trends, and environmental factors. Year-on-year trends confirm government initiatives accelerated wind and solar, especially between 2022-23 and 2023-24, showcasing India's strong commitment to green energy targets. The varied growth rates underscore how technology, policy, and finance shape India's renewable energy landscape.



Source: Based on Table 2.

Figure 2.1 represents the percentage change in India's renewable energy generation from 2014-15 to 2023-24. The data reveals a steady increase, with the highest growth rate recorded in 2023-24 at 17.07%. A notable shift occurred after 2016-17, when annual growth surpassed 6%, reflecting the impact of large-scale government initiatives like competitive bidding for solar and wind projects and increased foreign investment. The introduction of advanced grid infrastructure further improved energy transmission efficiency, accommodating higher renewable penetration. Additionally, India's commitment to clean energy transition, backed by global climate agreements, fueled the expansion of renewable energy generation. The year 2022-23 saw a significant jump to 15.38%, indicating accelerated adoption of renewables, particularly solar power. Overall, the upward trajectory of renewable energy generation aligns with India's energy security and sustainability goals.



Source*: Based on Table 2.*

Figure 2.2 shows the annual trend in renewable energy generation across various sources in India from 2014-15 to 2023-24. The graph highlights a sharp increase in solar energy generation, which surged from 4.6 BU in 2014-15 to 115.98 BU in 2023-24, demonstrating India's significant push towards solar adoption. Wind energy has also shown steady growth, reaching 83.39 BU in 2023-24 due to favorable wind policies and infrastructure advancements.

Additionally, bio-power and hydro energy generation have maintained a stable trend, contributing to India's diversified renewable energy mix. The accelerated expansion of solar and wind energy can be attributed to declining technology costs, government incentives, and large-scale investments.

Table 3. Renewable Energy Installed Capacity in India as on 31.03.2024

(in MW)

States /UTs	Small Hydro Power	Wind Power	Bio Power	Solar Power	Large Hydro	Total Capacity
Andhra Pradesh	163.31	4096.65	574.39	4584.98	1610.00	11029.33
Arunachal Pradesh	133.11		0.00	11.79	1115.00	1259.90
Assam	34.11		2.00	156.18	350.00	542.29
Bihar	70.70		140.22	239.23		450.15
Chhattisgarh	76.00		275.00	1212.39	120.00	1683.39
Goa	0.05		1.94	43.48		45.47
Gujarat	91.64	11722.72	112.48	13544.88	1990.00	27461.72
Haryana	73.50		283.70	1475.72		1832.92
Himachal Pradesh	969.71		10.20	95.23	10281.02	11356.16
Jammu & Kashmir	169.93		0.00	65.44	3360.00	3595.37
Jharkhand	4.05		19.10	162.40	210.00	395.55
Karnataka	1280.73	6019.61	1907.72	8544.68	3689.20	21441.94
Kerala	276.52	63.50	2.50	1022.79	1864.15	3229.46
Ladakh	42.99		0.00	7.80	89.00	139.79
Madhya Pradesh	123.71	2844.29	134.94	3995.43	2235.00	9333.37
Maharashtra	382.28	5207.98	2643.19	6249.67	3047.00	17530.12
Manipur	5.45		0.00	13.04	105.00	123.49
Meghalaya	55.03		13.80	4.24	322.00	395.07
Mizoram	45.47		0.00	30.31	60.00	135.78
Nagaland	32.67		0.00	3.17	75.00	110.84
Odisha	115.63		59.22	495.63	2154.55	2825.03
Punjab	176.10		567.25	1324.27	1096.30	3163.92
Rajasthan	23.85	5195.82	125.64	21347.58	411.00	27103.89
Sikkim	55.11		0.00	7.04	2282.00	2344.15
Tamil Nadu	123.05	10603.54	1045.45	8211.38	2178.20	22161.62
Telangana	90.87	128.10	221.67	4758.16	2405.60	7604.40
Tripura	16.01		0.00	18.46		34.47
Uttar Pradesh	49.10		2226.14	2920.33	501.60	5697.17
Uttarakhand	218.82		142.24	575.53	4035.35	4971.94
West Bengal	98.50		348.36	194.07	1341.20	1982.13
Andaman & Nicobar	5.25		0.00	29.91		35.16
Chandigarh			0.00	65.52		65.52
Dadar & Nagar Haveli/ Daman & Diu			0.00	46.47		46.47
Delhi			84.00	256.51		340.51
Lakshadweep			0.00	4.97		4.97
Puducherry			0.00	49.91		49.91
Others		4.30	0.00	45.01		49.31
Total	**5003.25**	**45886.51**	**10941.15**	**81813.60**	**46928.17**	**190572.68**

Source: *Ministry of New and Renewable Energy* (MNRE) & National Power Portal (NPP), Ministry of Power (MoP)

Table 3 represents the renewable energy installed capacity across Indian states as of March 31, 2024, It shows that as on 31st March, 2024, Gujarat, Rajasthan, Tamil Nadu, Karnataka and Maharashtra were the top five states in total renewable energy installed capacity. These top five states contributed significantly to the renewable energy sector, representing around 61% of total installed capacity of the country.

In solar energy sector, Rajasthan, Gujarat, Karnataka, Tamil Nadu, and Maharashtra were the top five states. For wind power, Gujarat, Tamil Nadu, Karnataka, Maharashtra, Rajasthan, and Andhra Pradesh, were the leading states. Bioenergy sector had also experienced substantial growth, with Maharashtra, Uttar Pradesh, Karnataka and Tamil Nadu. In the case of large hydro, Himachal Pradesh, Uttarakhand, Karnataka, Jammu and Kashmir, Maharashtra and Telangana were the top states contributed significantly to the renewable energy sector.

Rajasthan and Gujarat benefit from high solar irradiance, making them ideal locations for large-scale solar farms. Tamil Nadu and Karnataka have strong wind corridors that support wind energy expansion. These states have consistently implemented pro-renewable policies, including attractive tariff structures, subsidies, and land allocation for solar and wind farms, facilitating rapid growth.

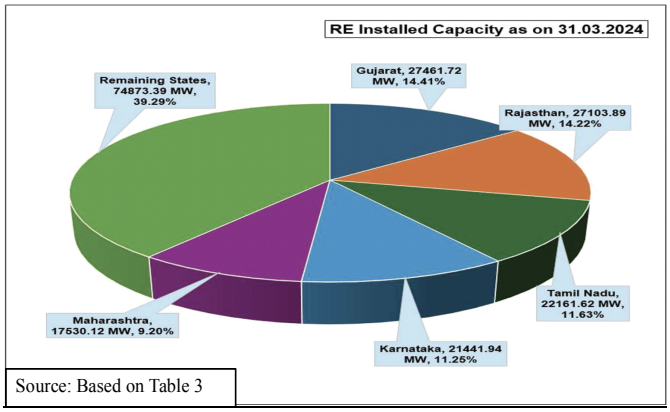
The bottom five states in **renewable energy installed capacity**, according to Table 3, are **Nagaland (110.84 MW), Mizoram (135.78 MW), Manipur (123.49 MW), Ladakh (139.79 MW), and Tripura (34.47 MW)**.

These states face several challenges limiting expansion. Their rugged terrain and extreme climates make large-scale solar and wind installations difficult. Weak transmission infrastructure hinders energy distribution, while lower industrial activity reduces demand for large-scale projects. Additionally, limited policy incentives and investment flows have slowed progress. Environmental restrictions and socio-political concerns further complicate development, with conservation laws and local opposition affecting project feasibility.

Top 5 states in Renewable Energy Installed Capacity and their contribution in the country's cumulative renewable energy Installed Capacity:

Fig 3. Top 5 states in Renewable Energy installed capacity and its share (%)

(in MW)



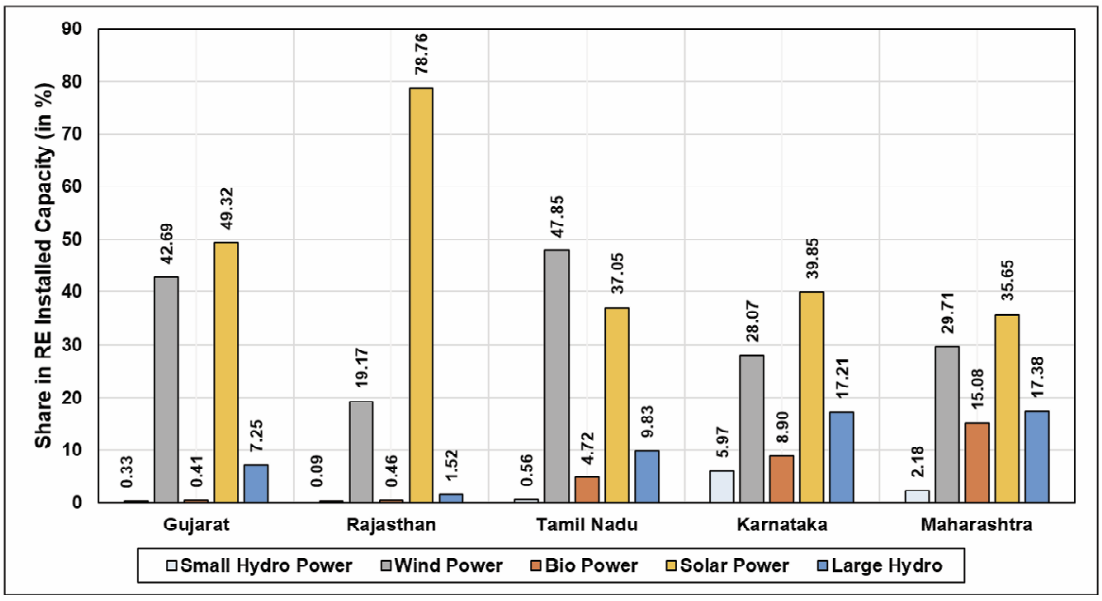
Source: Based on Table 3

This figure tells us that Gujarat, Rajasthan, Karnataka, Tamil Nadu and Maharashtra were the top 5 states in terms of their installed capacity in Renewable energy sector in the country. Total share of renewable energy in installed capacity as on 31.03.2024 shows that Gujarat emerges as the frontrunner with the largest share, standing at approximately 14.41%, followed closely by Rajasthan with 14.22% share. States of Tamil Nadu, Karnataka and Maharashtra contributes with shares of 11.63%, 11.25% and 9.20% respectively.

Contribution of various renewable energy sources of top 5 renewable energy installed capacity states within the respective state's renewable energy installed Capacity

Fig 4. Share of various renewable energy sources of top 5 renewable energy installed capacity states within the state's renewable energy installed capacity

(As on 31.03.2024)



Source: Based on Table 3

Figure 4 presents the contribution of various renewable energy sources within the top five renewable energy installed capacity states in India, with Gujarat standing out as a key player in the sector. As of March 31, 2024, Gujarat's renewable energy installed capacity reached **27,461.72 MW**, making up **14.41%** of India's total renewable capacity. The state's strong performance in the sector is driven by strategic policies, favorable geographic conditions, and significant investments.

The composition of Gujarat's renewable energy portfolio highlights its dominance in **solar and wind energy**. Solar energy holds the largest share in Gujarat's renewable energy mix at **49.32%**, reflecting the state's proactive solar adoption backed by ample sunlight, government incentives, and large-scale solar park developments, such as the **Dholera and Charanka Solar Parks**. Wind energy contributes **42.69%** of Gujarat's renewable capacity, benefiting from robust wind corridors along the coastline and favorable tariff structures under central and state policies.

Rajasthan led with a 78.76% contribution from Solar installed capacity. In the case of wind power, Tamil Nadu held the largest share having 47.85% in the state. With respect to large hydro sector, among top five states in renewable energy installed capacity, Maharashtra had the highest share of 17.38%. For biopower, Maharashtra led with a 15.08% share. Regarding small hydro power, Karnataka had the highest share at 5.97% among the top five states.

FINDINGS

- The total installed capacity under the Renewable Energy sector (including large Hydro) increased from 81.22 GW in 2014-15 to 190.57 GW by 2023-24, representing a growth of 134.63%.
- The installed capacity of Solar, Wind, Bio Power, and Small Hydro Power reached 143.64 GW as of 31st March 2024, a substantial increase from 39.95 GW in 2014-15, showing a remarkable growth of 259.55%.
- India's Global Ranking in Renewable Energy: According to IRENA's Renewable Energy Statistics 2024, India ranks 4th globally in overall renewable energy installed capacity. Specifically, India holds the 4th position in wind and bio power installations and the 5th position in solar and hydro power installations. India also ranks 5th globally in overall renewable energy generation and holds the 4th position in solar power energy generation.
- Renewable energy sources contributed 359.89 BU, representing 20.75% of the total energy generation during 2023-24. Energy generation from Solar Power, Wind Power, Bio-Power, and Small Hydro Power has surged by 265.89% since 2014-15.
- Top Performing States in Renewable Energy Capacity: As of 31st March 2024, the top five states in total renewable energy installed capacity were Gujarat (approximately 14.41%), Rajasthan (14.22%), Tamil Nadu (11.63%), Karnataka (11.25%), and Maharashtra (9.20%), collectively representing around 61% of India's total installed capacity in renewable energy.
    - ❖ Rajasthan had the largest share (78.76%) of solar power within its renewable energy installed capacity in Solar Power.
    - ❖ Tamil Nadu had the largest share (47.85%) of wind power within its renewable energy installed capacity in Wind Power.
    - ❖ Maharashtra had the highest share (17.38%) of large hydro among the top five states in renewable energy installed capacity in Large Hydro.
    - ❖ Maharashtra led with the highest share (15.08%) of bio-power among the top five states in Bio-power.
    - ❖ Karnataka had the highest share (5.97%) of small hydro power among the top five states in Small Hydro Power.

CONCLUSION

The research paper concludes that India has made significant and commendable progress in the renewable energy sector between 2014-15 and 2023-24. The exponential growth in installed renewable energy capacity and generation highlights a transformative journey driven by effective policy implementation. The country's improved global ranking in renewable energy installations

and generation further underscores this progress. The substantial contributions from solar and wind power, along with the identified leading states, demonstrate the diverse potential and regional strengths within India's renewable energy landscape. This growth in renewable energy capacity is crucial for mitigating the climate challenge and fostering sustainable development in India, reducing the reliance on fossil fuels despite the continued overall dependence. The consistent outperformance of the renewable energy sector in terms of growth rate compared to non-renewable sources suggests a positive trajectory towards a cleaner energy future for India.

LIMITATIONS

This research relies solely on secondary data from sources like MNRE and CEA, which limits its scope to existing data availability and granularity. While it effectively outlines growth in installed capacity and energy generation (2014-2024), the study doesn't deeply explore crucial aspects like efficiency, grid integration challenges, storage solutions, economic viability, or social/environmental impacts beyond carbon footprint.

Furthermore, the paper's limited historical analysis is due to data scarcity before 2014-15. Its aggregated view of renewable sources also lacks detailed insights into sub-categories (e.g., specific solar technologies, onshore/offshore wind). The analysis of top-performing states primarily focuses on installed capacity, omitting deeper dives into actual generation, state-level policies, or specific investment drivers behind their success. These limitations suggest avenues for future, more granular research.

SUGGESTIONS

- Future research could delve into the effectiveness of specific government policies and regulations in driving the growth of renewable energy in India. This could involve case studies, stakeholder interviews, and in-depth policy analysis.
- Further research could explore the economic and financial aspects of renewable energy projects in India, including investment flows, cost competitiveness with fossil fuels over the long term, job creation, and the role of financing mechanisms.
- Research could investigate the regional disparities in renewable energy adoption across India beyond the top five states, identifying barriers and opportunities for growth in other regions.
- More detailed studies could assess the broader environmental and social impacts of large-scale renewable energy deployments in India, including land use, biodiversity, and community engagement.
- comparative analysis of India's renewable energy journey with other leading countries can be done for identifying best practices and areas for improvement.
- Building upon the trends identified in this paper, future research could develop forecasting models and scenarios for the growth of renewable energy in India, considering various factors like technological advancements, policy changes, and economic growth.
- More focused studies could delve into the specific challenges and opportunities for each renewable energy source (solar, wind, bio-power, small hydro) in the Indian context, considering their unique characteristics and potential.

REFERENCES

- Lal, R., & Singh, S. (2023). Solar Energy for Sustainable Development in India. Journal of Emerging Technologies and Innovative Research (JETIR), 10(2), 1-10.
- Novas, N., Garcia, R. M., Camacho, J. M., & Alcayde, A. (2021). Advances in Solar Energy towards Efficient and Sustainable Energy. Sustainability, 13(11), 6295.
- Adebayo, T. S., Meo, M. S., Eweade, B. S., & Özkan, O. (2024). Analyzing the effects of solar energy innovations, digitalization, and economic globalization on environmental quality in the United States. Clean Technologies and Environmental Policy.
- **Priya, K., Ashokan, N., & Dinisha, C.** (2023). *An Analysis of the Renewable Energy Scenario in India and Public Engagement in Adaptation of Renewable Energy Sources*. Journal of Emerging Technologies and Innovative Research, 10(7), 554-567.
- Jacobson, M. Z. (2021). The cost of grid stability with 100% clean, renewable energy for all purposes when countries are isolated versus interconnected. Renewable Energy, 179, 1065-1075.
- Chien, F., Kamran, H. W., Albashar, G., & Iqbal, W. (2021). Dynamic planning, conversion, and management strategy of different renewable energy sources: a sustainable solution for severe energy crises in emerging economies. International Journal of Hydrogen Energy, 46(11), 7745-7758.

WEBSITES

- Ministry of new and renewable energy (MNRE) MINISTRY OF NEW AND RENEWABLE ENERGY | MINISTRY OF NEW AND RENEWABLE ENERGY | India
- central electricity authority (CEA) Home page - Central Electricity Authority
- Renewable energy statistics 2023-24
- https://www.irena.org/Statistics
- https://powermin.gov.in/en/content/annual-reports
- https://npp.gov.in/
- https://databank.worldbank.org/source/world-development-indicators
- https://www.iea.org/reports/india-energy-outlook-2021
- https://mnre.gov.in/
- https://www.unep.org/resources/publications
- (Centre Statistics Office, Ministry of Statistics and Programme Implementation 2017). https://www.mospi.gov.in/

Agricultural Prosperity through Natural Resource Management: A Case Study of Uttar Pradesh

Dr. Narendra Kumar[1] & Dr. Abhishek Pandey[2]

ABSTRACT

This study analyses the relationship between natural resource management and agricultural prosperity in Uttar Pradesh. Using secondary data from 2012 to 2022 using various reports, the most influential factor among various resource variables was identified through stepwise regression analysis. The analysis found that cropping intensity has a positive and significant impact on agricultural yield, while other factors such as irrigation, fertilizer use and rainfall were not found to be statistically effective. This study underlines the need for increasing land use intensity and efficient management of resources, which may prove useful for policy making and agricultural planning.

Key Words: *Natural resource management, agricultural yield, cropping intensity, regression analysis, Uttar Pradesh.*

Introduction

India is an agrarian country where the livelihood of a large part of the population depends on agriculture and allied activities. Especially in a state like Uttar Pradesh, agriculture is not only the mainstay of economic development but also the main source of rural employment and food security. The prosperity of the agricultural sector depends mainly on natural resources such as land, water, soil, and climate. Scientific and sustainable management of these resources plays a vital role in increasing agricultural productivity. In recent years, natural resource management (NRM) policies such as watershed development, soil health management, and crop diversification have brought positive changes in the agricultural sector. The aim of this study is to analyze the relationship between natural resource management and agricultural production in Uttar Pradesh to provide useful suggestions for policy making.

Review of Literature

The role of natural resources in agricultural development has long been a subject of research. Recent studies such as the ICAR (2020) report have made it clear those natural resource management strategies with crop intensification and advanced irrigation techniques have been helpful in ensuring agricultural prosperity. According to the Planning Commission (2011) report, unbalanced use of

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natural resources affects long-term agricultural productivity. The report suggested that local climate and resource-based policy making could provide sustainability to the agricultural sector. Similarly, Sharma (2015) analysed the Soil Health Card Scheme in Uttar Pradesh and found that the scheme motivated farmers to make balanced use of fertilizers, which improved yields. Singh and Kaur (2012) studied water resources management in Punjab and found that access to irrigation and water efficiency techniques significantly increased agricultural production. According to Pretty et al. (2006), natural resource management (NRM) such as sustainable use of water, land, and biodiversity plays a vital role in enhancing agricultural productivity. Especially in an agriculture-dominated country like India, irrigation, soil health, and cropping systems have profound impacts on agricultural prosperity.

Objectives

- To evaluate the impact of key natural resource management measures on agricultural prosperity in Uttar Pradesh.
- To identify the relationship between indicators of agricultural prosperity and natural resources.

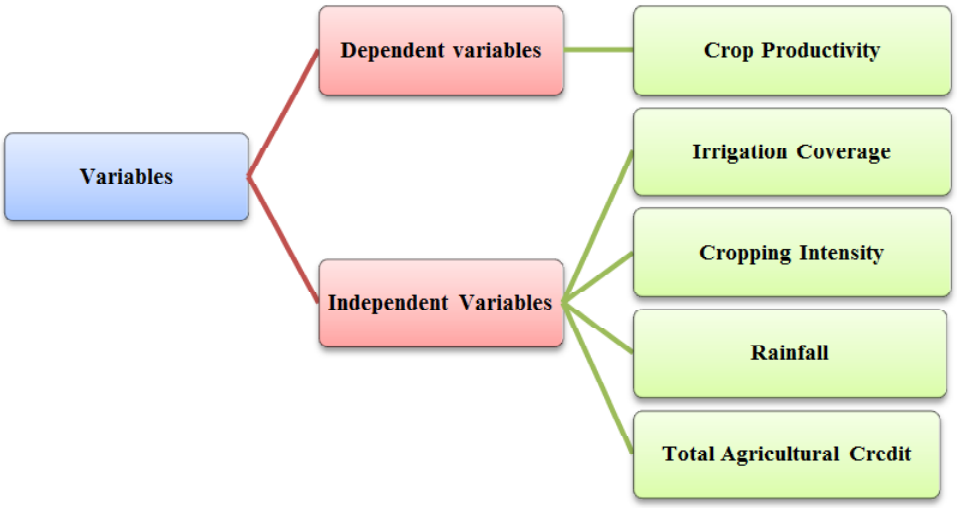
Hypothesis

H_0: There is no significant relationship between natural resource management and agricultural prosperity in Uttar Pradesh.

H_1: There is a positive relationship between natural resource management and agricultural Prosperity in Uttar Pradesh.

Research Methodology

Variables



Data

Tools of Data Analysis

The Stepwise Regression has been used with the following model to solve the objectives and to test the stated hypothesis. Data has been analysed using MS Excel and SPSS software.

$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_2 X_{2t} + \varepsilon_i$

Y_t = Agricultural Prosperity (Crop Yield Ton/Ha)

X_{1t}= Irrigation (%)

X_{2t} = Cropping Intensity

X_{3t} = Total Agricultural Credit

β_0 = Intercept (Constant term)

β_1, β_2, β_3 = Coefficients showing effect of each Natural Resource Management factor on agricultural prosperity

t = Years (2012-13 to 2022-23)

ε_i = Error term

Irrigation (%) = (Net Irrigated Area/Net Cropped Area) x 100

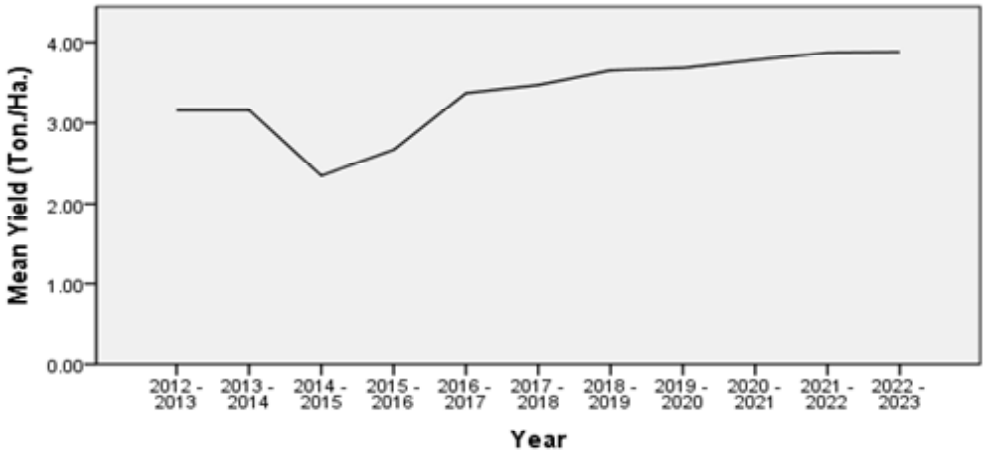
Cropping Intensity (%) = (Gross Cropped Area/Net Cropped Area) x 100

Results and Discussion

Data Analysis

Year	Food grain Production (Th. M.T.)	Yeald (Ton/Ha)	Net Irrigated area (Th. Ha.)	Irrigation (%)	Gross Cropped Are (Th. Ha.)	Net Cropped Are (Th. Ha.)	Cropping Intensity % = ((G/N)*100)	Annual Average Rainfall (mm)	Fertilizer use Total	Fertilizer use (Per Ha)	Total Agricultural Credit (Rs. Crore)
2012 - 2013	52276	3.16	13929	84.09	25821	16564	155.89	688.6	4651	18.01	46941
2013 - 2014	52276	3.16	14027	84.78	25896	16546	156.51	943.1	4026	15.55	56219
2014 - 2015	38927	2.35	14389	86.69	26147	16598	157.53	598.1	4272	16.34	74397
2015 - 2016	43948	2.67	14231	86.41	26203	16469	159.10	592.8	4230	16.14	88079
2016 - 2017	55747	3.37	14337	86.56	26949	16564	162.70	766.2	4261	15.81	95288
2017 - 2018	57384	3.47	14332	86.64	26864	16542	162.40	636.4	4655	17.33	106002
2018 - 2019	60415	3.65	14392	87.02	26859	16538	162.41	736.8	4722	17.58	104602
2019 - 2020	60184	3.68	14416	88.07	27109	16368	165.62	849.1	5271	19.44	117444
2020 - 2021	61945	3.78	14416	88.07	27109	16368	165.62	732.2	5345	19.72	115558.7
2021 - 2022	62371	3.87	13941	86.61	28346	16096	176.11	946.1	5169	18.24	119012.4
2022 - 2023	62523	3.88	14044	87.12	28381	16121	176.05	760.2	5256	18.52	-

Source: *Uttar Pradesh At A Glance (Annual Reports), ** UP Climate Change Authority, Govt. of Uttar Pradesh



Source: Table 1

The result of the analysis a positive trend of yield (ton./ha) has been found which that there is a significant positive relationship between the dependent variable (yield) and the independent variables (table 1 & graph 1).

Hypothesis Testing

Descriptive Statistics

	Mean	Std. Deviation	N
Yield (Ton./Ha.)	3.3673	.49812	11
Irrigation (%)	86.5509	1.20009	11
Fertilizer Use (Kg/Ha	17.5164	1.42920	11
Annual Average Rainfall (mm)	749.91	122.795	11
Cropping Intensity % = ((G/N)*100)	163.6309	7.00090	11
Total Agricultural Credit (Rs. Crore)	83958.4673	36994.94970	11

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Cropping Intensity % = ((G/N)*100)	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

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a. Dependent Variable: Yield (Ton./Ha.)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.747[a]	.558	.509	.34897

a. Predictors: (Constant), Cropping Intensity % = ((G/N)*100)

b. Dependent Variable: Yield (Ton./Ha.)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.385	1	1.385	11.374	.008[b]
	Residual	1.096	9	.122		
	Total	2.481	10			

a. Dependent Variable: Yield (Ton./Ha.)

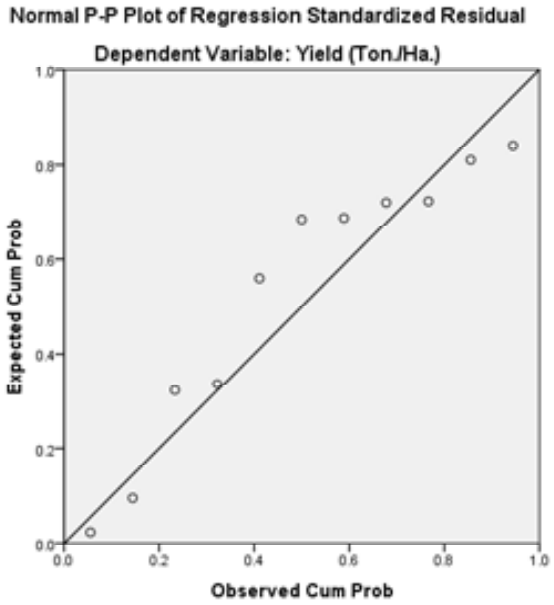
b. Predictors: (Constant), Cropping Intensity % = ((G/N)*100)

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Irrigation (%)	.006[b]	.023	.982	.008	.718	1.393	.718
	Fertilizer Use (Kg/Ha	.387[b]	1.572	.155	.486	.697	1.434	.697
	Annual Average Rainfall (mm)	.311[b]	1.327	.221	.425	.824	1.214	.824
	Total Agricultural Credit (Rs. Crore)	.148[b]	.646	.536	.223	1.000	1.000	1.000

a. Dependent Variable: Yield (Ton./Ha.)

b. Predictors in the Model: (Constant), Cropping Intensity % = ((G/N)*100)



Multiple Regression Analysis, Stepwise has been used to solve the objective of the study and to test the hypothesis. According to the results of the analysis the mean value of yield Ton/Ha is 3.36, σ = .498, Irrigation % ($\bar{X}$ =86.55 and σ = 1.2), Fertilizer use kg/ha ($\bar{X}$ = 17.51 and σ = 1.42), annual average rainfall ($\bar{X}$ = 749.91 and σ = 112.79), cropping intensity ($\bar{X}$ =163.63 and σ = 7.0), total agricultural credit ($\bar{X}$ =83958.46 and σ = 36994.9). R = 0.747, R^2 = 0.558 shows that about 55.8 % variation in the agricultural yield is explained by the predictors included in the analysis. Adjusted R^2 = 0.509 indicates a fairly strong model fit. According to the ANOVA table F = 11.374, Sig. = 0.008 which is less than 0.05 shows that the model is statistically significant. According to the results of the analysis the null hypothesis $\boldsymbol{H_0}$**:** There is no significant relationship between natural resource management and agricultural prosperity in Uttar Pradesh has been rejected. As per the results there is a positive effect on yield supports the alternative hypothesis $\boldsymbol{H_1}$**:** There is a positive relationship between natural resource management and agricultural Prosperity in Uttar Pradesh.

According to the analysis, the cropping intensity % shows a significant and strong positive effect on agricultural prosperity in Uttar Pradesh. The stepwise regression analysis exclude the variables like irrigation %, Fertilizer use, Rainfall and agricultural credit, because of these variables are not significant in the present analysis ($p > 0.05$).

Conclusion

On the basis of the present study, it is clear that natural resource management has a positive impact on agricultural prosperity in Uttar Pradesh. In particular, cropping intensity has proved to be an important determinant of agricultural production in Uttar Pradesh. The results obtained from statistical analysis show that the relationship between cropping intensity and agricultural yield is not only positive but also statistically significant. The effect of other factors such as irrigation %,

fertilizer use, annual average rainfall and total agricultural loan was found to be relatively less effective. Therefore, it can be said that if natural resources are used in a balanced and efficient manner, then significant increase in the productivity of the agricultural sector is possible.

Suggestions for Policy Implication

On the basis of the results of the study it is suggested that proper management of natural resources needs special attention to enhance agricultural prosperity in Uttar Pradesh. The government should encourage farmers to adopt multi-cropping system, use improved seeds, and modern agricultural techniques to increase cropping intensity. Also, the expansion of irrigation facilities, soil quality improvement (such as effective implementation of soil health cards), and water conservation projects should be given priority to ensure sustainable agricultural development in the state as well as in India to achieve the sustainable development goals.

References

- Govt. of UP. (2012-2024). Uttar Pradesh At A Glance (Annual Reports). Economic & Statistical Division, State Planning Institute, Planning Department, Uttar Pradesh.
- Govt. of India. (2024). Major Contributing State, Department of Agriculture & Farmer Welfare, Ministry of Agriculture & Farmers Welfare.
- ICAR (2020). *Annual Report 2019-20*. Indian Council of Agricultural Research, Ministry of Agriculture and Farmers Welfare, Govt. of India.
- Pretty, J., Noble, A. D., Bossio, D., Dixon, J., Hine, R. E., Penning de Vries, F. W. T., & Morison, J. I. L. (2006). *Resource-Conserving Agriculture Increases Yields in Developing Countries*. Environmental Science & Technology, 40(4), 1114–1119.
- Sharma, A. (2015). *Impact of Soil Health Cards on Sustainable Agriculture in Uttar Pradesh*. Indian Journal of Agricultural Development, 43(2), 98–106.
- Singh, G., & Kaur, H. (2012). *Water Resource Management and Agricultural Productivity in Punjab*. Journal of Agricultural Economics, 67(3), 234–245.

Websites

- https://data.desagri.gov.in/website/crops-report-major-contributing-State-web
- https://upccce.org/rainfall

Socio-Economic Dynamics of Forest-Dependent Households in Kumaon Hills of Uttarakhand: A Study of Livelihoods and NTFPs

Divya Oli[1], Dr. Jitendra Kumar Lohani[2] & Prof. Rajnish Pande[3]

ABSTRACT

This study examines the socio-economic characteristics of those households who are forest-dependent in the hilly part of Uttarakhand state, specially focusing on their reliance on Non-Timber Forest Products (NTFPs), contribution of NTFPs to household income and employment, on their livelihoods. 50 respondents randomly selected to collect data for this study. The findings of the study reveal that forest-dependent households often exhibit limited landholdings (preferably marginal), and they have a significant reliance on NTFPs for their livelihoods. Forest-based activities for NTFPs make a substantial contribution to respondent households' income and employment, particularly for women and marginalized groups. Both primary and secondary data is adopted to make the study meaningful.

Introduction

Non-Timber Forest Products (NTFP) play a crucial role in supporting the livelihoods of a vast number of people in developing nations (Arnold & Parez, 1997). They significantly contribute to food security and serve as an essential resource for health and well-being, cash income, and dependable wage labour in the remote areas where income opportunities are almost nil (Bhattacharya, n.d.). NTFPs govern the livelihood, especially for forest-dependent communities, in many developing economies. NTFP includes a variety of wild and partially domesticated biological resources obtained from the surroundings, and generally unaltered vegetation, such as grasslands, woodlands and forests (Shackleton et al. Citation2011 via Derebe & Alemu, 2023). Certain Non-Timber Forest Products (NTFP) hold significant commercial value and contribute substantially to revenue generation (Brial & Koen, 2004). Approximately 30% of the world's forests are managed primarily for the production of wood and non-timber forest products (NTFPs) (Yadav & Dugaya, n.d.).The size of NTFPs in India was about 263 billion INR within forest product sector of Indian economy in FY 2021 (Statista, n.d.).

For centuries, forest-dependent communities have coexisted on the Kumaon Hills of Uttarakhand with the forests as the main focus of their economic sustenance. Timber, fuelwood, fodder, and

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Non-Timber Forest Products constitute the numerous products for which forest-dependent communities have been traditionally dependent upon forests. The paper intends to analyse the socio-economic dynamics of the forest-dependent population living in the Kumaon Hills of Uttarakhand and the dependency on NTFPs as a source of household income and employment.

Literature Review

The detailed literature on forest-based livelihood systems emphasizes their vital and diversified contributions to rural economies, especially in developing countries (Arnold & Ruiz Pérez, 1998). In the Indian Himalayan region, numerous studies have highlighted the dependency of local communities on the forests for many products and services-for example, Jackson et al. (1998) and Nautiyal & Kaechele (2007) underlined that forests are an integral part of these communities' very zoolife sustenance. In Uttarakhand, selected studies have focused on the collection and trade of medicinal plants (Olsen & Bhattarai, 2005), the role of forests in livestock rearing (Mishra et al., 2004), and the economic importance of non-timber forest products (NTFPs) with regard to the most marginalized groups (Saxena, 2003). The studies indicate the interdependence between forest resources and the livelihood of a larger proportion of the population of the region.Traditional ecological knowledge and practice must, of necessity, enter into the arena of forest management if the goals of sustainability and equitable sharing of benefits are to be achieved (Berkes et al., 2000). The plight of forest-based livelihoods, however, is compounded by resource overharvesting, market exploitation, policy restrictions, and grave climatic phenomena (Wunder, 2001; Vedeld et al., 2007). The incomes earned from NTFPs go a long way in increasing household incomes and act as an important safety net during the agricultural off-season (Scoones et al., 1992). The resolution of NTFP-related issues becomes crucial in the process of resilience-building and economic viability of these livelihoods.

Despite abundant research literature concerning forest-based livelihoods and traditional uses of NTFPs in several regions, there appears to be an evident gap in specific research on Uttarakhand's Champawat district. No studies have, so far, been done on the NTFP contribution to household income and the socio-economics of communities relying on forest-based product livelihoods in this district. This would then create an opportunity for further impact assessment of the NTFPs on economic resilience and sustainable development in Champawat and accordingly address exclusive local challenges prevailing in the area. Such understanding should then lead to the formulation of corresponding policy and management strategies benefiting forest-dwelling communities and conservation of forest resources.

Objectives of the Study

- To study the Socio-economic characteristics of forest-dependent respondent households.
- To study the contribution of forest-based activities to household income and employment among respondents
- To study the impact of NTFPS on the household income among Respondents.

Research Methodology

(a) Study Area: Both the study and the collection of non-timber forest products were done in five villages under Champawat Development Block in district Champawat (Barpass, Gunth Garsari, Kallu Khan, Mirtola, and Mairoli), having reliance on forests for livelihood. A wide range of NTFPs were collected and utilized by local communities in the study region. As for example, Kafal (*Myrica esculenta*), Buransh (*Rhododendron Arboreum*), Bay Leaf (*Cinnamomum tamala*), Munj grass (*Saccharum munja*), Pattharchatta medicine (*Kalanchoe pinnata*) etc., and some other forest produce.

(b) Collection of Data: 50 households (10 from each village) were randomly selected and forest-dependent households. A well-structured Interview Schedule was prepared for collecting the data related to demographics, education, landholding, income sources, NTFP collection etc. from the sample respondents.

(c) Data Analysis: The socio-economic characters of respondents were analysed through descriptive analysis and NTFPs value chain analysis was conducted to understand the NTFP flows from primary collectors to consumers in order to examine what amount is worth addition at each stage.

Results and Discussion

Socio-economic Characteristics of Forest-Dependent Households

The previous studies in the context of forest-dependent households very often described the low level of education, a higher reliance on agriculture (even small and marginal landholdings), and NTFPs for their livelihoods, whereas non-forest-dependent households can be otherwise characterized. In the present study, the interesting finding was that a good proportion of households belonged to marginalized social groups (42 percent) that were engaged in traditional forest-based activities. The average household size of the respondent households is 6.2, and a dependency ratio of 0.65 indicates that a considerable pension on nonworking family members depends on the income generated by working family members. The literacy rate (68 percent) is an indicator of the potential educational challenges. The dependence on agriculture and forest resources is 49.8 percent, and this reflects the immense dependency of the respondent households on natural resources for their livelihoods.

Table 1: Socio-economic Characteristics of Forest-Dependent Households (N=50)

Characteristic	Value
Average Household Size of respondents	6.2
Dependency Ratio in family	0.65
Average Landholding (Hectares) size	0.7
Literacy Rate (%) of respondents	68%
Proportion of SC/ST Households (%) among respondents	42%
Primary Occupation of the respondents	Agriculture & NTFP Collection
Average Reliance on Forest Resources among respondents	49.8 percent

Source: Primary data.

Contribution of Forest-Based Activities to Household Income and Employment:

Household income data analysis has shown that traditional forest-based activities play a significant role in the total income of forest-dependent households. By and large, sales of NTFP gross an average of 38 percent of the total annual household income. By and large, the contribution is very important for those households that have less agricultural land or in periods of agriculture off-season wherein it counts largely in providing household income after agriculture. The supposed main occupation of the respondents in the study area.

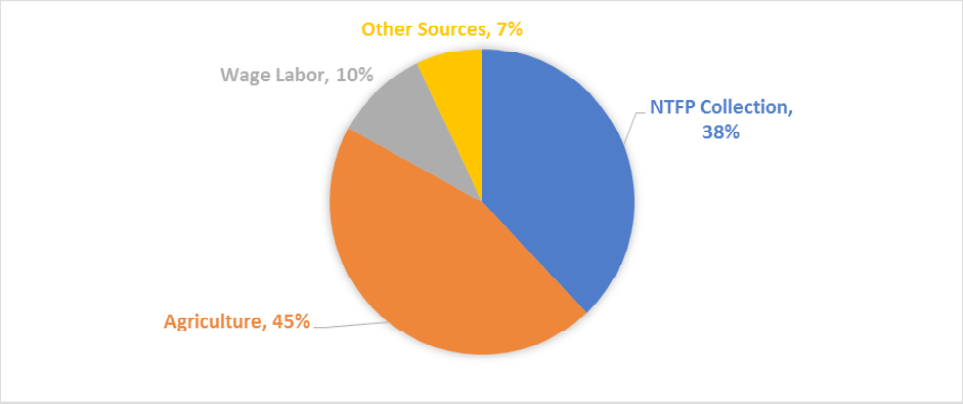
Forests provide relatively better employment opportunities to women and other disadvantaged groups. Activities like collection of NTFPs, processing (cleaning, drying, grading), and handicraft production generate full-time and part-time jobs in the rural areas. The study estimated approximately 120 person-days per household each year from forest-based activities. The emerging ecotourism sector is opening up many employment opportunities for the local communities in guiding, carrying loads, and providing accommodation as well as other services.

Table 2: Contribution of Forest-Based Activities to Household Income

S.No.	Income Source	Percentage of Total Income
1.	NTFP Collection	38%
2.	Agriculture	45%
3.	Wage Labor	10%
4.	Other Sources	7%

Source: Primary Data

Fig 1: Contribution of Forest-Based Activities to Household Income



Source: Primary Data

Impact on Household Income of NTFPs among Respondents

A linear regression model was prepared to evaluate the extent of the impacts of NTFP on the household incomes of the respondents, in which Total Household Income (THI) is the dependent

variable, Income from NTFP Collection (NTFP Income) is independent, while the control variables include Household Size (HH), Age of Household Head (AHH), Distance from Forest (DTF), and Level of Education (LE).

$$THI = \beta_0 + \beta_1(NTFP_Income) + \beta_2(HH) + \beta_3(AHH) + \beta_4(DTF) + \beta_5(LE) + \varepsilon$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.992(a)	.984	.982	2179.98210

a Predictors: (Constant), LE, DTF, NTFP_Income, HH, AHH

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	48864.088	8935.925		5.468	.000
	NTFP_Income	.815	.210	.303	3.885	.000
	HH	-1482.693	822.368	-.140	-1.803	.078
	AHH	70.529	139.196	.044	.507	.615
	DTF	-4560.912	899.036	-.331	-5.073	.000
	LE	3360.138	1069.235	.289	3.143	.003

a Dependent Variable: THI

Model summary table indicates that the model accounts for a significant part of variance in Total Household Income (THI). R=0.992 value shows very strong positive relation between dependent and independent variables. 98.4 percent of the variance is explained in model independent variables in THI (R2=0.984) Adjusted R Square indicates a well fit model of data. The Coefficients table presents the estimated coefficients, standard errors, t-values, and p-values for every variable in the model. The constant term is highly significant statistically ($p<0.001$, $t=5.468$) with a value of 48864.088. The independent variable NTFP_Income coefficient turns out to be statistically significant ($p<0.001$), thus showing the positive impact NTFP_income has on Total Household Income. On the other hand, it had shown DTF is significant negative predictor ($p<0.001$, $t=-5.073$). Level of Education is another significant positive predictor of THI ($p=0.003$, $t=3.143$). Marginally significant is household size ($p=0.078$, $t=-1.803$). Household Head Age was a non-significant predictor of THI ($p=0.615$, $t=0.507$).

This highlights the significant role of Non-Timber Forest Products (NTFPs) in supplementing the income of respondent households. The fact that the NTFP_income has a very high and statistically significant coefficient implies that it has direct positive implications for the overall household income of the respondents, thus showing the clear importance of NTFP_income as a significant source of household livelihood support to communities built on forest resources. The farther one is from the forest, the more limited their access to its opportunities and resources becomes. Households are very few, not sufficient based on this data, nor is the age of the household head showed any significant effect on total household income.

Conclusion & Suggestions

This study highlights the prominent role the forest and NTFPs play in the socio-economic well-being of communities in the Kumaon Hills of Uttarakhand. The second consideration regarding NTFP dependence is that it forms a considerable share of household income for the economically marginalised and households with limited agricultural land. The positive contribution of NTFP income to total household income is statistically significant. In contrast, the negative effect of distance from the forest underlines the importance of access to forest resources. With the additional concern of low handwriting skills and small landholdings, these communities may not improve on their livelihoods or sustainably manage forest resources.

Following the findings of this study, the further recommendations are proposed: Interventions are needed to ensure that NTFP primary collectors get fair prices. In this regard, it may involve the capacity building of their cooperatives, training in value addition (better processing and packaging), and building up direct linkages to market to minimize the role of middlemen. Training and awareness about sustainable harvesting of NTFPs is really what is needed for their long-term availability and to check on over-exploitation. The emerging ecotourism sector holds excellent promise for contributing to income and employment for local communities. Support should be directed toward initiatives for sustainable ecotourism that benefit local communities and accommodate conservation. The government policy should address sustainable utilisation of NTFPs, support community forest management, and incorporate mechanisms for equitable benefit sharing. Further research should be undertaken on the ecological consequences of NTFP harvest, possible value addition, and the impact of various interventions aimed at improving the livelihood of forest-dependent communities. It would also be useful to study the specific impacts of climate change on NTFP availability and community livelihoods.

By implementing these recommendations, the socio-economic well-being of the forest-dependent communities in the Kumaon Hills of Uttarakhand can be improved, while the sustainable management of the forest resources can also be encouraged.

References

- Arnold, J. E. M., & Ruiz Pérez, M. R. (1998). Can non-timber forest products offer a genuine option for sustainable forest management? CIFOR Occasional Paper No. 19.
- Arnold, J.E. Michael and Manuel Ruiz. (1997). Framing the Issues Relating to Non-Timber Forest Products Research. Current Issues in Non-Timber Forest Products Research (Ed. y M. Ruiz Pérez and J.E.M). Center for International Forestry Research, Bogor, Indonesia.
- Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. Ecological Applications, 10(5), 1251-1262.
- Bhattacharya, Prodyut. (n.d.). Sustainable Harvesting of Non Timber Forest Products. Retrieved from https://www.ignfa.gov.in/document/biodiversity-cell-ntfp-related-issues14.pdf on dated 22-04-2025.
- Brian, Belcher & Koen Kusters. (2004). Non-Timber Forest Product Commercialisation: Development and Conservation Lessons. *Forest Products Livelihood and Conservation, Vil-I Asia (Ed. Koen Kusters & Brian Belcher).* Center For International Forestry Research, Jakarta, Indonesia.

- Jackson, M. G., Dolkar, T., & Ambler, J. S. (1998). Livestock grazing in the Hindu Kush-Himalayas. In P. N. Sharma & P. Scott (Eds.), Development of Animal Husbandry in the Hindu Kush-Himalayan Region (pp. 183-204). ICIMOD.
- Mishra, C., Allen, P., McCarthy, T. M., Madhusudan, M. D., & Oli, M. K. (2004). Snow Leopard Conservation and Local Livelihoods: A Case Study from the Spiti Valley, Indian Himalayas. Biodiversity and Conservation, 13(6), 1141-1161.
- Nautiyal, S., & Kaechele, H. (2007). Non-timber forest products in Sikkim: Their socio-economic contribution and management issues. Forest Policy and Economics, 9(5), 631-641.
- Olsen, C. S., & Bhattarai, N. K. (2005). Income generation from non-timber forest products in the Makalu Barun Conservation Area, Nepal. Mountain Research and Development, 25(3), 228-237.
- Saxena, N. C. (2003). NTFPs, poverty and gender: A case study of Andhra Pradesh. Economic and Political Weekly, 38(47), 4935-4943.
- Scoones, I., Melnyk, M., & Pretty, J. N. (1992). The Hidden Harvest: Wild Foods and Agricultural Systems-A Literature Review and Annotated Bibliography. IIED.
- Shackleton, S., Shackleton, C., & Shanley, P. (Eds.). 2011. Non-timber forest products in the global context (Vol. 7). Berlin Heidelberg: Springer. *Via* Derebe, B., & Alemu, A. (2023). Non-timber forest product types and its income contribution to rural households in the Horn of Africa: a systematic review. *Forest Science and Technology*, *19*(3), 210–220. https://doi.org/10.1080/21580103.2023.2231963
- Statista. (n.d.). India: Economic Contribution of Non-Timber Forest products. Retrieved from *https://www.statista.com › Agriculture › Farming* on dated 22-04-2025.
- Vedeld, P. O., Angelsen, A., Bojö, J., Sjaastad, E., & Berg, G. K. (2007). Forest environmental incomes and the rural poor. Environmental Economics, 4(1), 1-23.
- Wunder, S. (2001). The economics of non-timber forest products: A review. CIFOR Occasional
- Yadav, Manmohan & Dharmendra Dugaya. (n.d.). Issues of NTFP Marketing. Retrieved from https://www.ignfa.gov.in/document/biodiversity-cell-ntfp-related-issues5.pdf on dated 22-04-2025

The Role of Natural Farming Practices in Achieving Agricultural Prosperity: An Analytical Study

Dr. Sitari Ram

ABSTRACT

Agriculture is the basis of livelihood of more than 58 per cent of population in India. It is the largest private profession in our country. It contributes about 20 per cent to the GDP of the country. India has an advantage of demographic dividend having 52 per cent of total population as youth. The main aim for promotion of Natural Farming is elimination of chemical fertilizers and pesticides usage and promotion of good agronomic practices. Natural Farming also aims to sustain agriculture production with eco-friendly processes in tune with nature to produce agricultural produce free of chemicals. Soil fertility & soil organic matter is restored by natural farming practices. Natural farming systems require less water and are climate friendly. Natural farming, also known as the Fukuoka the Natural Way of Farming. Japanese farmer and philosopher Masanobu Fukuoka (1913–2008) is presume the father of modern natural farming. He introduced this term in his book, ***The One-Straw Revolution*** *publish 1975. This study based on secondary data like related research journal, reports of various institution (national and International)**.**This study aims to explore the role that natural farming practices play in promoting agricultural productivity, economic equality and stability, environmental sustainability, and the overall well-being of farming communities**.***

Key Word*—Natural farming, Zero budget natural farming, government scheme, inclusive growth, chemical free, soil degradation, corner stone*

Introduction

According to FAO, by 2050 the world needs to increase overall food production by 70 percent to keep up with the growing global population and the changes in consumption driven by expanding the middle class. At the same time, India is expected as the most populous country in the world year in 2024, about 145 carore people. Under such conditions, ensuring food security for the populace would be one of the biggest concerns for the country Agriculture has long been a cornerstone of economic development and sustenance for societies around the world. With the growing pressures of climate change, soil degradation, and increasing demands for food production, it is imperative to reassess farming methods. Natural farming practices, characterized by the minimal use of synthetic

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inputs and a focus on ecological balance, have gained attention as a promising approach to achieving long-term agricultural prosperity. Natural farming, widely recognized as an innovative agro ecological practice, is a low-input, climate-resilient and cost-effective farming system. It relies on natural herbs and locally available resources to create inputs like insect repellents, fungicides and pesticides, significantly reducing the need for artificial fertilizers and industrial pesticides. So far, the natural farming movement in India has largely been led by farmers and civil societies. The natural farming is gaining momentum in India and is being practiced over 6.5 lakh hectares of agricultural land in 11 states of the country (NITI Aayog).. Natural farming in India is being promoted through a dedicated scheme of Bharatiya Prakritik Krishi Paddhati Programme (BPKP). The scheme promotes on-farm biomass recycling with major stress on biomass mulching, use of on-farm cow dung-urine formulations, periodic soil aeration and exclusion of all synthetic chemical inputs.

Objective of the Study

- ❖ To know about meaning and process of natural farming.
- ❖ To know about natural farming in India.
- ❖ To know government scheme for natural farming.
- ❖ To know impact of natural farming on agricultural production
- ❖ To know impact of natural farming on inclusive growth.

Meaning and Process of Natural Farming

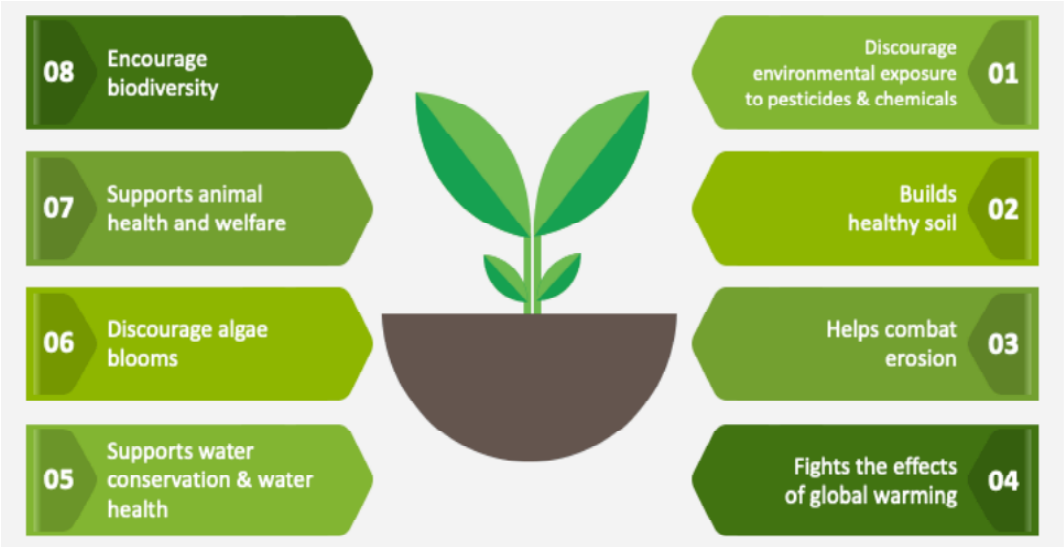
"Natural Farming is a chemical-free traditional farming method. It is considered as agro ecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity"-(Niti Ayog) Natural farming is a system where the laws of nature are applied to agricultural practices. This method works along with the natural biodiversity of each farmed area, encouraging the complexity of living organisms, both plants, and animals that shape each particular ecosystem to thrive along with food plants. Natural Farming builds on natural or ecological processes that exist in or around farms. Natural Farming can be defined as "chemical- free farming and livestock based". Soundly grounded in agro-ecology, It is a diversified farming system that integrates crops, trees and livestock, Allowing the optimum use of functional biodiversity. Natural Farming holds the promise of enhancing farmers' income while delivering many other benefits, such as restoration of soil fertility and environmental health, and mitigating and reducing greenhouse gas emissions. Natural Farming builds on natural or ecological processes that exist in around farms. Natural farming is distinct from organic farming.

Although organicfarming primarily focuses on utilizing chemicalfree substances in the soil, natural farming is a more expansive idea that includestheincorporation of all natural components, such as soil, water, air, and the complete ecosystem, for crop production.

NATURAL FARMING IN INDIA

Subhash Palekar is considering as the father of natural farming in India. He is an agricultural scientist and farmer who introduce Zero Budget Natural Farming (ZBNF) in the 1990s. The natural

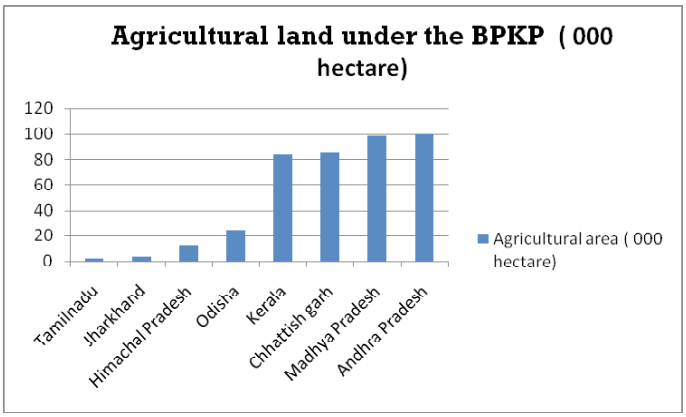
farming is gaining momentum in India and is being practiced over 6.5 lakh hectares of agricultural land in 11 states of the country (NITI Aayog)Many states are already fallowing natural farming and have developed successful models. State of Andhra Pradesh, Karnataka, Himachal Pradesh, Gujarat, Uttar Pradesh and Kerala are among the leading states. Currently, the acceptance and adoption of natural farming systems are at early stages and gradually gaining acceptance among the farming community.



Frame up of natural farming began in 2019-20, when Bhartiya Prakratik Krishi Paddhati (BPKP), a sub-scheme of PKVY, was launched to assist farmers in conforming traditional indigenous practices for encouraging all forms of ecological farming, including Zero-Budget Natural Farming (ZBNF). The scheme focuses on capacity building, training, handholding, and on-field demonstration of natural farming through champion farmers. Under this scheme, 4.09 lakh ha of land have been brought under Natural farming in 8 States (Andhra Pradesh, Chhattisgarh, Kerala, Himachal Pradesh, Jharkhand, Odisha, Madhya Pradesh and Tamil Nadu). Agricultural land under the BPKP following 8 states given table

	Agricultural land under the BPKP (000 hectare)
Tamil Nadu	2
Jharkhand	3.4
Himachal Pradesh	12
Odisha	24
Kerala	84
Chhattisgarh	85
Madhya Pradesh	99
Andhra Pradesh	100

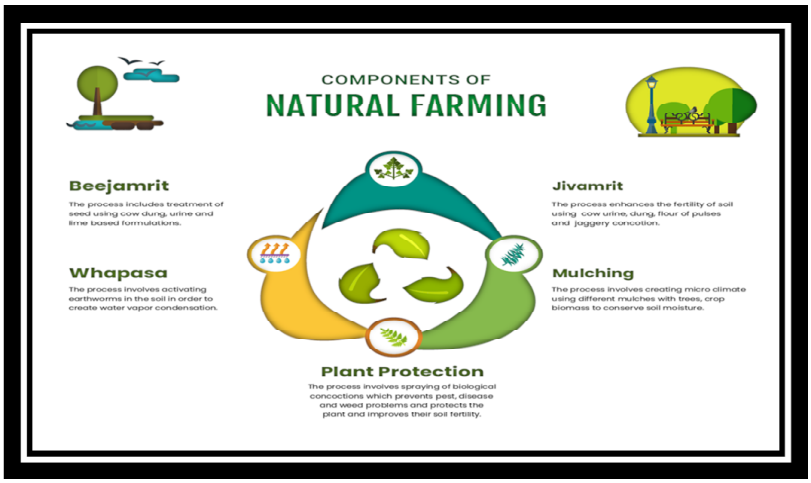
Source- economic survey 2021-22



An analysis conducted by the **Food and Agriculture Organisation (FAO)** in collaboration with the Andhra Pradesh (AP) government suggests that the **AP model of natural farming has the potential to double the employment opportunities for farmers** compared to industrial agriculture, thereby reducing overall unemployment and **increasing farmers' incomes by 2050**. Indian government has announced in 2023, facilitate1 crore (100 million) farmers transition to natural (or chemical-balanced) farming over the next three years.

The four pillars of natural farming -

- **Bijamrita**: A treatment made from cow urine, cow dung, and other local materials.
- **Acchadana**: Mulching can be done with soil, straw, or live mulch. Straw mulch protects seeds from birds, insects, and animals.
- **Jeevamrutha**: A fermented microbial culture that provides nutrients and prevents plant diseases.
- **Whapasa**: The idea that plant roots need water vapor, not water.



Government scheme for natural farming— The government of India has introduced various schemes to promote natural farming, which aims to reduce the use of chemical fertilizers and pesticides in agriculture. These initiatives are in line with sustainable agricultural practices that focus on ecological balance and long-term soil health. Here are some key government schemes related to natural farming:

1. **The National Missionon Natural Farming(NMNF)-** NMNF is a program initiated by the government of India aimed at promoting sustainable, chemical free agriculture practices through the country. It aim to motivate farmers to adopt natural farming techniques to improve soil health, boost productivity and informs the ecological balance of agriculture systems, The mission also offers financial and Technical assistance to farmers transitioning from conventional to natural farming adding with training raising awareness and insuring access to resources needed for natural farming methods. The national mission on natural farming has an overall budget ₹ 2481 crore for the year 2025-26. The central government will provide ₹ 1584carore whereas the state government will offer ₹ 897 carore.. This strategy supports the aim of making Indian agriculture more sustainable, and environmentally friendly, while enhancing the livelihoods of farmers and contributing to the larger objectives of environmental conservation and climate change mitigation**.**
2. **Paramparagat Krishi Vikas Yojana (PKVY):** PKVY aims to promote organic farming through traditional farming methods and practices that reduce the dependency on chemical fertilizers.
   - o It encourages farmers to adopt organic farming techniques.
   - o Financial assistance is provided for certification of organic produce and setting up organic clusters.
   - o It includes training, certification, and support for creating infrastructure for organic farming.
3. **National Mission on Sustainable Agriculture (NMSA):** NMSA focuses on promoting sustainable agricultural practices, including natural farming, for improving soil health and conserving natural resources.
   - o It supports farmers in adopting practices such as agro forestry, water use efficiency, and integrated nutrient management.
   - o Promotes the use of bio-fertilizers, organic manures, and natural pest control.
4. **Soil Health Management (SHM):** SHM aims to improve soil fertility and promote the adoption of eco-friendly farming practices.
   - o It supports the promotion of organic fertilizers, bio-fertilizers, and natural pest control methods.
   - o Encourages soil testing and application of balanced fertilizers for maintaining soil health.
5. **Rashtriya Krishi Vikas Yojana (RKVY): R**KVY provides financial assistance to states for promoting natural farming practices along with other agricultural development activities.
   - o States can use RKVY funds to implement projects that encourage natural and organic farming.

- It promotes integrated farming systems, which include natural farming components.

6. **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY—-**While primarily focused on irrigation, PMKSY also supports water-use efficiency, which is an integral part of sustainable and natural farming.

These schemes play a significant role in reducing the dependency on synthetic chemicals and encouraging environmentally friendly farming practices. By integrating organic and natural farming methods, these programs aim to enhance soil health, biodiversity, and agricultural sustainability.

Government also encouraged farmer to expansions natural farming given him various award in 2025 example farmer from Yavatmal a district in Maharashtra This district notorious for farmer suicides, a natural farmer Subhash Sharma receives For his groundbreaking effort in natural farming, Padma Shri, That regrettably gained renown for its high rate of farmer suicides, has been chosen to receive the Padma Shri award. He had also awarded to Smart farmer of Maharashtra.

Subhash Sharma wins Smart Farmer of Maharashtra award



Impact of natural farming on agricultural production —Short-term research on natural farming that spans one or two cropping seasons shows both gains and loss in crop production. However, thorough longitudinal data spanning various agricultural systems and agro climatic zones must be produced. This is also one of the causes of the divisive opinions regarding the effects of natural farming in India's food security debate. Poly cropping is the foundation of natural farming. In order to assess the overall productivity of chemical-based versus natural approaches, new methodologies that account for all hidden costs need be established. Study show that impact of natural farming on food production depend on many factors like farmer awareness, climate types of cropping pattern etc. The most crucial factor being explored under Natural Farming (NF) at the moment is crop productivity. The most hotly contested issue in recent years has been the impact of natural farming on crop output and farm income. Although a number of research have been done in the past, the outcomes have been inconsistent. According to Kumbar and Devakumar (2017), for example, an experiment carried out at, Bengaluru in 2014–15 showed that applying 2000 liters of jeevamritha per hectare resulted in a noticeably higher yield of french bean green pods, which also had superior crude protein and shelf life. Three groups of farm crops have had their yields calculated in the three states that were chosen: farmers using Jeevamritha, Beejamritha, etc. in addition to the

available Farm Yard Manure (NF with FYM), without NF.The case study in Andhra Pradesh, Maharashtra, and Karnataka show some hopeful result given following Andhra case study

Crop	CROP Productivity with NF	CROP Productivity with without NF
Paddy	53.79 q per ha	50.86 q per ha
Black gram	6.4q per ha	5.4 q per ha
Sugar cane	66.8 ton per ha	73.33 8 ton per ha

Source -Niti aayog data Andhra Pradesh

It is important o know that Andhra Pradesh targeted to 100 percent natural farming since 2024 with collaboration in Rythu Sadhikara Sanstha a not for profit company.In Karnataka, NF with FYM has marginally higher yield for banana (8.89 t/ha), finger millet (38.92 q/ha) and sugarcane (104.55 t/ha). In case of paddy, non-NF has higher 59 yield with 56.08 q/ha.In Maharashtra, turmeric yield under non-NF is higher at 40.03 q/ha than NF. NF with FYM is found to give higher yield in case of soybean (20.6 q/ha), jowar (10.51 q/ha), cotton (14.58 q/ha) and Chickpea (15.63 q/ha). It can be inferred from the above discussion that exclusively.In Karnataka, NF with FYM has marginally higher yield for banana (8.89 t/ha), finger millet (38.92 q/ha) and sugarcane (104.55 t/ha). In case of paddy, non-NF has higher 59 yield with 56.08 q/ha.

❖ **Natural farming help inclusive growth—** Natural farming, as a practice, emphasizes ecological balance, sustainability, and inclusivity, making it well-suited for promoting inclusive growth. Inclusive growth refers to economic development that benefits all segments of society, particularly marginalized groups, ensuring equal opportunities and reducing inequalities. When applied to agriculture, natural farming can play a key role in fostering such growth**.**

Economic & Social Empowerment for Farmers

- **Cost-Effective Practices**: Natural farming minimizes the need for costly synthetic inputs (e.g., chemical fertilizers, pesticides), making it more accessible to small-scale and marginalized farmers who may have limited access to financial resources. This can lead to improved economic outcomes for these farmers, reducing their dependency on external inputs and making farming more sustainable in the long run.
- **Increased Self-Sufficiency**: By focusing on local, sustainable resources and techniques such as crop rotation, composting, and integrated pest management, farmers can reduce reliance on external markets and suppliers. This self-sufficiency can lead to more resilient farming systems, especially in areas prone to economic volatility.
- **Gender Equality**: Natural farming often encourages greater participation of women and marginalized communities in agriculture. Women, who are frequently involved in small-scale and subsistence farming, can benefit from the labor- and resource-efficient methods of natural farming, leading to increased economic autonomy and social status. It can increased women participation in workforce which will help women economic empowerment.
- **Inclusive Knowledge Sharing**: Natural farming systems prioritize community-based knowledge exchange and learning. This inclusive approach helps bridge the knowledge gap between

different social groups and ensures that all farmers, regardless of their background, have access to sustainable farming practices.

- **Health and Well-being**: By promoting the production of nutritious, chemical-free food, natural farming directly impacts the health and well-being of both farmers and consumers. Reducing exposure to harmful chemicals improves public health outcomes, which in turn contributes to a more prosperous and equitable society. It will help reduce poverty and increase productivity all sector primary, secondary as well as tertiary.

In summary, natural farming's focus on sustainability, environmental stewardship, and low-cost inputs can promote inclusive growth by benefiting small farmers, marginalized communities, and the environment. By aligning agricultural practices with the principles of equity, resilience, and sustainability, natural farming can help create a more just and thriving agricultural sector that uplifts all segments of society.

Challenges and concerns about natural farming in India

Reduction in yields

- o While Andhra Pradesh emerges as a forerunner in adopting ZBNF with encouraging results, there are concerns about the sustainability and yield (productivity) potential of this farming method.
- o Findings of agro-scientists of the ICAR-IIFSR highlights a **59% decline in wheat yields and a 32% decline in basmati rice yield** compared to integrated crop management.
- o Many report show that a lot of farmer back to conventional farming due to their drop return.
- o Although Sikkim turn into completely organic/ natural farming but it have report loss of production.
- o Natural farming is both a time-consuming and labour-intensive system. In areas where labour availability is low, this could add to labour costs and increase farmers' overall production costs.

May adversely impact food supply:

- o Agriculture and food experts have their reservations surrounding a large-scale transition from chemical farming to natural farming in a country like India.
- o This is because it is a challenging task to meet the demands of **expanding food needs** in a country with a population as huge as India.
- o Natural farming is both a time-consuming and labour-intensive system. In areas where labour availability is low, this could add to labour costs and increase farmers' overall production costs.

Lessons from Sri Lanka:

- o A couple of years ago, neighbouring Sri Lanka went through economic and political turmoil after it shift 100percent organic, and banned the import of chemical fertilizers.

- The government's policy shift had severe consequences with farmers struggling to get natural fertilizers.
- **They faced a reduction in yields** of key crops including rice, putting the country's food security at risk.
- **A sharp price escalation** was witnessed in the country, resulting in huge **protests and unrest.**

Conclusion & Suggestions

Natural farming has the potential to revolutionize Indian agriculture by providing a sustainable and low-cost alternative to conventional farming. While there are challenges, especially in terms of knowledge dissemination and market access, the growing interest in organic and chemical-free produce offers a promising future for natural farming in India. In summary, natural farming in India offers a holistic approach to agriculture that balances economic, ecological, and social benefits. It promotes environmental sustainability, enhances farmer livelihoods, and ensures healthier food production, making it a valuable alternative to conventional chemical-intensive farming practices.Budget 2023 has announced that the government will assist 1 crore (100 million) farmers transition to natural (or chemical-balanced) farming till 2026. We havecareful shift natural farming here are some suggestions given-

- Multi location studied isneeded.
- Input cost also required but more important is training cost awareness for ZBNF.
- Use rainwater harvesting systems to reduce dependence on external water sources.
- Use homemade sprays like neem oil or garlic and chili mixtures for organic pest control.
- This is a knowledge-intensive and skill-driven farming method, capacity-building and hand-holding is required in the first few years, especially in the transition phase. Without proper knowledge and understanding of natural farming, it would not be easy to harness its full benefits.

References

- Department of Agriculture & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India. 2023-24
- ICAR- National Academy of Agricultural Research Management (2020) Adoption of Natural Farming and its Effect on Crop Yield and Farmers' Livelihood in India. Rajendranagar, Hyderabad- 500 030, Telangana, INDIA
- Lakhani & Geete (2024) Transforming Agriculture: Role of Natural Farming Models in India's Sustainable Future International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706.
- Economic Survey 2021-22 government of India page -250
- https://naturalfarming.dac.gov.in/NaturalFarming/Concept
- https://www.business-standard.com/industry/agriculture/cabinet-approves-rs-2481-crore-national-mission-on-natural-farming
- Arthare&Roy (2024) Journey of natural farming The pathway towards sustainable agriculture 1 ICAR-Agricultural Technology Application Research Institute, Pune, Maharashtra 411 005
- Neelam Patel; Bruno Dorin and Ranveer Nagaich Year of Publication: 2022 A New Paradigm for Indian Agriculture from Agroindustry to Agro ecology Publishing Agency: NITI Aayog ISBN: 978-81-953811-7-3
- C, Dhivya, Murugan P P, Senthilkumar M, and Arunkumar R.(2024.) "Opportunities and Challenges on Natural Farming"..Asian Journal of Soil Science and Plant Nutrition Volume 10, Issue 4, Page 301-309, 2024; ISSN: 2456-968
- https://vajiramandravi.com/upsc-daily-current-affairs/mains-articles/pros-and-cons-of-natural-farming-in-india/
- SR Reddy(2018) Principles of agronomy Kalyani publishers (book) ISBN-9789327297942

Soil Health Crisis in India

Prof. Priya Kumari[1] & Ayushi Yadav[2]

ABSTRACT

Soil is a very important and sensitive resource of any country as the crop yield of a nation on which the whole population depends is directly linked to the soil health. The dependence of a nation on others for meeting the demand of its population for food and other crop products is a matter of great concern. The Green Revolution in India intensified agricultural productivity to meet urgent public needs and for the commercialization of crop products. Indeed, Green Revolution helped in achieving goal up to a certain level with the use of high input of chemicals in the form of fertilizers, pesticides, fungicides, insecticides, nematicides and weedicides along with intense irrigation practices. After Green Revolution, the decline in crop yield in spite of fertilizer application reveals the loss of soil fertility. Toxic chemicals in soil affected the life of beneficial soil organisms, which indeed are responsible for maintaining soil fertility. Further, these chemicals polluted groundwater, air and adversely affected human and animal health. Hence, restoration of soil health and environment is an urgent need. Avoidance of chemical fertilizers and use of natural fertilizers like biofertilizers, vermicompost, farm yard and green manure, and biopesticides can be a sustainable approach in achieving the crop productivity along with nourishing the soil and environment. Present chapter discusses about the effects of Green Revolution on soil health in India and suggests for consideration of techniques with eco-friendly approaches to heal soil loss and to manage soil fertility for sustainable agriculture. Soil health crisis in India stems from a skewed fertilizer that heavily subsidizes urea, leading to excessive nitrogen application. The current NPK ratio of 7.7:3.1:1 stands in stark contrast to the ideal 4:2:1 ratio, reflecting a severe nutrient imbalance in agricultural soils. This over-reliance on nitrogen-based fertilizers, coupled with insufficient use of phosphorus, potassium, micronutrients, and organic manure, has triggered a vicious cycle of declining soil productivity. As India aims to ensure food security for its growing population, addressing this soil health crisis through balanced nutrient management and policy reforms demands urgent attention.

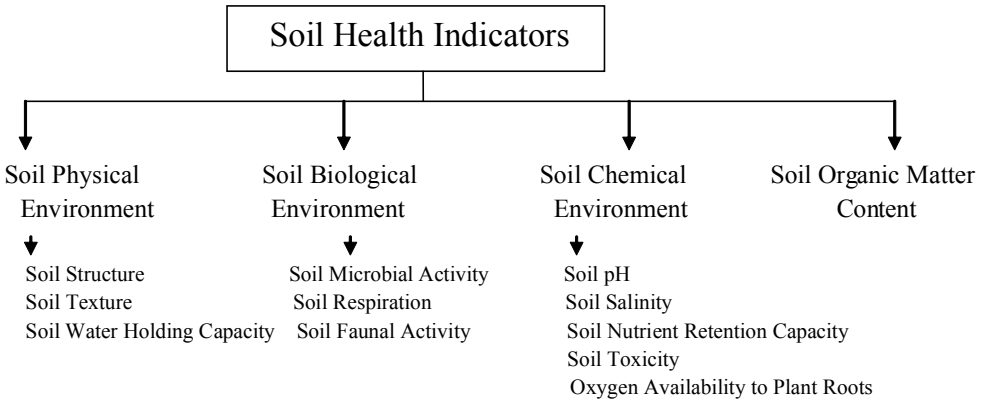
Keywords: *Green Revolution, Soil Health, Sustainable Agriculture, Productivity Restoration*

Introduction

India's agriculture sustainability faces a critical challenge with soil health deterioration. Recent assessments reveal that less than 5% of Indian soils have high nitrogen levels, while only 20%

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contain sufficient organic carbon. The current fertilizer subsidy system, predominantly focused on urea, has led to imbalanced nutrient usage, with excessive nitrogen and insufficient phosphorus and potassium application. This nutrient imbalance not only reduces agricultural productivity but also contributes to environmental degradation. Urgent systemic reforms are needed to address these challenges and ensure long-term soil health and agricultural sustainability. The Desertification and Land Degradation Atlas of India (SAC 2021) indicates the current extent of land degradation to be 97.85 million hectares covering 29.77% of the geographical area of the country during 2018-19. Semi-arid and dry sub-humid regions are the most impacted, with states like Rajasthan, Maharashtra, Gujarat, and Telangana showing significant degradation. Rajasthan alone has over 21 million hectares classified as degraded, primarily due to wind erosion in its arid zones. Desertification processes have increased, with 83.69 million hectares now classified as drylands undergoing desertification, a net rise of over 1 million hectares since 2003-05.



Objectives

1. To analyze the situation of Soil Health in India
2. To analyze the role of soil in maintaining India's Agricultural Prosperity
3. To analyze the measures India can adopt for Soil Health Restoration and Conservation

Role of Soil in Maintaining India's Agricultural Prosperity

Foundation of Food Security and Crop Productivity

Soil is the fundamental medium for plant growth, directly impacting crop yields, nutrient absorption, and overall agricultural output. The inherent fertility of Indian soils is critical for sustaining high productivity of staple crops like rice, wheat, and pulses, thereby ensuring food security for India's 1.4 billion people. The nation's diverse soil types, such as the rich alluvial soils of the Indo-Gangetic plains and the water-retentive black soils of Maharashtra, facilitate varied cropping patterns. As underscored by the FAO, 95% of global food production relies on soil, making its preservation paramount for India's agricultural sustainability. This robust foundation contributed to record foodgrain production of 329.7 million tonnes and oilseeds reaching 41.4 million tonnes in 2022-23.

Nutrient Cycling, Water Retention, and Climate Change Mitigation

Healthy soil functions as a vital natural nutrient reservoir, providing essential elements like nitrogen, phosphorus, and potassium crucial for plant growth. The vibrant microbial activity within soil is indispensable for decomposing organic matter, fixing atmospheric nitrogen, and maintaining fertility, underpinning initiatives like India's organic farming movement through vermiculture and biofertilizers. Efficient nutrient cycling is key to sustained agricultural productivity and reduces reliance on chemical fertilizers.

Furthermore, soil acts as a natural sponge, regulating water infiltration, retention, and drainage to ensure stable crop growth. High organic matter content significantly enhances water-holding capacity, curbing irrigation demand and bolstering crop resilience against erratic monsoons. In drought-prone regions such as Rajasthan and Bundelkhand, soil moisture conservation practices like mulching and cover cropping are vital for maintaining agricultural output. Proper soil structure also prevents waterlogging and root diseases in areas prone to high rainfall.

Beyond these roles, soil plays a critical part in absorbing and storing carbon, thereby mitigating climate change impacts on agriculture. Carbon-rich soils buffer against extreme weather by stabilizing temperatures and preventing desertification. Practices such as agroforestry and conservation agriculture actively enhance soil carbon sequestration, contributing to a reduction in greenhouse gas emissions. The vitality of India's agricultural soils directly influences its capacity to combat climate change and ensure long-term productivity, with a technical potential to absorb 3–8 gigatons of CO, annually for decades, helping bridge the gap to climate stabilization.

Biodiversity, Pest Control, and Economic Stability

Healthy soils support a rich and diverse ecosystem of beneficial microorganisms, fungi, and insects that naturally control pests. Soil-dwelling organisms like earthworms and mycorrhizal fungi enhance soil aeration and nutrient uptake for crops. A balanced soil ecosystem diminishes the need for chemical pesticides, fostering more sustainable and cost-effective agriculture; a recent study confirmed that farms with high soil biodiversity experienced fewer pest outbreaks compared to degraded soils.

Economically, soil fertility directly dictates agricultural income, as healthy soils lead to higher crop yields and better market prices. Given that approximately two-thirds of the Indian population relies on agriculture, soil health is paramount for their economic stability and employment prospects. Fertile soil reduces input costs by decreasing dependence on fertilizers and pesticides, thereby increasing farmers' profit margins. Moreover, soil-based agro-industries, including organic farming and compost production, create valuable livelihood opportunities across rural India.

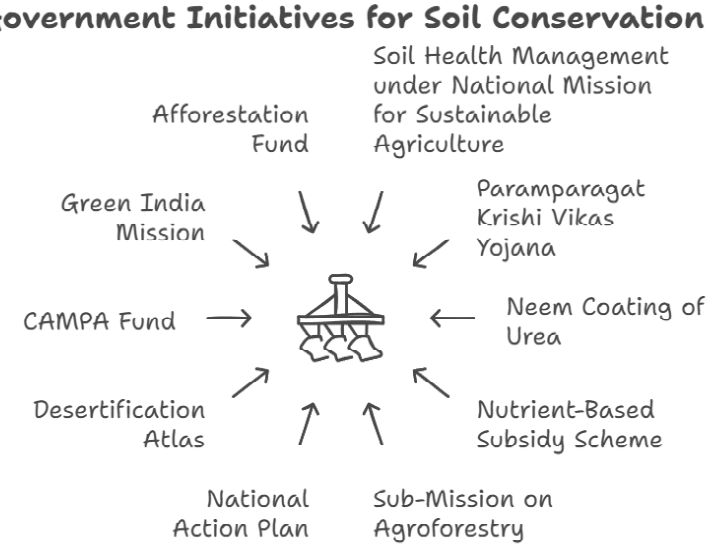
Key Factors Contributing to India's Soil Health Crisis

- **Unsustainable Agricultural Practices-** Excessive use of chemical fertilizers, pesticides, and monocropping has degraded soil fertility and caused nutrient imbalances. Intensive farming in states like Punjab and Haryana, driven by MSP-backed wheat-rice cycles, has led to severe soil degradation. Additionally, over-tillage and deep plowing break down soil structure, reducing its ability to retain water and nutrients. The 2022 State of India's Environment Report found that 30% of India's land faces degradation.

- **Declining Organic Carbon and Soil Microbial Life-** Soil organic carban (SOC) is crucial for fertility, but rapid depletion due to reduced organic matter incorporation has worsened soil health. Burning of crop residues, particularly in the Indo-Gangetic belt, eliminates organic matter instead of returning nutrients to the soil. Over-reliance on synthetic fertilizers disrupts microbial ecosystems, leading to lower nutrient cycling. Deforestation and encroachment for urbanization further strip soil of natural organic content. The Soil Organic Carbon (SOC) content in India has come down to 0.3% from 1% in the past 70 years. In states like Punjab, only 6.9% of soils had high organic carbon, and this percentage declined further in 2024-25.
- **Soil Erosion and Desertification-** Rampant deforestation, overgrazing, and poor water management contribute to severe soil erosion and land degradation, especially in semi-arid regions. Unsustainable mining and industrial activities also strip topsoil, reducing land's agricultural potential. According to the Desertification and Land Degradation Atlas of India (SAC 2021), the current extent of land degradation in India is 97.85 million hectares, which represents approximately 29.77% of the country's total geographical area.
- **Over Extraction and Salinization Due to Poor Irrigation Practices-** Unscientific irrigation, including excessive groundwater extraction and flood irrigation, leads to soil salinity, alkalinity, and waterlogging. In states like Punjab and Haryana, continuous irrigation without proper drainage has caused secondary salinization. Canal irrigation without proper management also leads to waterlogging, reducing soil aeration and microbial activity. The total annual groundwater extraction for the entire country in 2022 has been estimated as 239.16 bcm, with agriculture being the predominant consumer of groundwater resources, accounting for about 87% of the total annual groundwater extraction. India's 6.7 Mha of salt-affected land results in a loss of 11.18 million tonnes of crops, valued at around ₹ 150.17 billion.
- **Climate Change and Extreme Weather Events-** Unpredictable weather patterns, including erratic monsoons and rising temperatures, have worsened soil degradation through droughts, floods, and heat stress. Intense rainfall events lead to runoff, washing away topsoil and depleting nutrients. Rising temper atures accelerate soil carbon loss, reducing long-term sustainability of agriculture. Due to climate change, high to very high soil erosion zones are projected to rise from 35.3% to 40.3% by the century's end. For instance, the 2023 Himachal Pradesh floods led to significant topsoil loss in agricultural areas.
- **Pollution from Industrial and Urban Waste-** Unchecked dumping of heavy metals, industrial effluents, and plastic waste has led to toxic contamination of agricultural soils. In peri-urban areas, untreated sewage sludge and landfill leachates degrade soil structure and introduce hazardous chemicals. Groundwater pollution from landfills and chemical waste further affects soil chemistry. India's farmland is heavily contaminated by heavy metals like lead, cadmium, and arsenic.
- **Lack of Effective Policy Implementation and Awareness-** Despite schemes like the Soil Health Card (SHC) program, adoption of sustainable practices remains low due to inadequate farmer awareness and follow-up. For the 2024 fiscal year, India allocated one-ninth of its total agricultural budget to fertilizer subsidies. But many farmers still lack access to real-time soil quality data, limiting their ability to optimize fertilizer use. Government subsidies on urea encourage overuse, despite recommendations for balanced fertilizer application. The

existing NPK ratio of 7.7:3.1:1 deviates significantly from the ideal 4:2:1, highlighting a severe nutrient imbalance in soils.

- **Loss of Traditional Agroecological Practices-** Traditional organic farming methods, including green manure, crop rotation, and agroforestry, have declined due to the push for high-yield, chemical-dependent crops. Indigenous soil management techniques, such as "Zaï pits" in Rajasthan and "Vermiculture" in the Northeast, are being replaced by intensive, mechanized agriculture. The marginalization of indigenous knowledge, particularly among small and tribal farmers, reduces resilience to soil degradation.
- **Impact of Genetically Modified (GM) Crops and High-Yield Varieties-** The introduction of GM crops and high-yielding varieties (HYVs) has intensified nutrient depletion, as these crops demand higher fertilizer inputs. Bt cotton, for instance, has been linked to declining soil biodiversity in Maharashtra and Telangana. The rapid expansion of HYVs has also led to loss of traditional, resilient crop varieties that maintain better soil structure.



Measures India Can Adopt for Soil Health Restoration and Conservation

- **Promoting Integrated Nutrient Management (INM) for Balanced Fertilization-** India must shift from excessive chemical fertilizer use to Integrated Nutrient Management, combining organic manure, biofertilizers, and judicious synthetic inputs. Promoting Nano Urea and organic alternatives can help to reduce fertilizer overuse. Soil Health Cards (SHC) and Paramparagat Krishi Vikas Yojana (PKVY) should be linked to encourage bio-fertilizer adoption. Large-scale composting units in rural areas can enhance organic carbon levels in degraded soils.
- **Expanding Agroforestry and Perennial Crop Systems-** Integrating trees with agriculture through National Agroforestry Policy (NAP) enhances soil organic carbon, prevents erosion, and boosts farm income. Crops like alley-cropped millet and legume plantations can

rejuvenate degraded lands while maintaining productivity. Agroforestry, already popular in Karnataka and Odisha, should be scaled up nationwide. Linking Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) for soil conservation works can support large-scale afforestation on degraded farmlands.

- **Encouraging Zero-Tillage and Conservation Agriculture-** Shifting to zero-tillage farming reduces soil erosion, enhances microbial activity, and conserves moisture, especially in wheat-rice cropping systems. Happy Seeder technology in Punjab and Haryana has successfully reduced stubble burning while improving soil health. Direct Seeded Rice (DSR) method in paddy farming lowers groundwater usage and preserves soil structure. Conservation agriculture, backed by the National Mission for Sustainable Agriculture (NMSA), must be expanded to semi-arid regions. Brazil's success in no-till soybean farming can be adapted to India's pulse and cereal cultivation.
- **Restoring Degraded Lands Through Agroecological Approaches-** Soil restoration efforts must adopt agroecology-based models, incorporating natural ecosystems to improve soil structure and fertility. Encouraging intercropping and crop rotation with nitrogen-fixing plants like pulses and legumes can naturally replenish nutrients. Reviving techniques like Rajasthan's Zaï pit technique can successfully reverse soil erosion. These approaches should be mainstreamed through Watershed Development Component (WDC-PMKSY) under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).
- **Implementing Controlled Irrigation and Preventing Salinization-** Over-irrigation has led to soil salinity and waterlogging in the Indo-Gangetic plains; adopting drip and sprinkler irrigation can mitigate these effects. Micro-irrigation techniques under Pradhan Mantri Krishi Sinchayee Yojana can be promoted to a wider extent to conserve soil moisture while reducing erosion. Conjunctive use of rainwater harvesting and surface water irrigation will prevent groundwater depletion. Using salt-tolerant crop varieties in saline-affected areas (as done in coastal Gujarat) can restore productivity.
- **Strengthening Soil Biodiversity and Microbial Rejuvenation-** Enhancing soil microbial diversity through bioinoculants, vermiculture, and mycorrhizal fungi can improve soil fertility and plant resilience. Integrated Farming Systems (IFS) that combine livestock, cropping, and fish farming ensure natural nutrient cycling. Decomposers like Pusa Bio-Decomposer (IARI innovation) must be widely adopted for organic residue recycling. Soil-friendly techniques, such as Fukuoka's natural farming, have shown promising results.
- **Combating Soil Erosion Through Terracing and Grassland Regeneration-** Hilly and semi-arid regions require terracing, check dams, and vegetative barriers to prevent topsoil loss. Encouraging community-led watershed management (as done in Ralegan Siddhi, Maharashtra) can restore eroded landscapes. Grassland restoration efforts in Gujarat's Banni Grasslands provide a model for reviving degraded pasturelands. Linking Compensatory Afforestation (CAMPA funds) with soil conservation projects can ensure sustainable land use.
- **Strengthening Policy Implementation and Farmer Awareness-** Capacity-building initiatives through Krishi Vigyan Kendras (KVKs) and FPOs (Farmer Producer Organizations) must be strengthened. Linking Soil Health Card Scheme with Direct Benefit Transfer (DBT) can ensure customized fertilizer application for individual farms. A strong

policy push under the National Project on Soil Health and Fertility sub-scheme of National Mission for Sustainable Agriculture (NMSA) can coordinate state and central efforts effectively.

- **Preventing Industrial and Urban Soil Pollution-** Industrial effluents and untreated urban waste have led to toxic contamination of agricultural soils, especially near cities. Implementing strict soil quality monitoring under the CPCB guidelines can prevent heavy metal accumulation. Promoting phytoremediation (using plants to absorb toxins) can rehabilitate contaminated soils in peri-urban areas. Initiatives like Tamil Nadu's innovative biochar projects and Kolkata's East Kolkata Wetlands-based agriculture show how urban waste can be transformed into soil-enriching resources. Linking Smart Cities Mission with urban soil restoration projects can ensure sustainable urban farming.
- **Encouraging Farmers to Adopt Regenerative and Natural Farming-** Regenerative farming techniques, such as Zero Budget Natural Farming (ZBNF) and permaculture, can enhance soil health while reducing external inputs. Andhra Pradesh has demonstrated the feasibility of scaling regenerative practices. Encouraging cover cropping and mulching can improve soil structure and prevent nutrient depletion. Policy incentives under National Mission for Organic Farming (NMOF) should be expanded for wider adoption.

Conclusion

India's soil health crisis threatens long-term agricultural sustainability, food security, and rural livelihoods and requires a collaborative approach that drives the Food-Energy-Water Nexus. It requires a shift from chemical-intensive farming to balanced nutrient management, organic amendments, and climate-resilient practices. Policy reforms, including rationalizing fertilizer subsidies and promoting agroecological approaches, are essential for restoring soil fertility. Strengthening farmer awareness and technological interventions like Soil Health Cards can drive sustainable soil management.

References

- Arora VK, Singh CB, Sidhu AS, Thind SS (2011) Irrigation, tillage and mulching effects on soybean yield and water productivity in relation to soil texture. Agric Water Manag 98 (4):563–568
- Backman PA, Sikora RA (2008) An emerging tool for biological control. Biol Control 46(1):1–3 Bhattacharyya PN, Jha DK (2012) Plant growth-promoting rhizobacteria (PGPR): emergence in agriculture. World J Microbiol Biotechnol 28(4):1327–1350
- Chenu C, Rumpel C, Lehmann J (2015) Methods for studying soil organic matter: nature, dynamics, spatial accessibility, and interactions with minerals. In: Paul EA (ed) Soil microbiology, ecology and biochemistry, 4th edn. Academic Press, Amsterdam, pp 383–419
- Damodaran T, Sah V, Rai RB, Sharma DK, Mishra VK, Jha SK, Kannan R (2013) Isolation of salt tolerant endophytic and rhizospheric bacteria by natural selection and screening for promising plant growth-promoting rhizobacteria (PGPR) and growth vigour in tomato under sodic environment. Afr J Microbiol Res 7(44):5082–5089
- Karmakar S, Brahmachari K, Gangopadhyay A (2013) Studies on agricultural waste management through preparation and utilization of organic manures for maintaining soil quality. Afr J Agric Res 8:6351–6358
- Khosro M, Yousef S (2012) Bacterial bio-fertilizers for sustainable crop production: a review. APRN J Agric Biol Sci 7(5):237–308
- https://drishtiias.in
- https://agriwelfare.gov.in
- https://www.india.gov.in

Understanding the Pathway of Energy Transition to Tackle Climate Crisis

Dr. Priyanka Gaur[1]

ABSTRACT

Climate change affects the environment in many different ways, including rising temperatures, sea level rise, drought, flooding, and more. These events affect things that we depend upon and value like water, energy, transportation, wildlife, agriculture, ecosystems, and human health. In a growing concern about the climate; numerous voices stress that, in order to overcome the climate crisis, the transition to a low-carbon society is the most reasonable path to follow. Oil had a significant influence in past wars. During World War II, the US's decision to cut oil supply to Japan led to Japan attacking Pearl Harbor and the US subsequently bombing two major cities in Japan.

This paper examines India's current energy landscape in the context of its rapid economic growth and commitment to decarbonization. It also highlights the booming energy demand driven by India's large and growing population, juxtaposing this with the challenges of phasing out coal and meeting its net zero target by 2070. It explores the significant potential for a green technology market and the increasing investments in renewable energy, while also addressing the climate hazards already impacting India. Ultimately, it briefly analyzes India's ambitious energy transition plans, including the push for Nuclear and renewable energy and underscores the unrivaled opportunities for growth and innovation in its evolving energy sector.

Keywords: *Net Zero Emission, climate Change, Energy Transition, Sustainability*

Introduction

Climate change is a paramount global issue, inextricably linked with adaptation, mitigation, and sustainable development. As UNDP defines, adaptation involves actions to reduce vulnerability to existing or projected climate impacts like extreme weather, sea-level rise, or food and water insecurity. Lower-income nations, including India, are highly climate-vulnerable, necessitating urgent adaptive agricultural strategies and conservation efforts to protect natural habitats and bio-resources. Under the UNFCCC, all countries are tasked with defining their unique energy transition pathways.

India's vision of a 'Viksit Bharat' (Developed India) by 2047, coupled with its Net Zero carbon emissions target by 2070, guides its pursuit of robust, inclusive, and environmentally sustainable

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economic growth. Achieving stable, affordable energy on a low-carbon path is crucial for this development. This presents a significant challenge, as cleaner energy demands viable battery storage and access to critical minerals, making stable supply complex. Balancing development with decarbonization, especially when domestically financed, is a delicate act.

The global energy transition, from fossil fuels to renewables like wind and solar, is vital for reducing carbon emissions. This sustainable future requires a blend of technological innovation, strategic economic investments, comprehensive policy reforms, and robust international cooperation.

This paper scrutinizes India's current energy landscape, considering its rapid economic growth and decarbonization commitment. It highlights surging energy demand from a large population, juxtaposed against the challenges of phasing out coal and meeting the 2070 net-zero target. The study explores the vast potential of a green technology market and escalating renewable energy investments, while also addressing existing climate hazards in India. It briefly analyzes India's ambitious energy transition plans, including a push for nuclear and renewable energy, underscoring unparalleled growth and innovation opportunities. Crucially, the paper integrates economic, social, and technological dimensions into a comprehensive framework. It emphasizes sustainable mining for critical materials (lithium, cobalt) to avoid new environmental or social issues and provides an in-depth analysis of Antonio Guterres's "five-point energy plan," advocating for global cooperation and equitable renewable energy access to overcome transition challenges.

Benefits of Green Energy Transition

The move to green energy is described in the sources as both an environmental necessity and an economic opportunity for India. This transition involves embracing renewable power sources like solar and wind to reduce pollution, improve public health, and boost energy independence.

India, being the world's third-largest producer of greenhouse gas emissions, plays an essential role in the global energy transition. The country is particularly vulnerable to the effects of climate change, including extreme weather events, increasing sea levels, and unpredictable rainfall. With the global carbon budget rapidly decreasing and projected to be depleted by 2029, the need for India to urgently reduce carbon emissions is highlighted. The transition to green energy, by replacing fossil fuels with renewable energy options, is a key way for India to significantly reduce its greenhouse gas emissions, contributing to global climate change mitigation. Furthermore, reducing the reliance on fossil fuels will help mitigate the severe air pollution prevalent in many Indian cities, leading to improvements in public health and quality of life. Hartek Group blog post[2]outlines the significant advantages for India in shifting towards renewable energy. It is structured around such key themes that are as follows-

Economic Growth

The transition to green energy in India presents a significant economic opportunity. Investment in renewable energy infrastructure, such as solar and wind farms, can drive economic growth and create millions of jobs. The renewable energy sector, in general, is highlighted as having the potential to foster economic expansion. Furthermore, the source notes that renewable energy sources can be cost-effectively integrated with the grid. Studies by TERI indicate that the levelized cost of electricity

from solar and wind has already fallen below the tariff for new coal-based power, making renewables not only environmental friendly but also economically viable. This cost-effectiveness is presented as a key economic benefit of the green energy transition.

The pursuit of 450 GW of renewable energy by 2030 is also projected to establish India as a global leader in the green energy industry. This leadership position can lead to further economic benefits through technological advancements and industrial development.

Mitigating Climate Change and Pollution

The transition to green energy in India is presented as a crucial strategy for mitigating climate change. As the world's third-largest producer of greenhouse gas emissions, India's efforts in this area are essential for the global energy transition. India is particularly vulnerable to the effects of climate change, such as extreme weather events, rising sea levels, and unpredictable rainfall.

Several studies highlight the urgency of this transition by mentioning the rapidly decreasing global carbon budget. According to the Climate Change Tracker (2023), the remaining carbon budget for a 50% chance of keeping global temperature rise below 1.5°C is projected to be depleted by 2029, emphasizing the need for countries like India to urgently reduce carbon emissions.

Replacing fossil fuels with renewable energy options is a key way India can significantly reduce its greenhouse gas emissions, contributing to global efforts to combat climate change. Reducing the reliance on coal and other fossil fuels will also help mitigate the severe air pollution prevalent in many Indian cities, leading to improvements in public health.

India has set ambitious targets for renewable energy development, aiming to produce 450 GW of renewable energy by 2030, which is expected to lower greenhouse gas emissions and establish the nation as a global leader in the green energy industry. This transition is driven by advancements in energy storage systems and solar energy technology.

Furthermore, India's commitment to green energy aligns with its international obligations as a signatory to the Paris Agreement, demonstrating its commitment to reducing carbon emissions and increasing the share of renewables in its energy mix. Making significant progress in this area can strengthen India's leadership in global climate negotiations.

Energy Security and Independence

The green energy transition is also crucial for energy security and independence. India's substantial reliance on imported energy makes it vulnerable to geopolitical tensions and volatility in the global energy market. By utilizing local renewable resources like biopower, sun, wind, and modest hydropower, a reliable and secure energy supply can be ensured. The ambitious renewable energy development targets from 2023 to 2032, with projected annual growth rates of 21% for solar, 12% for wind, 1% for small hydro, and 4% for biopower, underscore India's commitment to energy self-sufficiency. Unlike limited fossil fuel reserves, renewable energy sources like solar and wind power are infinite. Adopting green energy positions India to become energy independent without the limitations of running out of fossil resources in the future.

Scientific Innovation and Industrial Growth

The transition is expected to spark a surge in scientific advancement and industrial growth, particularly in energy storage and renewable energy sources. The global market for battery energy storage systems is projected to grow significantly, with India playing a significant role in the development of lithium-ion batteries and other storage solutions. These innovations will make renewable energy more viable and reliable.

Improved Social Benefits and Public Health

Beyond environmental and economic benefits, the green energy transition can lead to profound social benefits, particularly in terms of public health, by reducing air pollution from fossil fuel combustion, which causes various health issues. Furthermore, renewable energy projects, especially in rural areas, can enhance energy access and reduce energy poverty. Solar micro grids and small-hydro projects can provide reliable electricity to remote communities, improving quality of life and enabling economic activities, while also empowering local communities through job creation and economic development.

In conclusion, the green energy transition in India presents a multifaceted opportunity to mitigate climate change and pollution, stimulate economic growth and job creation, enhance energy security, improve public health, and align with global climate goals. Achieving these benefits requires concerted efforts from the government, industry, and society, with supportive policies and investments in renewable energy and storage technologies being essential.

Challenges of Energy Transition

This papers discuss several challenges in the way of transition to renewable sources of energy. These challenges are multifaceted and span across economic, social, technical, policy, reliability, and public acceptance domains. Here's a breakdown of these challenges based on the study:

Mobilizing capital is a significant hurdle, as many clean energy technologies require high upfront investment costs, which may be difficult for most developing countries to bear. Furthermore, there is a lack of sufficient international support for developing countries, hindering their transition to renewable energy sources without external assistance. Developed countries need to fulfil their commitment to providing climate finance to developing countries to address this challenge.

Ensuring a **just transition** is crucial to provide decent work opportunities and social support for individuals whose livelihoods may be negatively impacted by the shift away from fossil fuels. Globally, a large number of people are employed in the fossil fuel industry, and the transition process carries a risk of destabilizing local economies. Governments need to develop comprehensive plans that protect affected workers and communities through measures like retraining programs, investment in new industries, and social safety nets.

There are **technical challenges** associated with the transition, including the need for significant upgrades to infrastructure, such as energy storage and transmission systems, which can be expensive. Investing in research and development is essential to drive down the costs of renewable energy

technologies and improve their efficiency. Building the necessary energy infrastructure, including grid upgrades, energy storage, and electric vehicle charging stations, also requires substantial investment.

The transition **necessitates significant policy and regulatory changes**, including reforms to subsidy systems, pricing mechanisms, and energy markets. Governments need to set ambitious targets for renewable energy deployment and create policy frameworks that incentivize investment in clean energy.

The **reliability and intermittency** of renewable sources pose a challenge, as they often cannot guarantee a stable electricity supply, unlike fossil fuels. Addressing this requires investments in energy storage and backup power systems to ensure a reliable supply.

Public acceptance can also be a barrier, as the transition may face resistance from some stakeholders, including those who depend on fossil fuels for their livelihoods or those concerned about the visual and environmental impacts of renewable energy infrastructure.

It can be concludes that while the transition towards renewables is an attractive option to mitigate the risks of fossil fuel-based energy, it requires access to affordable finance and international support to enable a just transition through measures like retraining and infrastructure investments. The lack of access to affordable and reliable energy is presented as a fundamental challenge to sustainable economic development. The global energy crisis, driven by factors like the Russia-Ukraine war and dependence on finite fossil fuels, further underscores the urgency and complexity of this transition.

The Path a Head

India has endorsed emission reduction commitments, setting a net-zero target for 2070. This announcement was made by PM Modi during COP26 in Glasgow. While this target is further in time compared to the usual 2050 target set by most G20 countries, it is still considered an important step.

Policy and Regulatory Support

Achieving the benefits of the green energy transition requires strong policy and regulatory support from the government. This includes implementing policies that promote renewable energy development, provide financial incentives and subsidies like tax breaks, grants, and low-interest loans, and remove barriers to investment. A robust regulatory framework is essential for integrating renewable energy into the national grid, ensuring fair pricing, and supporting the development of energy storage solutions, which can create a favorable environment for investors.

Despite the long-term target, India has made notable progress in implementing its climate agenda, primarily by increasing the share of renewables in energy production and enhancing energy efficiency. The country boasts one of the lowest energy intensities among emerging countries. Some of the quantified objectives and measures in place include:

- Allocation of $2.6 billion from the Union Budget 2022-2023 for a Performance-Linked Incentive scheme to boost manufacturing of high-efficiency solar modules.
- Plans to establish 21 new nuclear power reactors with a total capacity of 22 GW by 2031.

- A 45% cut in carbon intensity by the end of the decade (compared to the 2005 level).
- A target of achieving a 50% share of renewables in total power capacity by 2030 (up to 500 GW).

International Obligations

India's commitment to green energy strongly aligns with its international obligations under the Paris Agreement, demonstrating its dedication to reducing carbon emissions and increasing renewable energy's share in its energy mix. Progress in this domain is crucial for strengthening India's leadership in global climate negotiations, with access to international climate finance being essential for large-scale renewable projects. India aims for 450 GW of renewable energy by 2030, having already exceeded 150 GW with an annual growth of around 9%. Companies like Hartek Group are actively contributing; as an EPC company, Hartek has linked 10 GW of solar to the grid, and its subsidiary, Hartek Solar, has installed over 100 MW of rooftop and floating solar systems nationwide, significantly advancing India's sustainable energy future.

India's climate policy prioritizes poverty alleviation, a critical concern for millions. Given its robust demographics and strong economic growth—projected at around 6% annual GDP growth, making it the fastest-growing G20 economy—achieving the 2070 net-zero target demands colossal infrastructure investments to transition from fossil fuels to clean energy. As India focuses on leveraging GDP growth, peaks in emissions and energy consumption are yet to be seen. While its high emissions volume can be attributed to its large population, posing questions about rapid adaptation willingness and ability, India also presents unique opportunities in the energy sector.

The transition to renewables is an attractive hedge against fossil fuel risks, but it necessitates affordable finance and international support for a just transition. The study highlights the dilemma of balancing economic growth with decarbonization. India's substantial reliance on coal, comprising 55% of its power mix, remains a massive challenge. Nevertheless, the swift development of high-tech industries and infrastructure offers a fertile ground for cultivating a highly competitive domestic market for clean technologies. Ultimately, achieving India's 2070 net-zero target will require sustained efforts in policy, finance, technology, and international cooperation, all while meticulously balancing economic growth and poverty alleviation.

Conclusion

The study underscores the necessity for India to pursue a diversified energy mix comprising renewables (solar, wind, hydro), green hydrogen, nuclear, and biofuels to minimize risks associated with energy systems and to follow low-emission pathways. It also notes that thermal power, particularly coal-based plants, will continue to play a significant role in providing the base load required to support the extensive deployment of intermittent renewable energy sources. Interestingly, the document suggests that the risks inherent in ensuring energy security can also be seen as opportunities for innovation, adaptation, and growth for India. In the short to medium term, it advocates for a focus on actively adopting clean coal technologies and promoting government initiatives in this area, including coal gasification, methane extraction, and carbon capture and storage. The adoption of ultra-supercritical technologies for coal power plants is also highlighted as a means to lower emissions and enhance efficiency.

While acknowledging India's successful growth in renewable energy, especially solar power, the report cautions against shifting import dependence from petroleum to solar PV panels and critical minerals. It stresses the need for diversified energy sources. Furthermore, it points out that many technologies needed for global Net Zero are currently unavailable commercially, necessitating enhanced international cooperation in research and development across various clean energy domains. The conclusion strongly emphasizes that the availability, affordability, and accessibility of financial resources will be the driving force behind the green transition. While India has primarily relied on domestic resources, it is crucial for developed countries to provide and mobilize finance for developing nations in line with UNFCCC and Paris Agreement objectives, and the New Collective Quantified Goal negotiations must reflect this need. Finally, the document argues for a balanced approach to climate change, suggesting that framing it solely as a climate emergency can detract from equally critical development issues and cause unnecessary panic[3'4], advocating for a focus on both near-term human welfare and long-term climate management.

In summary, India faces a complex energy transition characterized by the need to balance rapid economic growth with ambitious climate goals. They highlight the importance of diversifying the energy mix, leveraging renewable energy sources while acknowledging their challenges, and the crucial role of finance and technological advancements. Both also point to the significant economic opportunities inherent in this transition, positioning India as a potentially major player in the global green economy. However, they also underscore the challenges related to financing, technology access, and the need for a balanced approach that considers both climate action and immediate developmental priorities.

References

- Olson, F. Lenzmann, The social and economic consequences of the fossil fuel supply chain, MRS Energy Sustain. 3 (2016) E6, https://doi.org/10.1557/ mre.2016.7.
- D.H. Vo, Q. Tran, T. Tran, Economic growth, renewable energy and financial development in the CPTPP countries, PLoS One 17 (6) (2022) e0268631, https:// doi.org/10.1371/journal.pone.0268631. M. Ahmad, Z. Ahmed, B. Gavurova, J. Ol´ ah, Financial risk, renewable energy technology budgets, and environmental sustainability: is going green possible? Front. Environ. Sci. 10 (2022) 909190 https://doi.org/10.3389/ fenvs.2022.909190.
- H. Yu, I. Zahidi, C.M. Fai, D. Liang, D.Ø. Madsen, Harvesting the Sky: a new horizon in photocatalytic hydrogen production, Results Eng. 21 (2024) 101852.
- Hulme, M. (2023). Climate change isn't everything: Liberating climate politics from alarmism. John Wiley & Sons.
- J. Kumar, C. R, M.A. Majid, Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities, Energ Sustain. Soc. 10 (2020) 2, https:// doi.org/10.1186/s13705- 019-0232-1.
- J.M. Halley, K.S. Van Houtan, N. Mantua, How survival curves affect populations' vulnerability to climate change, PLoS One 13 (9) (2018) e0203124, https://doi. org/10.1371/journal.pone.0203124. [10] Lv, Y. Transitioning to Sustainable Energy: Opportunities, Challenges, and the Potential of Blockchain Technology. Front. Energy Res., 11, 1258044. https://doi. org/10.3389/fenrg.2023.1258044.
- M.A. Bhuiyan, Q. Zhang, V. Khare, A. Mikhaylov, G. Pinter, X. Huang, Renewable energy consumption and economic growth nexus—a systematic literature review, Front. Environ. Sci. 10 (2022) 878394, https://doi.org/ 10.3389/ fenvs.2022.878394.

- M. Hafner, S. Tagliapietra, The global energy transition: a review of the existing literature, in: M. Hafner, S. Tagliapietra (Eds.), The Geopolitics of the Global Energy Transition, Lecture Notes in Energy, vol. 73, Springer, Cham, 2020, https:// doi.org/10.1007/978-3-030-39066-2_1.
- M. Mahdavi, A. Awaafo, F. Jurado, D. Vera, R.A.V. Ramos, Wind, solar and biogas power generation in water-stressed areas of Morocco considering water and biomass availability constraints and carbon emission limits, Energy 282 (2023) 128756.
- M. Mahdavi, F. Jurado, R.A.V. Ramos, A. Awaafo, Hybrid biomass, solar and wind electricity generation in rural areas of Fez-Meknes region in Morocco considering water consumption of animals and anaerobic digester, Appl. Energy 343 (2023) 121253.
- M. Mahdavi, K. Schmitt, R.A.V. Ramos, H.H. Alhelou, Role of hydrocarbons and renewable energies in Iran's energy matrix focusing on bioenergy, IET Renew. Power Gener. 16 (15) (2022) 3384–3405.
- M. Mahdavi, D. Vera, Importance of renewable energy sources and agricultural biomass in providing primary energy demand for Morocco, Int. J. Hydrogen Energy (2023).
- O. Janikowska, J. Kulczycka, Impact of minerals policy on sustainable development of mining sector – a comparative assessment of selected EU countries, Miner Econ 34 (2021) 305–314, https://doi.org/10.1007/ s13563-021-00248-5.
- P. Christmann, Mineral resource governance in the 21st century and a sustainable European union, Miner Econ 34 (2021) 187–208, https://doi.org/10.1007/ s13563-021-00265-4.
- R.M. Elavarasan, M. Nadarajah, R. Pugazhendhi, A. Sinha, S. Gangatharan, D. Chiaramonti, M. Abou Houran, The untold subtlety of energy consumption and its influence on policy drive towards Sustainable Development Goal 7, Appl. Energy 334 (2023) 120698, https://doi.org/10.1016/j.apenergy.2023.120698.
- T.L. Afonso, A.C. Marques, J.A. Fuinhas, Does energy efficiency and trade openness matter for energy transition? Empirical evidence for countries in the Organization for Economic Co-operation and Development, Environ. Dev. Sustain. 23 (2021) 13569–13589, https://doi.org/10.1007/s10668-021-01228-z.
- U. Nyambuu, W. Semmler, Fossil fuel resources, environment, and climate change, in: Sustainable Macroeconomics, Climate Risks and Energy Transitions. Contributions to Economics, Springer, Cham, 2023, https://doi.org/10.1007/978- 3-031-27982-9_4.
- V. Anantha Nageswaran, Climate change: Scaring people will only yield scars and no solutions, MINT, (Apr 16, 2024), https://www.livemint.com/opinion/online-views/climate-change-scaring-people-will-only-yield-scarsand-no-solutions-11713237716747.html.
- Website Information: HYPERLINK "https://news.un.org/en/story/2022/09/ 1126931" \o "https://news.un.org/en/story/2022/09/1126931" https://news.un. org/en/story/2022/09/1126931.
- Website Information: https://news.un.org/en/story/2023/01/1132452.
- Website Information (Nature): https://www.nature.com/articles/d41586-023-02 510-y.
- https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach/a-renewed-pathway-to-net-zero-emissions#abstract
- https://www.ey.com/en_in/insights/energy-resources/powering-the-future-india-s-role-inglobalenergytransition#:~:text=Summary,sustainable%20development%20and%20climate%20goals.&text=Discover%20EY%20energy%20transition %20insights,opportunities% 20of%20an%20uncertain%20future.&text=EY%20com bines%20deep%20 technical%20skills,our%20sustainability%20and%20ESG%20services.&text= EY%20teams%20can%20help%20address,Find%20out%20how.
- https://www.enerdata.net/publications/executive-briefing/india-decarbonisation.html
- https://hartek.com/post/how-can-india-benefit-from-green-energy-transition/#:~:text=For%20India%2C%20this%20transition%20has,global%20energy%20transition%20is%20essential.
- https://www.enerdata.net/publications/executive-briefing/india-decarbonisation.html

Agriculture Prosperity and Organic Farming: A Need of Ecological Sustainability

Dr. Rishi Vivek Dhar[1]

ABSTRACT

At the present era, developing countries must choose between securing food for their population while harming the environment and protecting the environment by compensating yields. The first situation necessitates the persistent use of conventional farming methods such as pesticides and fertilisers. However, the conventional farming method unsustainable nature and burgeoning negative health effects have already caused numerous concerns about how it will meet the rising population's food demand. The second option points towards organic farming practices, outperforming conventional farming in every aspect except yield. Organic farming promotes soil fertility and biodiversity and provides healthy and nutritious food for well-being. Further, organic farming can significantly contribute to addressing global environmental challenges. However, organic farming is not commensurate with conventional farming for a country like India, where securing food for its massive population is the highest priority. Nevertheless, organic farming is not developed enough to feed the population and faces multifaceted challenges, at least in the short run. Despite these challenges in organic farming, it shows significant performance in different aspects such as the area under cultivation, production of organic produce, number of producers, and exports of organic products. The area under organic farming practices has shown rising trends since last decade.

Key Words: *GMO's, GVA, GCF, APEDA, PKVY, IFOAM*

Introduction

Organic farming in India is a traditional yet modern approach to agriculture that emphasizes sustainable, chemical free farming practices. It aims to produce food in harmony with nature by avoiding synthetic fertilizers, pesticides and genetical modified organisms (GMO's). In recent years, organic farming is gaining momentum worldwide, including in developed and developing countries. This can be observed by the significant increase in demand for organic products, and more agricultural land goes into account for organic farming. Globally, the organic food and drink sales market reached more than 120.6 billion euros in 2020. With its enormous environmental and economic benefits, organic farming is taking new shapes, but simultaneously, farmers are facing multifaceted challenges in adopting this practice, such as transition periods, certification, productivity, markets, and extension services. These challenges are the key reasons for the slow development of organic agriculture.

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Organic farming has emerged as an alternative to conventional agriculture that preserves soil health and provides nutritious food by abstaining from using fertilisers and pesticides. Organic farming uses biofertilizers, vermicomposting, and green manure to promote soil health and biodiversity and provide healthy food. These qualities make organic farming a viable and sustainable option in the long run Moreover, organic farming ensures sustainability (economic, environmental, and social) and supports sustainable development goals. The International Federation of Organic Agriculture Movements (IFOAM), General Assembly in 2008 defined organic farming as: a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity, and cyclical adaptation to local conditions rather than using inputs with adverse effects. Organic Agriculture science to benefit the shared environment and promote fair relationships and good quality of life for all involved.

Data and Methodology

This paper basically examines the prospect of organic farming in India. For this purpose, numerous literature and reports published by international institutes and experts were reviewed. To promote organic farming in India, the government initiated the "National Programme for Organic Production (NPOP)" in 2001 under the Agriculture and Processed Food Products Export Development Authority (APEDA) and laid the foundation for the systematic development of organic farming in India. Since then, organic farming has grown almost 42 times. Realising the benefits of the organic farming consumer paying premium prices for the products also promotes farmers to shift to organic farming. Secondary data was collected from published sources like the International Federation of Organic Farming Movement (IFOAM), Research Institute of Organic Agriculture Statistics and the Agricultural Processed Food Products & Export Development Authority (APEDA).

Agricultural Development in India; Strategy and Efficacy

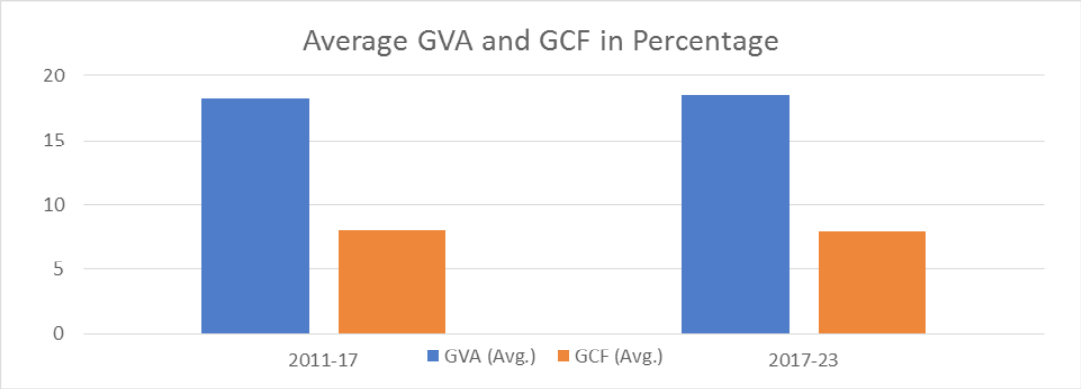
The agricultural sector's contribution to India has been very significant since independence as its performance decides the country's development path. After independence, the Indian economy depended substantially on agriculture; around 70 percent of the workforce was engaged in agriculture, accounting for 52 percent of the national income share. According to a study of Tripathi and Prasad in 2009; the Indian agricultural development can be divided into four phases. In the first phase after independence, the government took necessary actions to boost agriculture through land reforms. The second phase started after the severe drought in the mid-1960s; India adopted the new strategy of the green revolution in the late 1960s, which helped India to attain self-sufficiency in food grains. In the next phase, the agriculture sector was diversified, with a focus on milk, fishery, poultry, vegetables, and fruits. In the fourth phase, the impact of 1991 reforms on agriculture were studied, in which no immediate reforms were implemented. However, the devaluation of the exchange rate, the opening of foreign trade, and the removal of protection of industries indirectly affected this sector. Besides providing domestic demand for food to 1.35 billion people in 2020-21, its contribution also contributes to industrial growth and international trade. The agriculture sector in 2022-23 accounted for 18.3 percent and 8.7 percent of gross value added (GVA) and gross capital formation (GFC) at current prices, respectively (Agriculture Statistics at Glance, 2023).

Table 1 : Average GVA & GCF by Agriculture Sector in percentage

Year	Average GVA (in %)	Average GCF (in %)
2011-17	18.2	8.05
2017-23	18.5	7.95

Source: Calculated from, Agriculture Statistics at Glance, 2023

Figure:1



Source: Table-1

It is a well establish fact that in the process of the structural transformation of the economy, the role of agricultural sector declines in terms of its contribution to GDP. However, the agriculture sector in India is unique in that it employs as a large portion of the workforce and provides food to the world's most populous country (United Nations Department of Economic and Social Affairs [UN DESA], 2023). Data shows that gross value added and gross capital formation are consistent and growing on an average of 18 percent and 8 percent since 2011-12, respectively. The share of the agriculture sector in GDP is low, but its contribution is crucial for the nation's food security and self-reliance. Adding to the share of agriculture, it accounts for 14.3 percent of the national exports (Agricultural Statistics at a Glance, 2023) .

The source of India's agricultural growth can be traced back to the Green Revolution. This new strategy transitioned from traditional agriculture to modern agriculture in India. With improved quality of high-yielding varieties of seeds and intensive use of fertilisers and pesticides, productivity in the agriculture sector (especially crops like wheat and paddy in the northern part of India) increased tremendously, which helped India become self-reliant and affirmed the country's food security. The rapid growth in agriculture is supported by the increasing yield of produce to its new level, as evident from the low level of 52 million tonnes in 1951-52, and the production of food grain increased to 332.20 million tonnes in 2023-24.

Moreover, it has become more of a concern for India as food grain production has stalled since 2011-12 while population growth has continuously increased. The trend of foodgrain production stood at 259.29 million tonnes in 2011-12, which grew to 308.60 million tonnes of production in 2021-22. On the same side, the population has shown a rising trend. The population in 2011-10 was

1.22 billion and grew to 1.35 billion in 2020-21. The stagnancy in foodgrain production can be attributed to uncontrolled factors like extreme weather and environmental degradation.

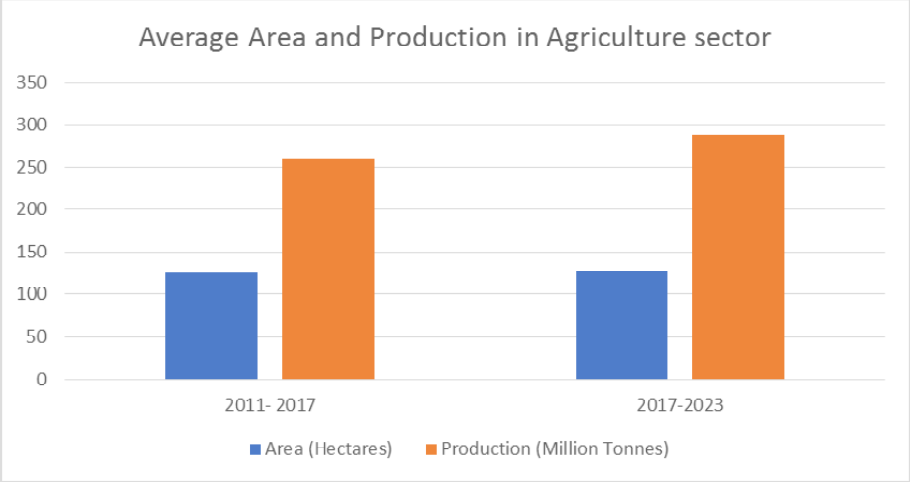
Table 2: Average

Year	Area (Hectares)	Production (Million Tonnes)	Yield (KG/Hectare)
2011- 2017	124.63	260.33	2154.16
2017-2023	126.98	288.66	2270.16

Source: Calculated from data of Agriculture Statistics at a Glance, 2023

This achievement of high production and productivity comes with the help of the intensive use of fertilisers and pesticides in the fields. The consumption of fertilisers increased exceptionally high from 70,000 tonnes in 1950- 51 to 2.17 million tonnes in 1970-71, 12.54 million tonnes in 1990-91, and 19.14 million tonnes in 1999-2000. This growth stood at 28.12 million in 2010-11, rising to 32.53 million tonnes in 2020-21. The paper observed that the farmers use more fertilisers and pesticides to increase productivity in the field, which results in more income.

Figure : 2



Source: Table:2

Organic Farming in India; its Status and Impacts

India is among the countries where the number of producers of organic products and areas of organic farming are increasing significantly. The farming, a composite of wild harvest (1.6 million hectares) and cultivable land (2.6 million hectares). Sikkim is the state in India that has converted its entire cultivable land into organic farming and is called the organic state of India. To analyse organic farming production across Indian states, the organic production state-wise was divided into six zones, that is Northern, Southern, Eastern, North-Eastern, Western, and Central in the study of Heena. The Northern zone embraced Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Uttar Pradesh, and Uttarakhand. The North-eastern zone includes Tripura, Sikkim, Meghalaya, Manipur,

Nagaland, Assam, and Arunachal Pradesh. The Eastern zone is comprised of Bihar, Jharkhand, Odisha, and West Bengal. The Western zone includes Rajasthan, Maharashtra, Goa, and Gujarat. The Southern zone comprises Tamil Nadu, Karnataka, Kerala, Andhra Pradesh, and Telangana. The Central zone includes Madhya Pradesh and Chhattisgarh.

Since the inception of the National Programme for Organic Production (NPOP) in 2001, it has constantly added areas under organic farming practices. However, the data is only available from 2012-13. Figure 3 shows the growth of the certified area under organic farming in India. The figure clearly shows a cyclic trend area of organic cultivation in India. In 2012-13, the organic farming area was a mere 7.23 lakh hectares, which increased to 57.10 lakh hectares in 2015-16 and started declining. This decline can be ascribed to the Participatory Guarantee System (PGS)[8], introduced under '*Paramparagat Krishi Vikas Yojana'* (PKVY) in 2015. Since then, the certified area under NPOP has been declining. However, it started rising in 2020-21 and peaked at 91.20 lakhs hectares in 2021-22. The encouraging growth indicates that more farmers are adopting organic farming practices. The increase in organic producers can observe the popularity of organic farming practices.

Impacts: The potential of organic farming is enormous as it plays a significant role in protecting the environment. According to Reganold & Wachter as organic farming abstains from chemical pesticides, there is a negligible risk of surface and groundwater chemical pollution. Excluding chemical fertilisers in organic farming, it grows safe and healthy food. Further, consuming organically produced food intake was associated with reduced incidents of various diseases. Another aspect in which organic farming is superior to conventional is that it fosters biodiversity. Besides, scholars have reported that there has been an increase in biodiversity while practising organic farming. Further, conventional farming is water-intensive and requires more water, which infers an inefficient technique in rain-fed areas. However, organic agriculture can increase yields even in rain-fed areas. These positive environmental externalities attached to organic farming were significant factors in its popularity. The economic performance of organic farming is more favourable compared to conventional.

Another importance of agricultural products is that it provides raw material to the industries. Cotton is among the agricultural products that are used in textile industries and is in high demand all over the world. For example, in the apparel market, the demand for organically produced clothes is high in developed countries and has a rapidly increasing share in the apparel market. Rieple and Singh (2010) analysed the value chain of organic cotton and found that the organic cotton value chain is beneficial at every stage. It was found that organic cotton adds value at every stage of the production process and is also beneficial for mediators and organic farmers. Moreover, the future of organically farmed cotton has the potential to be the largest seller in the future.

Some Basic Issues

Marketing in the agriculture sector plays a vital role in the growth of the sector and farmers. This helps farmers in every stage, from storing produce to selling products in the market, and helps them get a reasonable price. Organic products are currently only available to the most affluent consumers in society, creating a small market for farmers, followed by inadequate consumer demand, limited knowledge about premium prices, costly transportation, variation in the price of the crops, and insufficient support from the government. As these factors play an essential role in marketing channels, government support is also needed. The market for organic products is significantly different

from the regular market, which requires a particular skill set to deliver organic products. In year 2007 Das explained this difference and called for careful selection and development of target marketing to sell organic products in markets.

The other challenge the farmers are facing is the lower yield in the case of organic farming. Yield is the crucial factor through which the farmers' profitability is decided. Farmers' motive is to increase productivity on fixed land to earn more profit. In India, high yields of wheat and rice are the byproducts of the green revolution. These two crops are consumed immensely and exported to other countries. Nevertheless, organic produce has premium prices, and farmers resist shifting from conventional farming because of low yields.

Conclusions

Indian organic producers ranked first globally and showed exponential growth in adopting organic farming practices. Organic farming also fares better in terms of the trade of organic products. India showed a significant rise in exports of organic products. However, policymakers must be careful in adopting organic farming at a large scale taking into consideration of its massive population. The performance of the agricultural sector is key for the development of the economy, especially for developing economies. It helps the economy in various ways, such as increased income for farmers, employment in rural areas, and, most importantly, food security. With the growing demand for food, farmers use extensive fertilisers and pesticides to increase productivity. The emergence of organic farming is because of certain limitations of conventional farming. In our country, organic farming practices are taking a new shape. India has 1.59 million organic producers with 2.7 million hectares of agricultural land under organic agriculture. This paper aims to describe the evolution and status of organic farming in India. It also seeks to examine the impact of organic agriculture on various aspects of farming and economy and aims to identify the constraints in the growth of organic agriculture. Although the growth of organic farming is very encouraging, the statistics show the tremendous scope of expansion of organic farming all over the world. Nevertheless, the share of organic farming is minimal and at the very early stage of development. Proper research should be conducted when developing new agricultural development models to understand all aspects of organic agriculture in terms of its ability to preserve the environment, food security, production, and accessibility.

References

- Agricultural Statistics at a Glance. (2023), Government *of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture*, Cooperation & Farmers Welfare. Directorate of Economics and Statistics.
- Altenbuchner, C., Vogel, S., & Larcher, M. (2018). Social, economic, and environmental impacts of organic cotton production on the livelihood of smallholder farmers in Odisha, India. *Renewable Agriculture and Food Systems*.
- APEDA. (2021). Organic Products: National Programme for Organic Production (NPOP). *Agricultural & Processed Food Products Export Development Authority (APEDA)*.
- Das, K. (2007). Towards a smoother transition to organic farming. *Economic and Political Weekly*, *42*(24), 2243–2245.

- Dhar, Rishi Vivek (2024), An Analysis of Organic Farming In India: a vision towards a healthy Nation, The Indian Economic Journal, Vol-01B, December 2024.
- Donthi, N. R. (2021). Pesticide poisoning in India challenges of data and management in Public Health. *Economic and Political Weekly*, *45* & *46*, 17–20.
- Durham, T. C., & Mizik, T. (2021). Comparative economics of conventional, organic, and alternative Agricultural Production Systems. *Economies*.
- Heena, Malik, D. P., & Tanwar, N. (2021a). Growth in area coverage and production under organic farming in India. *Economic Affairs*, 66(4), 611–617.
- Narayanan, S. (2005). Organic Farming In India: Relevance, Problems And Constraints. *Department of Economic Analysis and Research*. Mumbai: National Bank for Agriculture and Rural Development.
- Ramesh, P., Singh, M., & Subba Rao, A. (2005). Organic farming: Its relevance to the Indian context. *Current Science*, *88* (4),561–568. .
- Reganold, J. P., & Wachter, J. M. (2016). Organic agriculture in the twenty-first century. *Nature Plants*, 2, 15221.
- Tripathi, A., & Prasad, A. R. (2009). Agricultural development in India since independence: A study on progress, performance, and determinants. *Journal of Emerging Knowledge on Emerging Markets*, *1*(1), 63–92.

An Introduction to Environmental Degradation: Causes, Consequence and Mitigation

Dr. Savita Dwivedi[1]

ABSTRACT

The environmental degradation is the deterioration of the environment through depletion of resources which includes all the biotic and abiotic element that form our surrounding that is air, water, soil, pant animals, and all other living and non-living element of the planet of earth. The major factor of environmental degradation is human (modern urbanization, industrialization, overpopulation growth, deforestation, etc.) and natural (flood, typhoons, droughts, rising temperatures, fires, etc.) cause. Today, different kinds of human activities are the main reasons for environmental degradation. The automobile and industries increase the number of poisonous gases like SOx, NOx, CO, and smoke in the atmosphere. Therefore, the government must enhance filling the gap in the legal system to avoid illegal activities. This chapter discusses the impact of environmental degradation with its future impacts, city planners, industry, and resource managers plan to be considered to mitigate the long-term effects of developmental environmental degradation.

Keywords*: Environmental degradation, Manmade impacts, Mitigation, Pollution*

INTRODUCTION

The environment is something we are very familiar with. It's everything that makes up our surroundings and affects our ability to live on the earth. Environmental degradation is a very serious problem worldwide which covers a variety of issues including pollution, biodiversity loss, and animal extinction, deforestation and desertification, global warming, and a lot more (Brown et al., 1987; Tian et al., 2004). The environmental degradation is deterioration of the environmental through depletion of resources which includes all the biotic and abiotic element that form our surrounding that is air, water, soil, plant, animals, and all other living and non-living element of the planet of earth (Bourque et al., 2005; Malcolm and Pitelka, 2000). Environmental degradation is also having a useful aspect, more new genes have been created, and some species have grown as someone's have declined. For natural selection, species are constantly regenerating as the environment changes, and human activity is the main driver's power. Human is also a product of nature; this shift is to natural replacement. Most of the people about three-fourths of its population depends directly for their livelihood on activities based on natural resource and the remainder of the population relies on these resources directly for food, fuel, industrial output, and recreation (Raven et al., 1998). Most of

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the natural resources including the environment in India are in a serious state of degradation. The use of agriculture fertilizer is a major factor for the degradation of soil quality, soil erosion, salinity and general loss of fertility of agricultural land as well as the loss of the production of the quality crop. Similarly, groundwater aquifers are overexploited in many arid and semi-arid areas, surface water sources are highly polluted and consequently, water for drinking and irrigation is increasingly getting scarce and polluted. Fishery yields are declining, and air quality is deteriorating. Increasing levels of air, water, and land pollution pose a serious threat to human health and longevity (Malik et al., 2018; Malik et al., 2019; Yadav et al., 2023). Good environmental management is essential for economic growth and development. It is not a sometime mistakenly asserted just a luxury for wealthy countries concerned with aesthetics. Climate change and environmental degradation affect all types of development projects in all countries. If the development agencies are seriously contributing to the reduction of poverty in the communities in which they work, they must give consideration to the climatic and environmental hazards which impact their projects. Climate change and environmental degradation are proceeding rapidly and are already affecting many communities in developing countries. O'Neill et al. (2020) reported that slowing population growth could provide 16-29% of the emissions reductions, and suggested to be necessary by 2050 to avoid dangerous climate change. His study in 35 countries suggested that, slowed population growth could save 1.4 to 2.5 billion tons of carbon emissions per year by 2050, certainly help to solve the climatic problem.

Causes of Environmental Degradation

The major factor of environmental degradation is human (modern urbanization, industrialization, overpopulation growth, deforestation, etc.) and natural (flood, typhoons, droughts, rising temperatures, fires, etc.) cause. Environmental pollution refers to the degradation of the quality and quantity of natural resources. Different kinds of human activities are the main reasons for environmental degradation. The automobile and industries increase the number of poisonous gases like SOx, NOx, CO, and smoke in the atmosphere. Unplanned urbanization and industrialization have caused water, air, soil, and sound pollution. Industrialization, urbanization, and sewage waste help to increase pollution of the sources of water (Olorode et al., 2022). Similarly, the smoke emitted by vehicles and industries like Chlorofluorocarbon, nitrogen oxide, carbon monoxide, and other dust particles pollutes the air. Since man began to use tools and gradually formed a society, he began to play an important role in the evolution of the natural environment shown in Figure 1.

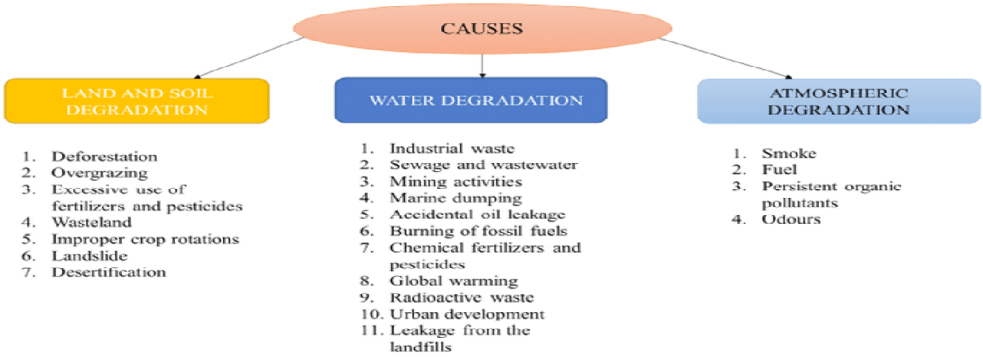


Figure 1. Different causes of environmental degradation.

Effects of Environmental Degradation

Impact on Human Health

Human health might be at the receiving end as a result of environmental degradation. Areas exposed to toxic air pollutants can cause respiratory problems like pneumonia and asthma. Millions of people are known to have died off due to the indirect effects of air pollution (Adakole and Oladimeji, 2006).

Loss of Biodiversity

Biodiversity is important for maintaining the balance of the ecosystem in the form of combating pollution, restoring nutrients, protecting water sources and stabilizing climate. Deforestation, global warming, overpopulation, and pollution are a few of the major causes of loss of biodiversity.

Ozone Layer Depletion

The ozone layer is responsible for protecting the earth from harmful ultraviolet rays. The presence of chlorofluorocarbons, hydrochlorofluorocarbons in the atmosphere is causing the ozone layer to deplete. As it will deplete, it will emit harmful radiation back to the earth (Buhaug et al., 2010)

Loss for the Tourism Industry

The deterioration of the environment can be a huge setback for the tourism industry that relies on tourists for their daily livelihood. Environmental damage in the form of loss of green cover, loss of biodiversity, huge landfills, increased air, and water pollution can be a big turn off for most of the tourists.

Economic Impact

The huge cost that a country may have to borne due to environmental degradation can have a big 9 Environmental Degradation: Causes and Remediation Strategies Pradip Kumar Maurya et al. (2023) economic impact in terms of restoration of green cover, cleaning up of landfills and protection of endangered species. The economic impact can also be in terms of the loss of the tourism industry. As you can see, there are a lot of things that can have an effect on the environment. If we are not careful, we can contribute to the environmental degradation that is occurring all around the world. We can, however, take action to stop it and take care of the world that we live in by providing environmental education to the people which will help them pick familiarity with their surroundings that will enable to take care of environmental concerns thus making it more useful and protected for our children and other future generations.

Conclusion and Recommendations

Environmental degradation is one of the most urgent environmental issues. Depending upon the damage, some environments may never recover. The plants and animals that inhabited these places will be lost forever. The primary causes of environmental degradation in India are attributed

to the rapid growth of the population in combination with economic development and Figure 8. Sustainability components of human environment. 17 Environmental Degradation: Causes and Remediation Strategies Pradip Kumar Maurya et al. (2020) the overuse of natural resources. In order to reduce any future impacts, city planners, industry, and resource managers must consider the long-term effects of development on the environment. Major environmental calamities in India include land degradation, deforestation, soil erosion, habitat destruction and loss of biodiversity. Economic growth and changing consumption patterns have led to rising demand for energy and increasing transport activities. Air, water and noise pollution together with water scarcity dominate the environmental issues in India. According to the World Bank estimate, between 1995 through 2010, India has made one of the fastest progress in the world, in addressing its environmental issues and improving its environmental quality. Still, India has a long way to go to reach environmental quality similar to those enjoyed in developed economies. There are ways which can help to decrease the degradation of our environment. The most effective method to control pollution and depletion is through completing the legal framework. There are some drawbacks existing in contemporary law, which encourages malfeasances implicitly. Therefore, the government must enhance filling the gap in the legal system to avoid illegal activities. Amendment to provisions relating to the exploitation of natural resources is urgent since over-exploitation is the main reason for the loss of biodiversity. The government has long shaped its perception of economic, as well as social methods to solve the problem of pollution, but the implementation remains limited. Eliminating environmental pollution and recovering our ecology requires more than a single effort to be successful. Authority of all levels must involve not only in policy-making but also in the implementation and supervision of progress, so that the national long-term environmental target can be attained, resulting in sustainable development.

- The government can utilize economic reward and punishment system to encourage forestation.
- Purchase recycled products
- Conserve water
- Do not litter or toss waste into inappropriate places
- Conserve energy
- Join an awareness group
- Talk with others about the impacts of environmental degradation
- Be an advocate to save our planet!
- improve the quality of drinking water
- Prevent casual use of other unapproved sources
- Increase the quality of water used
- Improve accessibility and of domestic supply
- Improve hygiene
- Strict laws should be passed to control water pollution by individuals and different bodies
- Safety measures to be implemented to prevent oil spillage.

- Chemical waste should be converted to harmless biodegradable substances before being dumped into the rivers and streams
- Refuse should be burnt in an incinerator with built-inn devices to prevent water pollution.
- By making people be aware of the causes and dangers of air pollution
- By improving machinery so that more efficient fuel combustion occurs.
- Control by ventilation- suitable ventilation system should be provided in the kitchen of every house so that the gases produced by burning of wood, coal, oil, etc. can be exhausted very quickly
- Control by vehicle rules- the design of vehicle should be such that complete combustion of fuel takes place in the engine
- Control by forestation- the planting of trees should be planted at parks and public place.

References

- Aber, J., Neilson, R.P., McNulty, S., Lenihan, J.M., Bachelet, D. and Drapek, R.J. (2001). Forest processes and global environmental change: predicting the effects of individual and multiple stressors: we review the effects of several rapidly changing environmental drivers on ecosystem function, discuss interactions among them, and summarize predicted changes in productivity, carbon storage, and water balance. BioScience, 51(9): 735-751.
- Adakole, J.A., and Oladimeji, A.O. (2006). The effects of Pollution on Phytoplankton in a stretch of River Kubanni, Zaria, Nigeria. Proceedings of the 15thannual Conference of Fisheries Society of Nigeria (FISON), pp. 151-158. AJS (1999). Amicus Journal Staff Natural resources defence council staff. Exxon Valdez (ten years later).
- Alexander, G.J. and Kanner, R.E. (1995). Air pollution: From irritating to life-threatening. IM (Internal Medicine) October, pp. 41–53. Anil, M.N.V., Kumari, K. and Wate, S.R. (2014). Loss of biodiversity and conservation strategies: an outlook of Indian scenario. Asian Journal of Conservation Biology, 3(2): 105-114.
- Bourque, C.P.A., Cox, R.M., Allen, D.J., Arp, P.A. and Meng, F.R. (2005). Spatial extent of winter thaw events in eastern North America: historical weather records in relation to yellow birch decline. Global Change Biology, 11(9): 1477-1492.
- Brown, B.J., Hanson, M.E., Liverman, D.M. and Merideth, R.W. (1987). Global sustainability: toward definition. Environmental Management, 11(6): 713-719. Buhaug, H., Gleditsch, N.P. and Theisen, O.M. (2010). Implications of climate change for armed conflict. Social dimensions of climate change: Equity and vulnerability in a warming world, pp. 75-101.
- Cheng, M., Zeng, G., Huang, D., Lai, C., Xu, P., Zhang, C. and Liu, Y. (2016). Hydroxyl radicals based advanced oxidation processes (AOPs) for remediation of soils contaminated with organic compounds: a review. Chemical Engineering Journal, 284: 582-598. Cunningham, W.P., Cooper, T.H., Gorham, E. and Hepworth, M.T. (1998).
- Environmental encyclopedia. pp. 1-110. Diamond, J.M. 1989. Overview of recent extinctions, Conservation for the twenty-first century, pp. 37- 41. Dirzo, R. and Raven, P.H. (2003). Global state of biodiversity and loss. Annual Review of Environment and Resources, 28(1): 137-167

Urbanisation and Climate Change: A Theoretical Perspective

Dr. Upasna Sharma[1]

ABSTRACT

Urbanisation is an index of economic progress. Half of the global population already lives in cities, and by 2050 two-thirds of the world's people are expected to live in urban areas. Infact any attempt towards the attainment of better standards of living must mean in economic terms, creation of new employment opportunities through a diversified economy with emphasis on non-agricultural pursuits. This study is based on induced climate change caused due to rapid urbanisation, burning fossil fuel and over use of resources like forest land etc. Some positive implications of urbanisation include the creation of employment generation, technological growth and infrastructural advancement, improved transport and communication system, quality education and medical facilities. But due to uncontrolled urbanisation, many problems have occurred in so many ways. Such as air pollution, noise and water pollution etc. Relative growth of towns and cities are increasing year by year. Large number of factories were added between 2005-2020 in India.

Urbanization and climate change are intertwined global challenges. Studies by Soumya Satyakanta, V. Vinoj, Keith Michael, and Guo Liying, Di Liping emphasize that urban activities significantly contribute to greenhouse gas emissions. Future climate adaptation strategies must integrate urbanization to manage its impacts effectively, balancing economic progress with environmental control in densely populated urban centers.

Keywords: *Urbanisation, Population Growth, Economic Progress, Climate Change*

Urbanisation is the increase of people living in towns and cities. Urbanisation occurs because people move from rural areas (country wise) to urban areas (towns and cities). Urbanisation is an index of socio-economic progress. The main causes of urbanisation are social benefits, employment opportunities, rural-urban change, change in the way of living, commercialisation and industrialisation etc. Urbanization is a process where the population shifts from rural to urban areas due to various factors.

According to UN Report, definition of an urban area can be given on the basis of following five concepts:

i) Administrative area;

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ii) Size of population;

iii) Expansion of local government;

iv) Urban features; and

v) Domination of economic activities.[1]

The primary objective of this paper is to know the positive implications of urbanisation, to analyse the growth of urbanisation and the number of factories which affect climate change and measures to solve urbanisation problems and give the suggestions for future generations also. This study is based on induced climate change caused due to rapid industrialisation, burning fossil fuel and over use of resources like forest land etc.

Review of Literature

Urbanisation and Climate Change

At the same time, cities are a key contributor to climate change, as urban activities are major sources of greenhouse gas emissions. Estimates suggest that urban areas are responsible for 70 percent of global CO2 emissions, with transport and buildings being among the largest contributors (IPCC, 2022).

Several studies shows that climate change is a result of urbanization. Some empirical study has been taken for the analytical purpose.

Saumya Satyakanta Sethi and V. Vinoj said in his article "Cities are vulnerable to the compounding effects of both climate change and urbanization. Here we show that urbanization alone has led to an overall 60% enhancement in warming in Indian cities, with eastern Tier-II cities leading the way. Such a difference in the urban contribution to warming over cities across India calls for a differential approach to combat urban warming effectively.

Warming trends in cities are influenced both by large-scale climate processes and by local-scale urbanization. However, little is known about how surface warming trends of global cities differ from those characterized by weather observations in the rural background. Here, through statistical analyses of satellite land surface temperatures (2002 to 2021), we find that the mean surface warming trend is 0.50 ± 0.20 K•decade^{-1} (mean ± one S.D.) in the urban core of 2000-plus city clusters worldwide, and is 29% greater than the trend for the rural background. On average, background climate change is the largest contributor explaining 0.30 ± 0.11 K•decade^{-1} of urban surface warming. In city clusters in China and India, however, more than 0.23 K•decade^{-1} of the mean trend is attributed to urban expansion. We also find evidence of urban greening in European cities, which offsets 0.13 ± 0.034 K•decade^{-1} of background surface warming.[3]

The intricate relationship between urbanization and climate change has gained significant research attention since the 1990s, establishing a new level of empirical and intellectual scope, as highlighted by Aidan and Mark Whitehead. This growing body of evidence underscores the critical need to integrate urban dynamics into climate change adaptation strategies.

Keith Michael asserts that urbanization's role in the climate crisis is being dangerously overlooked, noting that urban growth is driving environmental change at an unprecedented scale.

Data from the Intergovernmental Panel on Climate Change (IPCC) in 2020 revealed that urban areas collectively contribute approximately three-quarters of global carbon dioxide equivalent emissions. Recognizing this profound impact, the IPCC has commissioned a special report on climate change and cities for 2024. This signals a crucial juncture where international policy systems must fuse climate science with urban expertise to forge effective solutions for the 21st century's civilizational threats, a perspective notably published in Science as "Designing policy for Earth's Urban future."

Further elaborating on the direct impacts, Guo Liying, Di Liping, and colleagues have demonstrated that increasing urbanization induces the urban heat island (UHI) effect, leading to more heat-related health risks and extreme climate events, particularly impacting urban residents. Their study offers valuable reference for geoscience research at the intersection of urbanization and climate change.

This concern is amplified in rapidly developing regions. Xueqin Li, Lindsay C. Stringer, and Martin Dallimer's study on "The Impacts on Urbanisation and Climate Change on the Urban Thermal Environment in Africa" emphasizes that growing cities will become hotspots for heat-related risks. Modifications in land use and land cover (LULC) during urbanization intensify the UHI effect, exacerbating current and projected heat stress. This is particularly alarming in regions like East Africa, which, despite being the least urbanized, exhibits the strongest growth trend. Time-series observations already indicate a significant rising temperature trend in some East African cities. Both urban densification and urban sprawl are predicted to increase UHI intensity, placing additional strain on health and economic systems in a changing climate, thus demanding integrated research on urbanization and climate change in rapidly evolving regions like East and West Africa.

Empirical evidence from developed nations also corroborates this link. B. Maheshwari, U. Pinto, S. Akbar, and P. Fahey's study, "Is Urbanisation also the Culprit of Climate Change? – Evidence from Australian cities," analyzed daily maximum and minimum air temperature, evaporation, and rainfall data (1960–2011) for Sydney, Melbourne, and Brisbane. Using modified segmented regression and linear regression, their findings indicated a significant overall climate change during 1986–2011 compared to 1960–1985, with urbanization demonstrably contributing to this change. While specific impacts varied (e.g., increased Tmax and Tmin in Sydney, decreases in Melbourne), the study strongly suggests that climate change adaptation strategies and policies must explicitly integrate urbanization alongside greenhouse gas considerations to effectively manage future climate scenarios.

In conclusion, the collective body of research overwhelmingly demonstrates a positive correlation between urbanization and climate change, unequivocally indicating that urbanization significantly affects climate change.

Discussion

Urbanisation Rate: Global Scenario

According to global data, the countries that had the highest urbanisation rate in 2021 include Burundi, Uganda, Ethiopia, Nepal, Burkina Faso, Tanzania and Bangladesh. Countries with the lowest urbanisation rate include Samoa and Barbuda, Saint Pierre and Miquelon, Andorra, Curacao,

South Korea, Puerto Rico and Uzbekistan. In 2021, Poland, Cyprus, Trinidad and Tobago, Aerican Samoa and Zimbabwe had the highest year- on- year growth, and Mauritius, Uzbekistan, Tonga, South Korea, Antigua and Barbuda, and Curacao were some of the countries with the lowest year-on-year growth in their urbanisation rate.

Some positive implications of urbanisation include the creation of employment generation, technological and infrastructural advancement, improved transport and communication system, quality education and medical facilities. Here are some positive and negative implications of urbanisation. Some discussed are here.

Positive Implications of Urbanisation

1. Employment generation
2. Technological and infrastructure advancement
3. Improved transport
4. Improved communication system
5. Quality education
6. Medical facilities
7. Better standard of living
8. Creation of new employment opportunities

But in present times, due to uncontrolled urbanisation many problems have been occurring in so many ways. Pollution (Air, noise, water), high temperature, increasing health issues etc. Urbanisation is increasing at a rapid pace across the world. Citi hues will get denser and overcrowded everywhere.

The urbanisation rate is measured as the average annual percentage change of the urban share of the population (proportion of urban to total population) if the urban population grows at a rate faster than the total population, then it would result in the rate of urbanisation being positive.

Urban Population of India

The urban population of India attained a value of 475 million people in2021. It recorded a growth of 2.2 percent in 2021 compare to the previous year. Between 2010-2021, the urban population of India increased by 7.1 percent. The urban population of India was highest in 2021 with a value of 475 million people and lowest in 2018 with a value of 443 million, between 2018 and 2021.

Table 1 shows that the Urban population in India 1901 was 256 lakhs which was increased to 624 lakhs in 1951. It has increased to 971 lakhs in this period. In 1901 the percentage of urban population in total population was 11.00 and it has increased 14.7 percent between 1901-1991. In the census of 2011, urban population has become 31.2 percent of the total population. It shows a drastic change of urban population in the period of 1901-2011.

Table 1: Relative Growth of Town and Villages in India

Year	Population (In Lakhs)		Percentage of Total Population		Town Village Population Ratio
	Rural	Urban	Rural	Urban	
1901	2,073	256	89.0	11.0	1: 8.1
1951	2,987	624	82.7	17.3	1: 4.7
1961	3,063	789	82.0	18.0	1: 4.5
1971	4,319	1091	80.1	19.9	1: 3.7
1981*	5,257	1595	76.7	23.3	1: 3.3
1991*	6,271	2172	74.3	25.7	1: 2.8
2001	7,420	2850	72.2	27.8	1: 2.6
2011	8,333	3771	68.8	31.2	1: 2.2

Note- Jammu & Kashmir and Assam are not included in this data.

Source- Census of India 2001 & 2011

India's Rate of Urbanisation (2010-2021 in percent)

- Between 2010-2021, the urbanisation rate in India increased by 19.6 percent.
- Urbanisation rate in India increased by 1.5 percent on a year-on-year basis in 2021.
- India had an urbanisation rate of 1.34 percent in 2021.

Urbanisation in India 2023- In 2023, approximately a third of the total population in India lived in cities. The trend showss an increase of urbanisation by more than 4 percent in the last decade, meaning people have moved away from rural areas to find work and make a living in the cities.

Leaving the field- Over the last decade, urbanisation in India has increased by almost 4 percent, as more and more people leave the agriculture sector to find work in service sector. Agriculture's contribution to India's GDP has been decreasing while the service sector gained in importance.

No Rural exodus in sight- While urbanisation is increasing as more jobs in telecommunications and IT are created and the private sector gains in importance, India is not facing a shortage of agricultural workers or a mass exodus to the cities yet.[9]

Recent Trends Impacting Urbanisation

The economy, natural increase in pouplation, commercialisation, female fertility rates, birth rates, death rates, healthcare facilities, industrialisation, immigration and emigration rates, education, and other social and cultural variables all influence urban population growth.[10]

Number of cities and population in different census shown in table no. 2 which shows the city category wise population.

Table-2: Number of Cities and Population in different Census

CITY CATEGORY						
Population (in Lakhs)						
Year	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**
1951	278	61	97	84	80	19
1961	405	87	132	99	54	6
1971	619	121	171	119	48	5
1981	959	182	216	145	54	8
1991	1,401	236	287	171	57	6
2001	1,767	341	420	2 2 3	77	8
2011	2,649	NA	NA	NA	NA	NA

Census Wise city categories (I, II, III, IV, V and VI) shown in table no. 2 from 1951-2011.

The number of factories added between the financial years 2005-2020. Maximum number of factories were added in Tamilnadu(17789), Telangana (15271) and Gujrat (14876). Haryana, Maharashtra, Karnataka, and Uttar Pradesh have four-digit factories of around six thousand. Minimum factories added in Chandigarh (37) whenever Chandigarh is the capital of two states. After that Nagaland (77), Meghalaya (100) and Delhi (103) were in the sequential order.

Half of the global population already lives in cities, and by 2050 two-thirds of the world's people are expected to live in urban areas. In 1991 urban population in India was 25.7% sharing total population and 35.4% in 2021. It is expected that the percentage of urban population will be 43.2% in 2035(Expected). In sheer numbers "Urban India" is the third most populous country in the world after China and "Rural India".

Climate Change

Climate change[11] presents a unique risk to the livelihood of people. Over the past few decades, it has become increasingly apparent that human actions are changing atmospheric conditions, thereby causing Global climate change.

Root Causes of Climate Change

1. Developing fossil fuels
2. Producing electricity and heat
3. Cars and planes
4. Buildings
5. Industrial wastage
6. Overcrowding in urban areas

Effects of Climate Change

- Hotter temperature
- More severe storms
- Increase drought
- A warming, rising ocean
- Loss of species
- Not enough food
- Increasing health risks
- Poverty and displacement

Recognition of climate changes, significant universal environmental challenges, has its origin in the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992. After that various actions were taken by international and national governments.The newly formed climate change department has received its first budget allocation Rs. 100 crores for 2010-11.

Grants from Green Climate Fund

The Green Climate Fund (GCF) was set up under the United Nations Framework Convention on Climate Change (UNFCCC) at the 16th Conference of the Parties (COP-16) in 2010 to support developing countries in reducing greenhouse gas emissions and strengthening capacity to adapt to climate change. The Fund aims to mobilize funding at scale to invest in low-emission and climate-resilient development. All developing country Parties to UNFCCC are eligible to receive resources from the GCF in the form of grants, loans, equity, and guarantees. The GCF has started approving projects/programmes to developing countries from 2015 onwards. The Government of India has been engaging with the GCF and so far, eleven (11) projects/ programmes have been approved to India with a total allocation of USD 782.4 million to mitigate and adapt to climate change in sectors including water, clean energy, coastal, livelihood, transport, medium and small enterprises and climate start-ups. The details of projects are given below:

S. No.	Projects/Programmes	Year of Approval	GCF Funding (in Million USD)
1.	Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha	2017	34.357 (Grant)
2.	Line of Credit for Solar Rooftop Segment for Commercial, Industrial and Residential Housing	2018	100 (Concessional Loan)
3.	Enhancing Climate Resilience of India's Coastal Communities	2018	43.18 (Grant)
4.	Green Growth Equity Fund (GGEF)	2021	137(132.5 Equity, 4.5 Grant)
5.	India E-Mobility Financing Program	2022	200 (Equity)

6.	Climate Investor Two	2022	145 (Multi-country) (Grant)
7.	Green Guarantee Company (GGC)	2022	40.5 (Multi-country) (Equity)
8.	Climate Investor One	2022	100 (Multi-country) (Grant)
9.	Project GAIA ("GAIA")	2023	152.5 (multi-country) (Equity)
10.	Avaana	2024	24.5 (Equity)
11.	Financing Mitigation and Adaption Projects (FMAP) in Indian MSMEs	2024	215.6 (200 Concessional Loan, 15.6 Grant)

(Above information was given by the Minister of State for Environment, Forest and Climate Change, Shri Kirti Vardhan Singh in a written reply in the Rajya Sabha)[12]

Findings of this Study

There are so many positive implications of urbanisation in developing and developed countries like India also. After the observation of table 1 and table 2 we find that Urban population has increased 1.8 times between 1951 to 2011 but the population has increased 9.5 times in the first category. The second, third and fourth category wise population increased to 5.6, 4.3 and 2.6. Fifth and sixth are those categories where population decreased between 1951-2011. Tamil Nadu is the most industrialised state and minimum factories added in Chandigarh.

Measures to Solve Urbanization Problems: The following measures can be suggested to solve the problem of urbanisation.

1. In the majority of developing countries like India, the public sector owns and controls urban areas. The local bodies or Municipal corporations should provide such services as water supply, sewerage, management of solid and liquid waste gas, electricity etc.
2. Population growth in urban areas should be controlled and brought down. The need is to reduce the birth rate, especially among the urban poor. So far as the death rate is concerned, it is being cut down with improvement in health services even in slums.
3. There is greater need for infrastructure development in urban areas in order to remove crowding and population.
4. There should be controlled crime and violence by city police and administration.
5. There should be dispersal of industries by establishing new industrial centres and towns in the Periphery of the metropolis.

6. Living conditions in villages should be improved by providing drinking water, electricity, Medical, Health and education facilities. It is also imperative to create larger employment opportunities in villages by setting up ancillary, food processing and other industries.
7. Besides, a good network of transport and communication system should be laid for the movement of labour, farm produce and industrial raw materials from rural to urban areas.[13]
8. Villages should be developed in a systematic manner like urban areas and should be Support to handicrafts industries.
9. For climate peace go back to agrarian economy because agriculture inputs are raw materials of industries.[14]
10. It is better than the best for future generations as well as culture and climate safety also.

References

1. Jhingan M.L., Jhingan B.K.- "Urbanisation" in "The Economics of Development and Planning", Vrinda Publications (P) LTD. Delhi, 2021, page 376.
2. Urbanisation Yale.Yale.edu/research/theme-4
3. https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities-and-climate-change#:~:text=At%20the%20same%20time%2C%20cities,contributors%20(IPCC%2C%202022).
4. Zihan Liu https://www.nature.com/articles/s43247-022-00539-x?frompaywallRec=false
5. Keith Michael- "Expert comment: Urbanisation's role in the Climate Crisis is being Overlooked", Financial Times, https://www.ox.ac.uk>news>20.
6. Ibid.
7. Xueqin Li [1, *], Lindsay C. Stringer [1] and Martin Dallimer [2] - "The Impacts of Urbanisation and Climate Change on the Urban Thermal Environment in Africa", https://www.mdpi.com/2225-1154/10/11/164
8. B. Maheshwari [a], U. Pinto [b], S. Akbar [c], P. Fahey [a-] "Is urbanisation also the culprit of climate change? – Evidence from Australian cities", https://www.sciencedirect.com/science/article/abs/pii/S2212095518301998
9. published by Aaron O'Neill, Feb 13, 2025, https://www.statista.com/statistics/271312/urbanisation-in-india/
10. https://www.globaldata.com/data-insights/macroeconomic/urbanisation-rate-in-india-2096096/
11. https://www.ox.ac.uk/news/2024-01-29-expert-comment-urbanisation-s-role-climate-crisis-being-overlooked#:~:text=The%20data%20on%20this%20is,of%20carbon%20dioxide%20equivalent%20emissions.
12. Posted On: 08 AUG 2024 1:21PM by PIB Delhi https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2043003
13. https://www.nature.com/articles/s41598-022-18193-w#:~:text=Both%20global%20climate%20warming%20and,depending%20on%20a%20specific%20year
14. https://www.nature.com/articles/s44284-024-00074-0#:~:text=The%20mean%20urban%20effect%20for,%2Durban%20areas%20(Supplementary%20Fig.

State Accountability in Climate Change: India's Case Study on Cooperative Federalism with Special Reference to Uttar Pradesh

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ABSTRACT

The Indian Constitution's unitary nature with a federal setup underscores the roles of states in areas like agriculture and climate change. Uttar Pradesh, India's most populous state, has made notable strides in climate action, being the first to align its state budget with the PM's PANCHAMRIT initiative. However, despite increased budgetary allocations for renewable energy and environmental protection, challenges in implementation and accountability persist. Disparities in income, resources, and policy execution across states impact the overall effectiveness of climate initiatives. This article explores how international standards for climate change mitigation influence the collaborative efforts between India's central and State governments, particularly focusing on cooperative federalism and its impact on state accountability. It examines the division of responsibilities, assesses the effectiveness of current collaborative actions, and reviews the state's climate initiatives to gauge accountability. The study shows that states are addressing the issue of climate change in a responsible manner, as most of the states have SAPCCs, and the mean SDG index for state and energy efficiency has been improving over the years. Also, the disparity in performance for climate action among the states is decreasing. Addressing these disparities, enhancing state accountability, and promoting sustainable, inclusive development are essential for cohesive national progress.

Keywords: *Climate Change, Climate Governance, Co-operative Federalism, State Accountability, Uttar Pradesh SAPCC, SDGs and Energy Efficiency*

Introduction

Climate governance, referred to as the use of institutions, rules, and administrative resources for climate actions, is a multifaceted and complex issue. It involves various stakeholders, different levels of governance, and international frameworks. The coordination from all tiers of government demanded to work together on common global challenges of climate change. And keeping the balance between economic development and environmental sustainability. State accountability in

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climate change involves a complex interplay between domestic and international responsibilities, with Central and State governments playing crucial roles. The challenge lies in effectively coordinating these roles to address climate change impacts and fulfilling obligations under international law.

The major factor behind climate change is human activities such as the use of petroleum products and continuous deforestation. Thus, the increase in greenhouse gases such as carbon dioxide (CO_2) makes the environment harmful to species. Climate change can be referred to as the long-term shifts in temperature, precipitation, and weather patterns. Decentralized governance redistributes decision-making power across different levels of government and promotes inclusive development strategy involving local communities in climate action. Thus plays a crucial role in addressing climate change. It can enhance the effectiveness of climate policies by transforming them to local contexts and demands. Federal systems can both facilitate and hinder effective climate policy implementation. Federalism is characterized by the division of powers between national and subnational governments and offers some unique opportunities. And also challenges climate governance as well. This dynamic is evident in various countries, each with its federal structure and approach to climate policy.

Federalism can lead to policy fragmentation and coordination challenges, as seen in the European Union (EU) and Switzerland. Diverging priorities among member states in the EU and cantons in Switzerland can complicate intergovernmental decision-making and hinder the implementation of the concerned climate policies (Fenna et al., 2023). Indonesia's decentralized governance has allowed sub-national entities to engage directly with transnational climate initiatives, fostering innovative policies in the land use sector (Gregorio & Moeliono, 2023). Federal systems, like those in Canada and India, allow for localized climate action. The sub-national entities can tailor policies to their specific environmental and socio-economic contexts. This proximity to local issues enables more effective implementation of climate policies (Chakraborty et al., 2024). Decentralized governance fosters cooperation among various levels of government, which is essential for achieving climate mitigation goals. It also encourages policy innovation, as seen in Indonesia, where sub-national jurisdictions have developed unique approaches to climate action in the land use sector (Gregorio & Moeliono, 2023). Decentralized governance enables diverse actors, including subnational and nonstate entities, to initiate and implement climate actions at various levels of government. This polycentric approach fosters innovation and adaptability, allowing for tailored solutions that can be scaled up, thereby enhancing the overall effectiveness of climate governance beyond the limitations of traditional nation-state-centric frameworks (Jordan et al., 2018; Stehle, 2021). The term "polycentric" has its origin in botanical studies. Ostrom, Tiebout, and Warren (1961) introduced polycentricity to explain how U.S. metropolitan areas operate without a single dominant authority, instead relying on multiple independent local bodies that, despite appearing uncoordinated, effectively provide public goods and services (Stephan et al., 2019). While decentralization can lead to innovative solutions, it also risks policy fragmentation, which may hinder cohesive national and international climate strategies. Ensuring coordination and alignment across different governance levels is crucial to overcoming these challenges (Stehle, 2021).

Despite the benefits of decentralized governance, global coordination remains essential. The 'United Nations Framework Convention on Climate Change' (UNFCCC) and the Paris Agreement adopted on December 12, 2015, at the 'UN Climate Change Conference' (COP21) in Paris, provide

frameworks for international cooperation. They highlighted the need for a balance between domestic actions and global commitments. The question arises, that under the international standards over climate change mitigation, how do the collaborative efforts of the Centre and State governments in India and financial decentralization shape state accountability in addressing climate change? To figure it out we work on the following objectives in this article:

- Evaluating the distribution of roles and responsibilities between the Central and State governments in policy implementation,
- Examining the strength of current collaborative efforts of the Centre and State governments towards climate change,
- To go through India's case study on climate actions to determine state accountability and performance,

The next section is on the literature review to examine the studies on the climate change response in India at the state level with special reference to Uttar Pradesh. The third is on the methodology. The fourth section describes the distribution of roles and responsibilities under the constitution of India. The fifth section mentions the collaborative effort of the Centre and States with a focus on Uttar Pradesh. The next section describes the state's accountability towards climate action in India. The last section concludes the study with recommendations to enhance the effectiveness of India's efforts in mitigating the problem of climate change.

Literature Review

India has been actively undertaking the mitigation of climate change initiatives. This drive is operational at both the national and sub-national levels, to address the challenges posed by climate change. The country's efforts are driven by international commitments and the need to balance developmental goals with environmental sustainability. Various State governments have implemented specific policies and programs to mitigate climate impacts, reflecting a diverse approach tailored to regional needs.

India has developed comprehensive national policies. The 'National Action Plan on Climate Change' (NAPCC) at the national level, includes missions focused on solar energy, energy efficiency, sustainable agriculture, and water conservation (S. Singh & Singh, 2021). Some states like Gujarat and Tamil Nadu have pioneered renewable energy projects, while others focus on climate-resilient agriculture and water management strategies (Sinha et al., 2018). Transitioning to a low-carbon economy presents challenges. Challenges such as balancing economic growth with emission reductions. However, it also offers opportunities for innovation in renewable energy and sustainable infrastructure (Sinha et al., 2018). Initiatives at the subnational level serve as experimental grounds for testing climate policies, potentially influencing broader national strategies (Jörgensen, 2011).

The Indian Constitution provides an institutional framework for environmental protection and climate change. It assigns the roles and responsibilities to both the Union and state governments. This framework is crucial for addressing climate and environmental challenges, given India's federal setup. The Constitution not only empowers the legislature to enact environmental laws but also elevates environmental protection to a high national goal. The division of legislative authority and the interpretation of constitutional provisions by the judiciary further shape the role of states in

environmental responsibilities. The Indian Constitution includes specific provisions for environmental protection. It mentions environmental protection in the Fundamental Duties and the Directive Principles of State Policy. And these are the guides of both the Union and state governments in environmental governance (Divan & Rosencranz, 2022). The federal structure demarcates law-making powers, with states responsible for areas crucial to climate action, such as water and electricity, necessitating cooperation between the Union and states (Fenna et al., 2023).

Decentralization allows for a bottom-up approach to policy implementation, which can lead to more effective climate policies. This is particularly evident in advanced economies where decentralization is associated with increased government spending on environmental programs and higher environmental tax collection (De Mello & Jalles, 2024). The state governments are well-positioned to identify climate change mitigation opportunities. However, the financial burden of these efforts can be significant (Gilmore & St.Clair, 2018). Resource constraints are a major barrier to State accountability, as they limit the state's ability to follow its obligations.

Uttar Pradesh, India's most populous state, with a geographical position well in the northern Gangetic plains, however, making significant contributions in actions to mitigate climate change, faces significant challenges in implementing climate action and green policies. The state's environmental issues are compounded by socio-economic factors, which makes it crucial to analyze the literature on challenges, and intergovernmental cooperation in climate action. Uttar Pradesh has made strides in promoting renewable energy sources, with a Renewable Energy Board and significant potential for renewable energy. However, the state still lags in fully exploiting these renewable energy sources because of various challenges, including policy implementation and infrastructure development (Sharma et al., 2019). The vulnerability to climate change in the state is linked to its socio-economic conditions. Districts with better infrastructure and economic development show less vulnerability, thus highlighting the requirement for integrated development strategies at the state level (Tripathi, 2014)(Tripathi, 2017). Effective implementation of climate programs and policies is hindered by institutional and resource capacity, implementation challenges, and the need for policy reforms. Public participation and inter-departmental collaboration are crucial for overcoming such barriers. The lack of green financing mechanisms and investment in sustainable infrastructure poses a challenge to implementing environmental policies (Selvamuthu & Lavaraju, 2024).

There is a significant gap in comparison to other states in Uttar Pradesh's climate strategy. The lack of awareness and education among farmers and illiterates about Climate Smart Agriculture (CSA), is compounded by uncertain returns (H. C. Singh et al., 2023). Climate Smart Agriculture is a farming method that aims at adaptation, increased productivity, and reduction in greenhouse gas emissions. The state exhibits varying levels of vulnerability to climate change across different regions. For example, the socio-economic condition and lack of adaptive capacity make the Bundelkhand region highly vulnerable to climate change. A need for targeted interventions for climate change mitigation can be identified there (Jatav, 2024).

Political will is important for effective state accountability because it renders the commitment to uphold legal and ethical standards. The lack of political will can lead to a gap between policy formulation and implementation (Nordin, 2018). The politics on accountability highlight the influence of political dynamics on accountability processes.

Data Collection and Research Methodology

The paper includes qualitative and quantitative analysis. Qualitative analysis using the case study of India for cooperative federalism and state accountability and policy document reviews has been done. Secondary data has been taken from the Report on Key Features of Budget 2024-25, Government of Uttar Pradesh, Budgetary Provision, Department of Additional Source of Energy, Government of Uttar Pradesh, and Handbook of Statistics on Indian Economy, RBI. The results are concluded based on facts and figures from various government reports and official websites of related government agencies, along with the graphical presentation of the data. Uttar Pradesh has been taken as the special reference for the analysis of India's state-level response and accountability to the problem of climate change.

The descriptive statistics on the index of Sustainable Development Goals is added to represent the performance of states in achieving the set target under the SDGs. SECI and SEEI indexes are added to determine the efficiency of states in energy and climate change mitigation actions.

Distribution of Responsibilities and Cooperative Federalism

The Indian Constitution's Seventh Schedule through Union, State, and Concurrent lists, delineates responsibilities between the Centre and States and describes the powers through Union, State, and Concurrent lists, necessitating cooperation for effective governance, especially given the political diversity across states (Hill, 2022; Simon, 2024). However, with the given responsibilities, the use of fiscal powers is always a challenge before the subnational level governments in India. The concept of cooperative federalism is often important in this scenario. And, in India, NITI Ayog is also promoting cooperative federalism for inclusive growth. Cooperative federalism refers to the collaboration between the state and Central governments to promote decision-making and resource allocation with coordination. In Brazil, cooperative federalism is proposed as a means to enhance the protection of cultural heritage through better coordination among federal entities, however, there is a challenge to practical implications (Júnior & de França Pereira, 2023). Environmental protection, and climate change mitigation are examples of bottom-up (refers to the implementation, negotiation, and consensus-building approach) policy-making models. These models tend to be relatively more effective under a federal system of government, because of local-level authorities which are closer to the communities, they serve (Chakraborty et al., 2024).

India has made notable progress in addressing climate change, but more action is needed to move to impactful implementation. The success of emissions reduction and resilience efforts relies on the coordinated execution of plans by state governments. Overcoming implementation barriers requires a participatory approach grounded in political economy, engaging local stakeholders and leveraging existing structures to ensure efficiency and sustainability. Enhanced coordination among states can enable the exchange of best practices, paving the way for effective climate action at both national and sub-national levels. Environmental protection remains a cornerstone of governance in India, with the National Action Plan on Climate Change (NAPCC), launched in 2008, serving as a guiding framework through its eight National Missions. Ministries and departments collaborate closely to achieve the goals set by the NAPCC. Complementing these efforts, most states and union territories have formulated their State Action Plans on Climate Change (SAPCC) to address national objectives while catering to state-specific priorities. By 2018, 33 States and Union Territories (UTs)

had developed SAPCCs to integrate climate considerations into their planning processes. Subsequently, these plans were revised to align with India's post-2020 climate commitments.

As per the SAPCC revision guidelines, India's post-2020 Nationally Determined Contributions (NDCs) have eight goals, with key quantifiable targets for reduction in emissions (to reduce it by 33 to 35 percent through 2030 from the level of 2005), renewable energy (to achieve the target of 40 percent of cumulative electric power by 2030 from renewable sources), and forestry (to create additional 2.5 to 3 billion tonnes of carbon dioxide through the forest cover by 2030). SAPCCs should align with the NDC implementation cycle (which is 2021-2030 and beyond), leveraging state budgets and integrating existing schemes for funding. SAPCCs should also outline additional state resources beyond nationally funded programs.

Table 1: Uttar Pradesh SAPCC Financial Budget (in Crore Rs.)

Mission	Budget SAPCC (2014-18)	Budget SAPCC (2021-30)
Sustainable Agriculture Mission (SAM)	102.75	29,797.73
Solar Mission (SM)	449.75	-
Energy Efficiency Mission (SEM)	-	3,127.55
Green UP Mission (GUPM)	8,480.50	6,292.68
Strategic Knowledge Mission (SKM)	136.00	12.75
Jal Mission (JM)	24,400.67	64,170.13
Sustainable Habitat Mission (SHM)	13,375.90	8,326.75
Human Health Mission (HHM)	-	171.50
Disaster Management Mission (DMM)	-	305.70
TOTAL	46,945.56	1,12,204.79

Source: 1 Report on UP SAPCC- 2014-18, Department of Environment, Forest and Climate Change, Government of Uttar Pradesh (GoUP). 2. UP SAPCC- 2021-30, Department of Environment, Forest and Climate Change, GoUP.

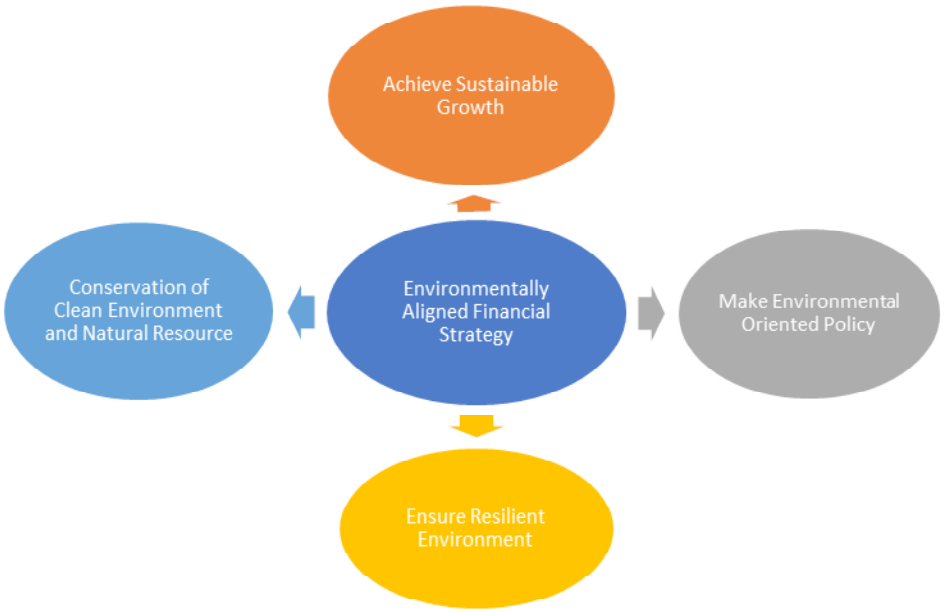
Department of Environment, Forest and Climate change, the Government of Uttar Pradesh provides the financial budget and policy framework for climate action under the SAPCC. The above table provides the details of the financial budget for the action plan for 2014-18 and 2021-30. SAPCC for 2014-18 includes the Sustainable Agriculture Mission (SAM), Solar Mission (SM), Energy Efficiency Mission (SEM), Green UP Mission (GUPM), Strategic Knowledge Mission (SKM), Jal Mission (JM), Sustainable Habitat Mission (SHM) with a total budget of Rs. 46945.56 crore. The SAPCC 2021-30, includes the Human Health Mission, and Disaster Management Mission additionally, with a total financial requirement of Rs. 112204.79 crore.

Collaborative Efforts of the Centre and Uttar Pradesh Governments

The 26th United Nations Climate Change Conference (COP26) occurred at the SEC Centre in Glasgow, Scotland, from October 31 to November 13, 2021. During the conference, India's Prime Minister outlined the "Panchamrit" action plan to combat climate change. The plan includes:

achieving 500 GW of non-fossil fuel energy capacity, meeting 50% of the country's energy needs from renewable sources, cutting total projected carbon emissions by one billion tonnes, lowering the economy's carbon intensity to below 45% by 2030, and reaching net-zero emissions by 2070. In response to this plan, the government of Uttar Pradesh has included a new budget initiative (green budget) and has become the first state in India to use the green tagging budgetary estimate. The government of Uttar Pradesh has included in its budget 2024-25, the environmentally aligned financial strategy which targets achieving sustainable growth, making an environmentally oriented policy, ensuring a resilient environment, and conserving the environment and natural resources. The government of Uttar Pradesh is hopefully undertaking the drives to make environmentally oriented policies and conserve natural resources to put a step further towards sustainable growth; but aggravated fundamental economic issues such as low income, high rate of poverty, and unemployment lower the people's participation in this drive and challenge the idea of inclusive development which gives a tough fight against the plan outlined in the budget 2024-25. For this purpose, as well, the state's will and fiscal autonomy is demanded.

Figure 1: Environmentally Aligned Financial Strategy of Uttar Pradesh in the Budget 2024-25



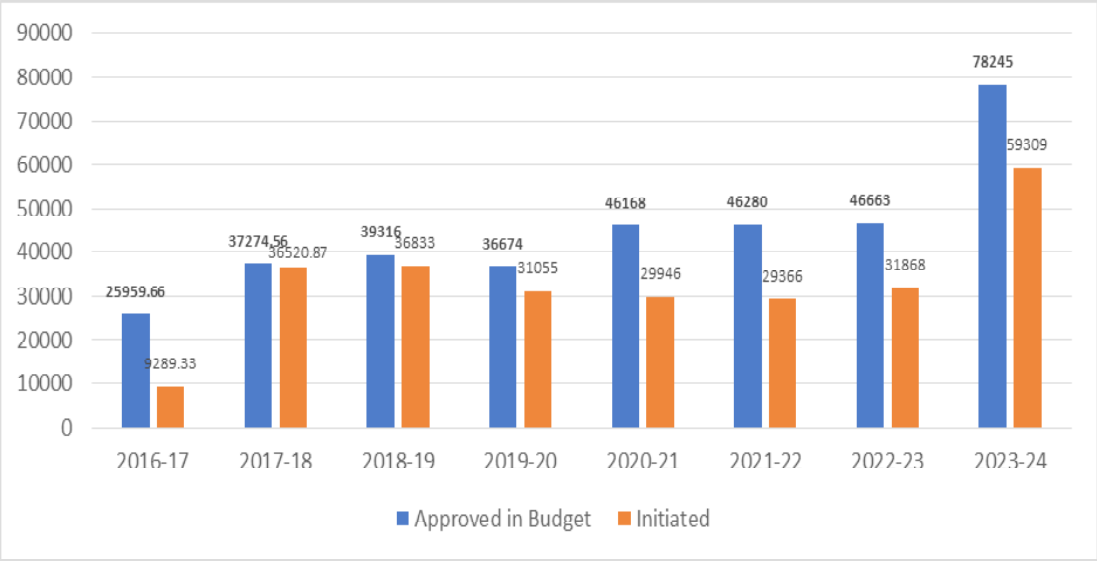
Source: Report on Key Features of Budget 2024-25, Government of Uttar Pradesh.

Although, some remarkable and pathbreaking steps have been taken by the government of Uttar Pradesh towards the climate change policy like Solar Energy Policy 2022, State Bio-Energy Policy 2022, Enhancing Bio-diversity through Namami Gange Initiative, Electrictric Vehicle Manufacturing and Mobility Policy 2022, and Green Energy Corridor.

State Governments are contributing towards renewable energy sources and providing a separate budget outlay, which is shown in Figure 2. The figure shows the budgetary provisions and final amount initiated (in Lakhs) for the development of renewable energy sources. These budgetary

provisions include promotion, publicity, implementation, modernization, and establishment of renewable energy sources in Uttar Pradesh. The trend is increasing, however, there is a significant gap between figures in the budget and the final approval of finances. A sharp increase in financial outlay from 9289.33 lakh to 36520.87 lakh was seen with the new government taking place in the state in 2017 (Figure 2). And again, a similar jump is seen in 2023-24, from 31868 lakh in 2022-23 to 59309 in 2023-24, after a gradual decline period of five years (Figure 2).

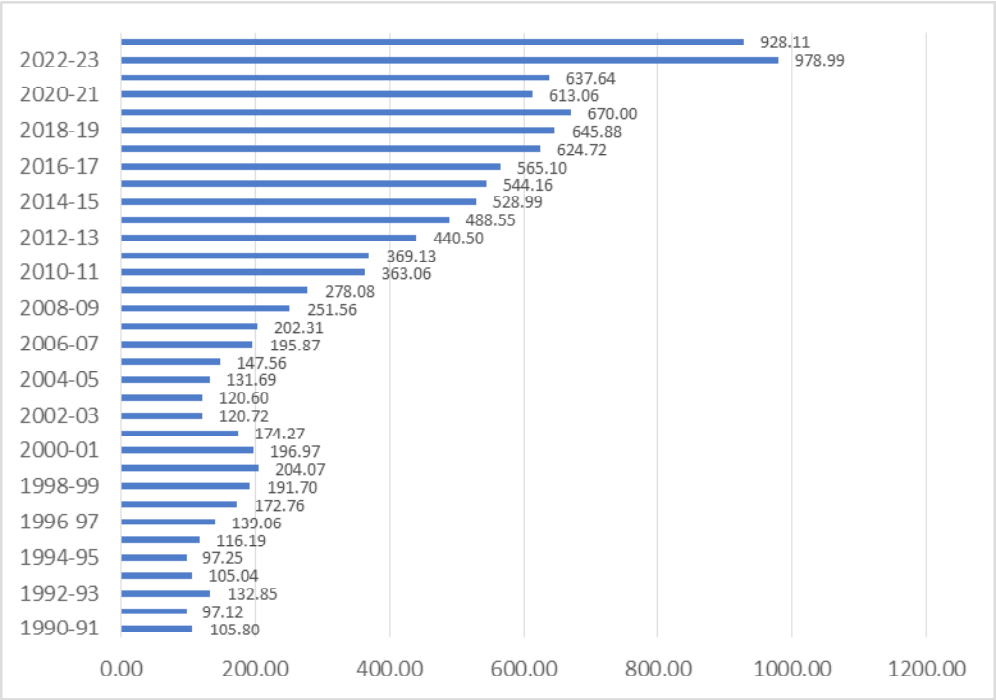
Figure 2: Budgetary Provision for Expenditure on Renewable Energy Sources (Lakh)



Source: Budgetary Provision, Department of Additional Source of Energy, Government of Uttar Pradesh.

Uttar Pradesh has taken significant steps to increase its green cover, as highlighted by the state government's ambitious effort. Between July 20 and September 30, 2024, the state planted a record-breaking 36.80 crore saplings to fulfil its long-term environmental commitment. This initiative aligned with the state's target of achieving 15 percent green cover by 2027. The optimism underlying this target is supported by a dedicated historical survival rate of 79% for saplings planted by the forest department of Uttar Pradesh from 2017 to 2021, as noted in the plantation monitoring report. Apart from these recent developments in this direction, figure 3 shows financial outlay for the plantation, forestry, and wildlife development an increasing trend since 1991-92, particularly relatively bigger bars making a tree-like shape show a significant and fast action towards this direction of climate policy actions in recent years. In the year 1998-99, for the first time, the expenditure has crossed the level of 200 crore (Figure 3). The expenditure on forestry and wildlife in Uttar Pradesh during 1998-2002 increased due to policy initiatives for conservation, afforestation programs, response to depleting forest resources, and compliance with national and international commitments. In the years 2021-22 and 2022-23, there is a sudden rise in expenditure (Figure 3).

Figure 3: Expenditure on Forestry, Wildlife, and Plantation in Uttar Pradesh (Crore)



Source: Handbook of Statistics on Indian Economy, RBI.

Effectiveness of State Accountability

The Constitution outlines the concurrent powers on subjects such as forests, the environment, and renewable energy, allowing for cooperative federalism in policy implementation. This framework facilitates shared governance while ensuring state accountability, crucial for climate action given the diverse environmental and socio-economic conditions across regions. The 2015 Climate Change Agreement (Paris Agreement) highlighted the need for strong accountability mechanisms at both international and domestic levels. Effective accountability requires a mix of legal, policy, and institutional frameworks that ensure states adhere to their climate commitments (Karlsson-Vinkhuyzen et al., 2018).

The following Table (Table 2) presents the descriptive statistics of Sustainable Development Goals at the state level for all the states for the years from 2018 to 2023. It represents the improvement in the performance of regional sustainable development. The mean score of all the states was 58.11 in 2018, which has shown a significant improvement in the subsequent years. In 2019, it was 60.83, and a significant improvement was seen in 2020 with an average score of 66.05. It further increased to 70.72 percent in 2023. The same trend is observed in the median of the score. Standard deviation is presented to capture the disparity in the performance of states, which was 6.44 in 2018, and improved after that. In 2023, the standard deviation of 5.39, an improvement over previous years, suggests a decrease in the disparity in the performance of states in sustainable development.

Table 2: SDG Score of All States and UTs

Statistics	Year 2018	Year 2019	Year 2020	Year 2023
Mean	58.11	60.83	66.05	70.72
Median	58.50	60.50	67.00	71.50
Std. Dev.	6.44	5.21	5.98	5.39

Source: Authors' calculations on the state-wise SDG data provided by RBI.

Some examples of cooperative federalism for India's climate action efforts can be seen in states like the Integrated Approach for Climate Resilience in Maharashtra and Ecosystem-Based Adaptation in Kerala. Maharashtra's SAPCC focuses on sustainable agriculture, water conservation, and renewable energy expansion. Leveraging funds from the central government through schemes like the National Mission for Green India, the state launched projects combining federal and local resources. The 'Jalyukt Shivar Abhiyan', a flagship water conservation initiative, represents an example of blending state and central support to counteract severe droughts. The scheme reduces farmers' dependence on erratic monsoons, thus strengthening climate resilience. Kerala, known for its high rainfall and dense forests, created a SAPCC emphasizing ecosystem-based adaptation. The state partnered with the central government and international bodies to implement programs focusing on sustainable forest management and community-led initiatives to combat flooding. The success of these programs was evident when Kerala mitigated the impacts of successive floods in 2018 and 2019 through enhanced local response systems supported by state accountability mechanisms.

Fiscal support from the central government and coordination, providing suitable institutional frameworks, and public-private partnerships are impactful factors that make climate actions at the state level more effective. Central funding through programs like the Green India Mission and National Adaptation Fund for Climate Change empowered states to implement local projects. The integrated approach enabled states to prioritize areas needing immediate attention while aligning with national policies. Joint committees between central and state representatives facilitated transparency and accountability, ensuring adherence to environmental targets. States that embraced the Public-Private Partnership Model (PPPs) saw accelerated technology transfer and funding for climate projects. Maharashtra's solar energy initiatives benefited from corporate partnerships that complemented state and central investments.

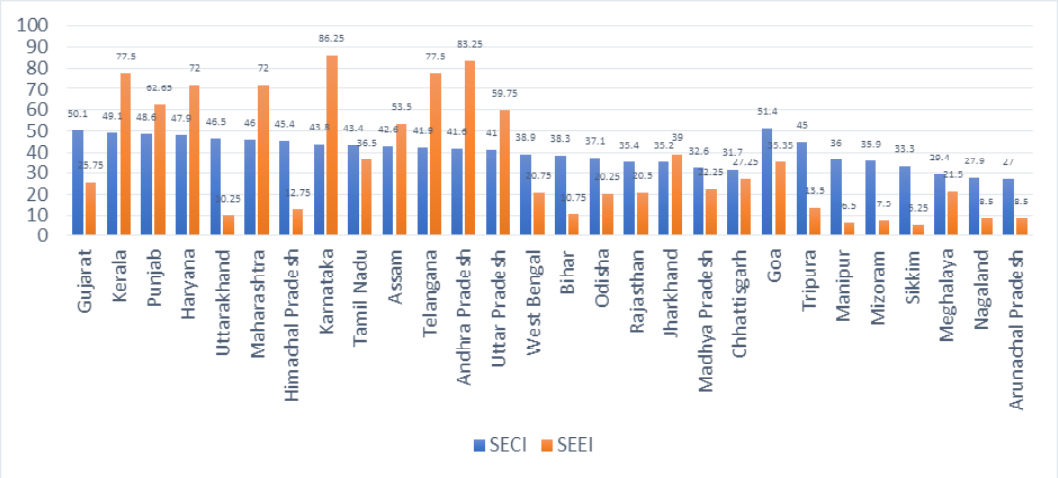
Cooperative efforts among states and the federal government can amplify the impact of climate actions, thus highlighting the need for integrated policy approaches. However, State actions, while significant, often face limitations without central support. The interplay between state and federal policies can either enhance or hinder the effectiveness of state-led climate change mitigation initiatives (Ramseur, 2007).

The state-level disparity in resources and administrative capacity affects the implementation of climate actions. While states like Maharashtra showed progress due to administrative capacity and resource availability, poorer states struggled to implement their SAPCCs effectively. States like Maharashtra and Karnataka have better access to financial resources through state revenues and robust economic activities. For instance, Maharashtra's GDP is one of the highest among Indian states, enabling more substantial investment in climate action. In contrast, states such as Bihar,

Odisha, and Jharkhand have comparatively lower per capita income, and their budget constraints limit their ability to finance SAPCC initiatives. Poorer states often rely heavily on central government funding and external sources, such as international climate funds. This dependence hampers their ability to plan long-term climate actions autonomously and adapt policies effectively when funding is inconsistent or delayed. States like Maharashtra and Karnataka have shown significant progress, meeting or exceeding targets outlined in their SAPCCs, such as improvements in renewable energy capacity and water management. For instance, Maharashtra's 'Jalyukt Shivar Abhiyan' led to a measurable increase in water availability and agricultural productivity. On the other hand, states with weaker capacity struggle to update or maintain momentum in their SAPCCs. As a result, the progress toward national climate goals is inconsistent and creates gaps in regional preparedness and adaptation.

There are some accountability issues as well in policy implementation at the state level. Some states like Bihar, Uttar Pradesh, and Jharkhand initially prepared SAPCCs but failed to update them or enforce targets, highlighting the need for better monitoring by the central government, attributed to limited technical expertise and administrative capacity, funding shortage, and insufficient coordination between state departments, or an insufficient institutional framework. A report from the Centre for Science and Environment (CSE) 2021 pointed out that several state SAPCCs lacked proper implementation frameworks, with only a few states maintaining strong enforcement mechanisms. The Ministry of Environment, Forest and Climate Change (MoEFCC) oversees the review and approval of SAPCCs but has limited capacity for ongoing monitoring due to resource constraints. The central government could establish a dedicated task force for SAPCC evaluations, ensuring that updates are regular and aligned with current research. Technical training and financial support programs for state governments can bridge knowledge and resource gaps. Enabling local bodies to participate in monitoring efforts can improve on-the-ground implementation and transparency.

Figure 4 State SECI and SEEI (2022-23)



Source: Report on State Energy and Climate Index 2022 (NITI Aayog)

The State Energy Consumption Index (SECI) and State Energy Efficiency Index (SEEI) are pivotal tools for assessing and benchmarking the energy performance of states in India. SECI typically focuses on measuring the overall energy consumption patterns across various sectors, including residential, industrial, transportation, and agricultural domains. It includes the index of the Distribution company's Performance Access, affordability & reliability, Clean Energy Initiatives, Energy Efficiency, and Environmental Sustainability. In contrast, SEEI evaluates the efforts and effectiveness of states in improving energy efficiency. It considers parameters such as the implementation of energy-efficient technologies, policy initiatives, compliance with energy conservation measures, and overall reduction in energy intensity per unit of economic output. Together, these indices provide a comprehensive view of a state's energy profile, offering insights into consumption trends and the effectiveness of efficiency measures. By integrating these metrics, policymakers and researchers can identify disparities, track progress toward sustainable energy goals, and design targeted interventions to optimize energy use while minimizing environmental impact (*27_stateactionplan.Pdf*, n.d.).

Their relevance to climate change lies in their ability to link energy patterns with greenhouse gas (GHG) emissions, as energy production and consumption are among the largest contributors to GHG emissions globally. High SECI values often correlate with increased emissions, highlighting the need for transitioning to cleaner energy sources. Meanwhile, improvements in SEEI signify a state's progress in reducing energy wastage and mitigating climate impacts by optimizing resource use. By focusing on these indices, policymakers can identify energy-intensive sectors and implement targeted interventions to lower emissions, aligning with India's commitments under the Paris Agreement and its broader goals of achieving net-zero emissions. These indices not only aid in tracking progress toward sustainable energy consumption but also emphasize the role of states in combating climate change by promoting energy efficiency and transitioning to renewable energy sources.

Figure 4 represents the SECI and SEEI index of all the states in 2022-23 through the bar chart. It divides the states into larger and smaller state categories. From Gujarat to Chhattisgarh, it shows the larger states in descending order of SECI and smaller states from Goa to Arunachal Pradesh in descending order of SECI. However, SEEI is not ordered in the figure. Gujarat is at the top of the larger states with the highest State Energy Consumption Index, and Chhattisgarh is at the lowest place. In smaller states, Goa is at the top in SECI, while Arunachal Pradesh is at the lowest in the Index. Uttar Pradesh is in the 13th place in the larger states category with a score close to 40 in SECI. State Energy Efficiency Index suggests that Karnataka is at the top in energy efficiency, and Uttarakhand is at the lowest in the index table among larger states. In smaller states, Goa is the most energy efficient, while Sikkim is the most inefficient. Uttar Pradesh, with a score of 59.75, is in the 8th position.

The dependence of sub-national governments on central financing creates a hurdle in the smooth implementation of state-level climate action plans. Over-reliance on central grants without generating internal revenues limited states' fiscal autonomy in independently advancing their climate agendas. States like Bihar, Jharkhand, and Odisha rely on over 80% of climate financing from central sources, leaving limited room for autonomous, locally tailored climate action (Comptroller and Auditor General (CAG) Report, 2021). The need to adhere to central program guidelines can also delay projects, as states must wait for central approvals and allocations. For example, the Jal Jeevan

Mission, a centrally funded water initiative, faced delays in states unable to provide matching funds or fulfill specific project criteria. States could be encouraged to generate revenue through local green bonds, environmental taxes, or fees on high-emission industries. For example, 'green bonds' issued at the state level could attract private investment, allowing states to develop climate projects independently. Some states, like Tamil Nadu, have piloted state-level climate funds, pooling resources from state revenue, local businesses, and international donors. Establishing such funds across states could provide more financial autonomy for local projects. Encouraging private sector partnerships in renewable energy, waste management, and water conservation could supplement state finances. States can develop localized carbon pricing or emissions trading schemes to raise funds. California, a state in the U.S. exemplifies this model with its successful Cap-and-Trade Program, which has generated sufficient revenue for the state's climate and environmental projects.

Conclusion and Recommendations

The Indian constitution, being unitary with a federal setup, places importance on state and local governments with the roles and responsibilities concerned to local communities, such as agriculture, rural development, environmental protection, and climate change. The studies assert the importance of state-level action and accountability towards climate change. In India, the most populous and geographically located in northern India, Uttar Pradesh, is showing remarkable progress in climate actions. Particularly in recent years, the state has given special attention to climate action. It has prepared a budgetary plan and became the first state in India to initiate the target action in the form of an environmentally aligned financial strategy in the budget of the state after the PM introduced the PANCHAMRIT actions against climate change in India. But only mentioning the plan in the budget is not the whole work done, as the study also points out poor implementation and accountability in some states, including Uttar Pradesh. These climate actions have to be sincerely monitored and completed within the state's capacity.

The study shows that the budgetary provision towards renewable energy source promotion and development, as well as the expenditure on forestry and wildlife, and expenditure on plantation, has seen a significant increase in Uttar Pradesh. But with the increase in population and dependence on resources requires the pace needs to continue in the future, as environmental protection is an impactful factor in any economic activity. It is required to promote sustainable and inclusive development in the state as well as in India.

In the SDGs, states show an improvement over the years in the mean score. And decreasing standard deviation shows that all the states are performing better with increased competitiveness towards climate change policies and sustainable development. The State Energy Efficiency Index suggests that smaller states, such as Uttarakhand, Himachal Pradesh, Bihar, Tripura, Manipur, Mizoram, Sikkim, and Arunachal Pradesh, have the lowest energy efficiency, with a score lower than 20 out of 100.

The analysis of state accountability towards climate action provides that, however, cooperative federalism and inclusive development are the core of the development agenda of modern India. But, state-level disparity of income and resources, administration, political will, and policy implementation governs the outcome of not only the state level but also of the national level climate actions differently, and therefore their effectiveness is also different based on the regions. The

nation should work on reducing disparity, increasing state accountability, empowering the backward regions in resources, and guiding the state machinery to take proper action towards climate change.

Research Limitations

This research revolves around the accountability of states and their financial independence towards climate change mitigation. But as we discuss fiscal decentralization and climate governance, we are concerned with the importance of local government in India's case, as they are much closer to the community. Therefore, local governments should be highlighted in the discussion of climate policy. Another thing is that this research article has used some recent trends representing the current picture of Uttar Pradesh towards the climate action plan. It can be increased to get a broader understanding of India's state-level climate action plan. The study points out that fiscal autonomy matters to make states more responsive towards environmental protection and climate change policies. The discussion about the impact and benefits of budgetary autonomy at the state and local levels in India can be done concerning the climate change mitigation plans.

References

- Chakraborty, S., Banerjee, N., & Srivastva, U. (2024). FEDERALISM AND CLIMATE CHANGE: GAUGING THROUGH THE DECENTRALISED STRUCTURE OF INDIAN AND CANADIAN POLICIES. *NUJS Journal of Regulatory Studies*, *9*(2). https://doi.org/10.69953/njrs.v9i2.5
- De Mello, L., & Jalles, J. T. (2024). Decentralization and the environment: Cross-country evidence. *Applied Economics*, 1–11. https://doi.org/10.1080/00036846.2024.2313607
- Fenna, A., Jodoin, S., & Setzer, J. (Eds.). (2023). *Climate governance and federalism: A forum of federations comparative policy analysis*. Cambridge University Press.
- Gilmore, E. A., & St.Clair, T. (2018). Budgeting for climate change: Obstacles and opportunities at the US state level. *Climate Policy*, *18*(6), 729–741. https://doi.org/10.1080/14693062.2017.1366891
- Gregorio, M. D., & Moeliono, M. (2023). Climate Governance and Decentralization in Indonesia. In A. Fenna, S. Jodoin, & J. Setzer (Eds.), *Climate Governance and Federalism* (1st ed., pp. 198–217). Cambridge University Press. https://doi.org/10.1017/9781009249676.011
- Hill, G. (2022). Cooperative Federalism. In G. Hill, *National Uniform Legislation* (pp. 61–75). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-3292-2_4
- Jatav, S. S. (2024). Farmers' perception of climate change and livelihood vulnerability: A comparative study of Bundelkhand and Central regions of Uttar Pradesh, India. *Discover Sustainability*, *5*(1), 11. https://doi.org/10.1007/s43621-024-00193-7
- Jordan, A., Huitema, D., Van Asselt, H., & Forster, J. (Eds.). (2018). *Governing Climate Change: Polycentricity in Action?* (1st ed.). Cambridge University Press. https://doi.org/10.1017/9781108284646
- Jörgensen, K. (n.d.). *Climate Initiatives at the Subnational Level of the Indian States and their Interplay with Federal Policies*.
- Júnior, G. S. L., & de França Pereira, L. C. (2023). O FEDERALISMO COOPERATIVO NA PROTEÇÃO DO PATRIMÔNIO CULTURAL. *Revista Direitos Culturais*, *18*(44), 55–72.
- Karlsson-Vinkhuyzen, S. I., Groff, M., Tamás, P. A., Dahl, A. L., Harder, M., & Hassall, G. (2018). Entry into force and then? The Paris agreement and state accountability. *Climate Policy*, *18*(5), 593–599. https://doi.org/10.1080/14693062.2017.1331904

- Nordin, R. (2018). Accountability: State Capacity in Upholding the Rights of Indigenous Peoples in Malaysia. *SHS Web of Conferences*, *54*, 05006. https://www.shs-conferences.org/articles/shsconf/abs/2018/15/shsconf_icolgas2018_05006/shsconf_icolgas2018_05006.html
- Ramseur, J. L. (2007). Climate change: Action by states to address greenhouse gas emissions. *Global Climate Change Revisited*, 27.
- Selvamuthu, C. M., & Lavaraju, B. (2024). Examining the Environmental Policies and Sustainable Development Initiatives in India. *ESS Open Archive Eprints*, *273*, 27357299.
- Sharma, A., Singh, H. P., Sinha, S. K., Anwer, N., & Viral, R. K. (2019). Renewable energy powered electrification in Uttar Pradesh state. *2019 3rd International Conference on Recent Developments in Control, Automation & Power Engineering (RDCAPE)*, 443–447. https://ieeexplore.ieee.org/abstract/document/8979128/
- Simon, C. (2024). Building a Robust Federalism in India: Constitutional Provisions, Practical Challenges, and Pathways to Overcome. *International Journal of Multidisciplinary Research in Arts, Science and Technology*, *2*(7), 13–21.
- Singh, H. C., Verma, A. K., Patel, R. R., & Prajapati, C. S. (2023). Constraints perceived by the farmers regarding opportunity and challenges of climate smart agriculture in central plain zone of Uttar Pradesh, India. *International Journal of Environment and Climate Change*, *13*(10), 4366–4372.
- Singh, S., & Singh, R. B. (2021). Indian Climate Policy, Programs, and Initiatives. In S. Singh & R. B. Singh, *Simulating Climate Change and Livelihood Security* (pp. 273–299). Springer Singapore. https://doi.org/10.1007/978-981-16-4648-5_9
- Sinha, S. K., Subramanian, K. A., & Dutta, V. (2018). India's Progress and Plan of Action in Addressing Climate Change and Its Role in Setting an Effective, Cooperative and Equitable Climate Policy Architecture. *Climate Change and Environmental Sustainability*, *6*(1), 1. https://doi.org/10.5958/2320-642X.2018.00001.7
- Stehle, F. (2021). *Governing Climate Change: Polycentricity in Action?* By Andrew Jordan, Dave Huitema, Harro van Asselt, and Johanna Foster, editors. 2018. Cambridge: Cambridge University Press. *Global Environmental Politics*, *21*(1), 157–159. https://doi.org/10.1162/glep_r_00596
- Stephan, M., Marshall, G., & McGinnis, M. (2019). An Introduction to Polycentricity and Governance. In A. Thiel, W. A. Blomquist, & D. E. Garrick (Eds.), *Governing Complexity* (1st ed., pp. 21–44). Cambridge University Press. https://doi.org/10.1017/9781108325721.002
- Tripathi, A. (2014). *Socioeconomic backwardness increases vulnerability to climate change: Evidence from Uttar Pradesh*. Inst. of Economic Growth, Unvi. of Delhi Enclave. https://iegindia.org/upload/publication/Workpap/wp337.pdf
- Tripathi, A. (2017). Socioeconomic backwardness and vulnerability to climate change: Evidence from Uttar Pradesh state in India. *Journal of Environmental Planning and Management*, *60*(2), 328–350. https://doi.org/10.1080/09640568.2016.1157059

The Economics of Environmental Stewardship and Climate Action: Economic Impacts and Sustainable Solutions

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ABSTRACT

This paper explores the economic dimensions of environmental stewardship and climate action, emphasizing the interplay between economic development and environmental sustainability. It examines how climate policies, such as carbon pricing and green industrial policies, influence economic outcomes like GDP growth, employment, and sectoral shifts. The paper also discusses the role of businesses in advancing sustainability through innovation and investment in nature-positive strategies. Finally, it highlights the importance of international cooperation and policy coherence in achieving sustainable economic growth.

Introduction

The Economic Imperative of Environmental Stewardship and Climate Action

In today's rapidly changing world, environmental stewardship and climate action are not only environmental priorities but also economic imperatives. The traditional view that economic growth and environmental protection are mutually exclusive is outdated. A stable, resilient economy depends on healthy ecosystems, sustainable resource use, and climate stability. Climate change is already imposing heavy costs globally—damaging infrastructure, disrupting agriculture, worsening health outcomes, and threatening livelihoods, especially in developing nations. These impacts reduce economic productivity, increase public spending on disaster recovery, and deepen poverty and inequality.

However, taking proactive steps toward environmental sustainability offers significant economic benefits. Investing in renewable energy, improving energy efficiency, and adopting green technologies can create millions of jobs, increase productivity, and reduce long-term costs. According to the International Labour Organization, the global shift to a green economy could result in a net increase of 18 million jobs by 2030.The Stern Review, a landmark economic analysis, concluded that investing

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1% of global GDP annually in climate mitigation could prevent economic damage of up to 20% of global GDP in the future. Additionally, the rise of sustainable finance and ESG (Environmental, Social, and Governance) frameworks signals that financial markets increasingly reward environmental responsibility. In essence, climate action is not just about avoiding environmental catastrophe—it's a pathway to economic resilience, innovation, and inclusive growth. Governments, businesses, and societies must embrace sustainable development as a foundation for long-term prosperity.

The purpose of this paper is to explore the economic impacts of environmental stewardship and climate action, and to present a compelling case for sustainable solutions that align economic incentives with ecological preservation. It will examine the economic risks posed by environmental neglect, the benefits of green policies and technologies, the role of markets and businesses in driving change, and the importance of policy coherence and global cooperation. Ultimately, this paper argues that the economic imperative for environmental action is not just strong—it is urgent, unavoidable, and foundational to building a resilient and equitable global economy.

The Economics of Climate Change: An Overview

Climate change is no longer a distant threat—it is a current and pressing economic challenge. Its impacts stretch beyond environmental concerns, directly affecting global markets, productivity, and long-term development. Understanding the economics of climate change involves analyzing how rising temperatures, extreme weather, and sea-level rise influence economies, the cost of failing to act, and the systemic failures that market mechanisms alone cannot address.

- **Economic Impact of Climate Change**: The economic consequences of climate change are diverse and significant. Extreme weather events such as hurricanes, floods, and droughts damage infrastructure, disrupt supply chains, and reduce agricultural output. Developing nations are particularly vulnerable due to their higher dependence on climate-sensitive sectors and limited capacity to adapt. For example, lower crop yields can lead to food insecurity and higher prices, increasing poverty and social unrest.In the long term, productivity declines as heat stress affects human labor, particularly in sectors like construction and agriculture. Additionally, rising healthcare costs associated with climate-related diseases and the spread of vector-borne illnesses strain public health systems. Coastal cities face the risk of damage from sea-level rise, threatening property values and displacing communities, which adds to economic instability.
- **The Global Cost of Inaction**: The cost of inaction on climate change is projected to be far greater than the cost of proactive measures. According to various studies, including the influential Stern Review, if left unaddressed, climate change could shrink global GDP by up to 20% by the end of the century. This would result from increased disaster recovery expenses, lost productivity, migration pressures, and damage to natural capital. Conversely, investing in mitigation and adaptation strategies now—such as renewable energy, sustainable agriculture, and resilient infrastructure—could limit economic losses and create new opportunities. Transitioning to a green economy may initially require substantial investment, but it fosters innovation, job creation, and long-term cost savings.
- **Market Failures and the Role of Governments:** Climate change exemplifies market failure, primarily due to **negative externalities**—emitters don't bear the full cost of their pollution, leading to excessive greenhouse gas emissions. Because climate risks are long-term and global,

individuals and businesses often underreact, reinforcing the need for government intervention. Government can correct these failures through carbon pricing (taxes or cap-and-trade), subsidies for clean technology, regulations, and public investment in research. Since climate change transcends borders, international cooperation is essential. By integrating economics with climate policy, governments can drive the shift to a low-carbon economy, avoiding severe consequences and ensuring sustainable growth.

Environmental Stewardship as an Economic Strategy

1. Cost-Effectiveness of Sustainable Practices:

Adopting sustainable practices offers both environmental and financial benefits. Here's how businesses and individuals can save money through energy efficiency, waste reduction, and resource conservation:

Energy Efficiency: Lower Bills, Higher Profits

Businesses:

- **LED Lighting**: Replacing fluorescent lighting with LED bulbs can reduce energy consumption by 50–70% and lower maintenance costs due to their longer lifespan.
- **Energy Management Systems (EMS)**: Implementing EMS allows businesses to monitor and control energy use efficiently, leading to informed decisions and cost reductions.

Individuals:

- **Energy-Efficient Appliances**: Investing in Energy Star-rated appliances, such as refrigerators and air conditioners, can significantly lower electricity bills.
- **Behavioural Changes**: Simple actions like turning off unused electronics, using ceiling fans, and adjusting thermostats can lead to substantial energy savings.

Waste Reduction: Cutting Costs and Environmental Impact

Businesses:

- **Recycling Programs**: Establishing comprehensive recycling programs for paper, plastic, and electronic waste can reduce disposal costs by up to 50%.
- **Digital Documentation**: Transitioning to digital documentation reduces paper waste and associated costs.

Individuals:

- **Smart Shopping**: Opting for quality over quantity, buying second-hand items, and repairing instead of replacing can reduce waste and save money.
- **Reusable Products**: Using reusable bags, bottles, and containers decreases the need for single-use items, leading to cost savings.

2. The Green Economy and Job Creation

The green economy is rapidly transforming global and local job markets, creating diverse opportunities across sectors like renewable energy, sustainable construction, environmental consulting, and more. Here's an overview of how this transformation is unfolding, with a focus on India and its regional developments:

Green Economy: A Catalyst for Job Creation

1. Renewable Energy

India's renewable energy sector is a significant driver of job growth. With ambitious targets such as achieving 500 GW of renewable energy capacity by 2030, the sector is expected to generate over 3 million jobs by 2030. Roles in high demand include:

- Solar PV installers and technicians
- Wind turbine engineers and maintenance personnel
- Green hydrogen specialists
- Battery storage system experts
- Bioenergy process engineers

For instance, Adani's solar manufacturing facility in Gujarat aims to create over 13,000 green jobs.

2. Green Construction and Sustainable Urban Development

The push for energy-efficient buildings and sustainable urban planning is fostering job opportunities in:

- Sustainable architects and urban planners
- Green building material suppliers
- Energy auditors and LEED consultants
- Construction project managers specializing in sustainability

The green construction sector is projected to account for 18% of green jobs in India by FY25.

3. Envirofnmental Consulting and Green Finance

As businesses and governments strive to meet environmental regulations and sustainability goals, there's a growing demand for professionals in:

- Environmental impact assessment (EIA) consultants
- Carbon footprint analysts
- Sustainability auditors
- Green finance advisors

These roles are essential for guiding organizations through the complexities of environmental compliance and sustainable investment.

4. Circular Economy and Waste Management

The transition to a circular economy is creating jobs in:

- E-waste recycling technicians
- Plastic waste management experts
- Sustainable packaging designers
- Composting and organic waste specialists

The waste management sector is expected to see a 20% increase in jobs by FY25.

India's green economy is on a robust growth trajectory, with projections indicating the creation of over 3 million new jobs by 2030. The most sought-after skills include:

- Solar and wind energy system design and maintenance
- Sustainable agriculture practices
- Electric vehicle infrastructure development
- Environmental policy and regulation expertise

This growth is supported by government initiatives, private sector investments, and a global shift towards sustainability.

Climate Action: Economic Impacts of Mitigation and Adaptation

1. Mitigation Strategies and Their Economic Impact

Mitigating climate change through strategies like transitioning to renewable energy, enhancing energy efficiency, and reducing carbon emissions offers substantial economic benefits. These measures not only foster job creation but also lead to long-term cost savings and economic growth. Here's an in-depth analysis:

- **Renewable Energy**: Investments in solar, wind, and hydropower not only support climate goals but also create large numbers of jobs. In India, over 1 million people were employed in renewable energy in 2023. With falling costs of solar and wind power, clean energy is now a competitive and profitable alternative to fossil fuels. Globally, the renewable energy sector could grow to $23 trillion by 2030.
- **Energy Efficiency**: Boosting energy efficiency supports economic growth by lowering energy bills and creating jobs. According to the IEA, better efficiency could increase global GDP by up to 2% by 2030. It also leads to more jobs in areas like construction, manufacturing, and technology.
- **Carbon Emission Reduction: Long-Term Economic Benefits:** Reducing carbon emissions not only mitigates climate change but also offers economic advantages:
  - (i) Health Benefits: Lowering emissions reduces air pollution, leading to improved public health and decreased healthcare costs.
  - (ii) Energy Independence: Reducing reliance on imported fossil fuels enhances energy security and keeps energy expenditures within the domestic economy.

(iii) Economic Resilience: Investing in low-carbon technologies can make economies more resilient to climate-related shocks and global energy price fluctuations.

Mitigating climate change through renewable energy adoption, energy efficiency improvements, and carbon emission reductions presents a compelling economic case. These strategies not only contribute to environmental sustainability but also drive job creation, economic growth, and long-term cost savings.

2. Adaptation and Economic Resilience

Adapting to climate change through investments in flood defences, climate-resilient infrastructure, and disaster relief systems offers substantial economic benefits. These proactive measures not only reduce long-term costs but also enhance community resilience and economic stability. Here's an in-depth analysis:

- Flood Protection: Building barriers like levees and flood gates can prevent massive damages. Studies show such measures can return up to 10 times their cost in avoided losses. In 2023 alone, floods caused over $51 billion in damages worldwide—costs that could be reduced with early action.
- Climate-Resilient Infrastructure: Constructing buildings and systems that can withstand climate events saves money over time. For every $1 spent, there's a potential $6 return in reduced damage and maintenance.
- Disaster Preparedness: Well-developed emergency response systems help economies recover faster from natural disasters. These systems reduce the need for large-scale rebuilding and keep local businesses and communities functioning during crises.

If we act on climate change can makes benefit in economic sense. Whether through cutting emissions or preparing for climate impacts, these strategies create jobs, reduce long-term costs, and strengthen economic resilience. Countries like India stand to gain significantly by investing in both mitigation and adaptation can lead to a more resilient and prosperous future.

Regional Context: India–Climate Adaptation and Economic Resilience

India faces significant climate challenges, particularly in infrastructure vulnerability and disaster preparedness. Globally, annual losses in key infrastructure due to climate change range between $301–$330 billion, with developing nations—including India—bearing a substantial share. Addressing these risks requires major investments: nearly $9.2 trillion annually by 2050, of which $2.84–$2.90 trillion is needed in low- and middle-income countries. Investing in adaptation strategies in India—such as resilient infrastructure, flood protection, and emergency systems—can reduce losses and enhance long-term economic stability.

Climate Adaptation Efforts and Associated Costs and Benefits in Uttar Pradesh and Uttarakhand

Uttar Pradesh: Climate Adaptation Initiatives

1. **Ganga Expressway Project:** A 1,047 km expressway from Greater Noida to Ballia doubles as a flood-control embankment. It aims to reduce agricultural damage from flooding while boosting

connectivity. This infrastructure is expected to greatly reduce economic losses and improve local resilience.

2. **UP Climate Change and Environment Centre (UPCCCE):** The UPCCCE focuses on implementing various climate adaptation strategies, including waste management, resource conservation, and promoting sustainable practices. These initiatives aim to reduce environmental degradation and associated economic losses, fostering a more resilient economy.

Uttarakhand: Resilient Infrastructure Development

1. **Power System Modernization:** A $200 million project, supported by the ADB, aims to upgrade Uttarakhand's electricity infrastructure. It includes installing 537 km of underground cables, 354 ring main units, and 99 compact substations, ensuring reliable, climate-resilient power in Dehradun and beyond.
2. **Urban Mobility and Water Systems:** Projects include stormwater drains, early warning systems, and the development of green-certified urban infrastructure. Water supply in key towns is being upgraded with 1,024 km of smart pipelines, 26 tube wells, and 3.5 MLD treatment plant to ensure reliable, climate-resilient water access.

Proactively investing in climate adaptation measures—such as flood defences, climate-resilient infrastructure, and efficient disaster relief systems—offers substantial economic benefits in Uttar Pradesh and Uttarakhand. These investments not only reduce long-term costs but also enhance community resilience and economic stability. In regions like Uttar Pradesh and Uttarakhand, where climate-related risks are escalating, such investments are crucial for sustainable development and economic growth

Government Policies and Economic Incentives for Climate Action

Effective climate action requires strong government policies rooted in sound economic theory. Key tools include carbon taxes, emissions trading systems (ETS), and green subsidies—each aiming to internalize environmental costs and encourage sustainable behaviour.

- **Carbon taxes** are grounded in Pigouvian economics, which advocates taxing activities that generate harmful externalities. By placing a fee on every ton of CO, emitted, carbon taxes make polluting more expensive, encouraging both consumers and businesses to shift toward cleaner options. These taxes also generate public revenue that can support climate projects or cushion low-income households. Empirical studies suggest that even modest carbon taxes can lead to noticeable emission reductions over time.
- **Emissions Trading Systems (ETS)** adopt a cap-and-trade approach, limiting total emissions and allowing companies to buy or sell emission permits. This market-based system ensures emissions are reduced in the most cost-effective way. ETS encourages innovation and investment in green technologies, although challenges such as market volatility and speculative trading must be addressed to maintain efficiency.
- **Green subsidies** are essential for promoting early-stage clean technologies, reducing investment risks, and boosting employment in green sectors. These incentives can accelerate the transition to a low-carbon economy while also driving economic growth.

- Countries like **Costa Rica** and **Germany** show that early, strategic climate policies lead to both environmental and economic gains. Costa Rica's green energy initiatives and forest restoration efforts have strengthened its economy and created jobs. Germany's sustained investment in climate infrastructure has curbed emissions and built resilience.

Conversely, delays in climate action—as seen in the **UK** and **Canada**—can result in steep future costs. Reports indicate that the economic impact of inaction could outweigh adaptation investments many times over. Proactive climate policies not only mitigate environmental impacts but also offer significant economic benefits by reducing long-term costs associated with climate change. Countries that delay action may face escalating economic challenges. Investing in climate resilience and sustainable development is crucial for long-term economic stability.

Economic Barriers to Effective Climate Action

India faces numerous hurdles in advancing climate action, primarily due to its heavy reliance on coal for electricity and the economic clout of fossil fuel industries. These sectors shape policy decisions, often prioritizing short-term economic gains over long-term environmental goals. Despite increasing climate risks, such as severe heatwaves and flooding, environmental issues remain low on the political agenda, especially during elections. Fragmented governance across national and state levels, coupled with limited institutional coordination, weakens the effectiveness of climate initiatives. Public engagement is also minimal—climate change rarely sparks widespread discussion or pressure for action, partly due to low awareness and education. This combination of economic pressure, political inattention, and institutional gaps results in slow progress toward renewable energy adoption and climate resilience. Without strong leadership, consistent policies, and active public involvement, India risks falling behind in its climate commitments and becoming increasingly vulnerable to the economic and human costs of climate-related disasters.

The Path Forward: Sustainable Economic Solutions in India

India stands at a crucial crossroads in embedding environmental responsibility within its economic framework. Through the adoption of forward-thinking economic strategies and strengthened collaborative initiatives, the nation has the opportunity to build a more sustainable and resilient future.

- **Integrating Environmental Stewardship into Economic Systems:** India is witnessing a shift towards circular economy practices, emphasizing the reuse, repair, and recycling of materials to minimize waste, so gradually integrating environmental stewardship into its economic systems through circular economy practices and sustainable consumption. The Gujarat Hybrid Renewable Energy Park in Kutch, set to be the world's largest hybrid renewable energy project, showcases the use of wasteland to produce 30 GW of clean energy from solar and wind sources. Simultaneously, the market for eco-friendly consumer goods is expanding. Businesses are adopting biodegradable packaging and organic materials, while certifications like the 'Green Label' and public awareness campaigns boost demand for sustainable products.
- **Innovative Economic Models for a Green Future:** India is embracing innovative economic models for sustainability, including circular business practices like Tata Motors' battery recycling

and vehicle leasing. Peer-to-peer energy sharing is also emerging, enabling communities to produce, share, and benefit from local renewable energy, enhancing access and reducing transmission losses.

- **Collaborative Efforts for a Sustainable Future:** India is fostering sustainable development through collaborative efforts like public-private partnerships and co-financing initiatives. The Rewa Solar Project in Madhya Pradesh exemplifies successful PPPs with record-low tariffs, while the IREDA–PNB partnership supports diverse green energy projects. These models are crucial for achieving India's target of 500 GW non-fossil fuel energy capacity by 2030.

India's path to a sustainable future lies in integrating environmental stewardship into economic systems through circular and regenerative models. By fostering collaboration among governments, businesses, and consumers, and investing in innovative solutions, the country can achieve its climate goals and ensure long-term prosperity.

Conclusion

The path toward climate action and environmental stewardship is not just a moral necessity but an economic opportunity also. By embracing sustainable practices, governments and businesses can not only mitigate the devastating impacts of climate change but also stimulate economic growth through new technologies, job creation, and long-term savings. The economics of climate change and environmental stewardship shows that proactive measures, though initially costly, offer far greater returns than inaction. As global leaders and citizens, it is imperative to recognize the interconnectedness of environmental health and economic vitality, and to invest in solutions that safeguard both.

References

- Adani Green Energy Ltd. (2024, April 7). *Adani begins commercial output of wafers, ingots for solar power*. Reuters. Retrieved from https://www.reuters.com/business/energy/adani-begins-commercial-output-wafers-ingots-solar-power-2024-04-07/
- Adani Group. (2025, February 12). *Tycoon profited after India relaxed border security rules for energy park*. The Guardian. Retrieved from https://www.theguardian.com/world/2025/feb/12/tycoon-profited-after-india-relaxed-border-security-rules-for-energy-park
- Economic Times. (2024, March 15). *Powering rural India: OMC Power's microgrids bring light to remote villages*. The Economic Times. Retrieved from https://economictimes.indiatimes.com/industry/renewables/mega-projects-like-hybrid-renewable-energy-park-solar-park-fuelling-gujarats-progress-officials/articleshow/106543282.cms
- Hinkel, J., & Bisaro, A. (2016). *The Economics of Adaptation to Climate Change*. Springer.
- International Labour Organization (ILO). (2018). *World Employment and Social Outlook: Greening with Jobs*. ILO.
- International Monetary Fund (IMF). (2019). *World Economic Outlook: The Challenges of Steady Growth*. International Monetary Fund.
- Jackson, T. (2009). *Prosperity without Growth: Economics for a Finite Planet*. Earthscan.
- McKinsey & Company. (2010). *Impact of Green Technologies on the Economy*. McKinsey Global Institute.

- Nordhaus, W. D. (2008). *A Question of Balance: Economic Modeling of Global Warming*. Yale University Press. Gillingham, K., Newell, R. G., & Palmer, K. (2009). *Energy Efficiency Economics and Policy*. Annual Review of Environment and Resources.
- OECD. (2015). *The Economic Consequences of Climate Change*. Organisation for Economic Co-operation and Development.
- Oreskes, N., & Conway, E. M. (2010). *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. Bloomsbury Press.
- Parry, M. L., Canziani, O. F., Palutikof, J. P., van der Linden, P. J., & Hanson, C. E. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Cambridge University Press.
- PM India. (2020, July 10). *PM dedicated Rewa Ultra Mega Solar Power project to the Nation*. Prime Minister of India. Retrieved from https://www.pmindia.gov.in/en/news_updates/pm-dedicated-rewa-ultra-mega-solar-power-project-to-the-nation/
- Stern, N. (2006). *The Economics of Climate Change: The Stern Review*. Cambridge University Press
- The Economic Times. (2020, July 10). *PM opens Asia's biggest 750-MW solar power project in Madhya Pradesh*. The Economic Times. Retrieved from https://economictimes.indiatimes.com/news/india/pm-opens-asias-biggest-750-mw-solar-power-project-in-madhya-pradesh/articleshow/76888628.cms
- The World Bank. (2013). *Turn Down the Heat: Why a 4°C Warmer World Must Be Avoided*. The World Bank.

Assessing Agricultural Trade Dynamics and their Implications for Sustainable Economic Growth in India

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ABSTRACT

This study investigates the dynamics of agricultural trade and its implications for sustainable economic growth in India, with a focus on trends in Gross Value Added (GVA), agricultural imports, and exports from 2012–13 to 2022–23. Despite the diversification of India's economy, agriculture remains a critical sector, contributing significantly to GDP, employment, and food security, particularly in rural regions. The analysis of GVA reveals both positive growth and volatility, influenced by factors such as climatic conditions, policy interventions, and global market trends, with the agricultural sector demonstrating resilience during the COVID-19 pandemic. The study also examines agricultural trade patterns, highlighting fluctuations in import shares and a declining proportion of agricultural exports in total national trade. While agricultural imports have risen, particularly due to shortfalls in essential commodities, agricultural exports continue to play a key role in foreign exchange earnings. However, the declines in the share of agricultural exports points to a broader shift toward the diversification of India's export basket, with non-agricultural sectors outpacing agriculture. This underscores the need for strategic interventions to enhance the competitiveness of Indian agriculture, diversify export portfolios, and promote value addition through agro-processing. The study concludes by recommending policies that strengthen agricultural resilience, reduce import dependency, and enhance export competitiveness. It emphasizes the importance of adopting sustainable practices, leveraging technological advancements, and improving infrastructure to ensure the long-term sustainability of agricultural growth, thereby fostering inclusive economic development in India.

Keywords: *Agricultural, Gross Value Added (GVA), Imports, Exports, Economic Growth.*

INTRODUCTION

India's agricultural sector remains a cornerstone of its economy, significantly contributing to GDP, employment, and foreign exchange earnings. Despite ongoing economic diversification, agriculture continues to play a central role in the livelihoods of a large portion of the population,

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especially in rural areas. With over half of India's workforce engaged in agricultural activities, the sector is crucial for alleviating rural poverty, ensuring food security, and fostering inclusive national development.

The agricultural landscape in India is characterized by a wide variety of crops and livestock, meeting substantial domestic demand and positioning the country as a leading global exporter of agricultural commodities. Agricultural trade has become a key component of India's economic interactions, bolstering foreign exchange reserves, reducing the trade deficit, and contributing to macroeconomic stability. The diversification of export destinations and commodities has further strengthened India's competitiveness in global agri-trade.

Beyond economic contributions, agricultural trade has significant implications for rural development. It enhances farmer incomes, generates rural employment, and stimulates related sectors such as food processing, logistics, and packaging. The growing importance of agri-exports has prompted policy reforms focused on boosting competitiveness through technological advancements and sustainable practices.

Despite these gains, the sector faces challenges such as supply chain inefficiencies, price volatility, and environmental vulnerabilities. These issues necessitate strategic evaluation of agricultural trade dynamics to support sustainable economic growth. This study aims to explore these evolving patterns and inform policies that enhance agricultural productivity, promote equitable trade, and ensure long-term, inclusive growth.

REVIEW OF LITERATURES

Recent research provides multifaceted insights into Indian agriculture and its economic landscape. **Anjum & Tarique (2017)** found that agricultural GDP significantly reduces poverty, advocating for balanced growth. Analyzing employment from 1984-2022, **Bhat et al. (2024)** noted a major shift of women from agriculture to the tertiary sector, highlighting increased female labor force participation and entrepreneurship, signifying their expanding economic role.

Challenges persist, as **Bhattacharya et al. (2021)** detailed, with low farmer incomes, debt, and climate change driving suicides, necessitating comprehensive policy reforms and improved support. **Chand et al. (2018)** examined the rural shift to non-farm employment, revealing regional and gender disparities and labor casualization challenges.

Conversely, **Anju & Kaur (2024)** and **Verma & Shrivastava (2023)** emphasized agripreneurship as a key growth driver, stressing youth involvement, innovation, skill enhancement, and government support to foster sustainable agricultural entrepreneurship. **Palla & Nayak (2024)** explored e-agriculture's transformative potential through ICT integration for productivity and inclusive rural growth. Finally, **Surendra (2020)** assessed post-Green Revolution agricultural performance, advocating for modern technologies, organic practices, and land reforms to boost productivity and livelihoods, while addressing regional disparities and environmental impacts.

RESEARCH GAP

The existing literature extensively covers various aspects of Indian agriculture, including farmer challenges, regional disparities, labor transitions, and the role of entrepreneurship. However, there is a notable gap in integrating agricultural trade dynamics with broader economic sustainability, particularly regarding the impact of Gross Value Added, imports, and exports. Additionally, while technological advancements and policy reforms are often discussed, the cumulative effect of these factors on long-term growth remains underexplored. This study aims to address these gaps by providing a comprehensive analysis of agricultural trade and its implications for sustainable economic development in India.

SIGNIFICANT OF THE STUDY

This study provides valuable insights into the role of agricultural trade in India's sustainable economic growth. By examining GVA, import-export trends, and trade share, it highlights sectoral contributions and challenges. The findings support informed policymaking to enhance competitiveness, reduce dependency, and strengthen rural resilience. It contributes to the discourse on balanced and inclusive economic development.

OBJECTIVES OF THE STUDY

1. To analyse the trends in agricultural Gross Value Added (GVA) in India from 2012–13 to 2022-23 evaluating its contribution to the national economy.
2. To assess the performance and trade dynamics of agricultural imports and exports, and their implications for sustainable economic growth and policy development in India.

RESEARCH QUESTIONS

A. How have the dynamics of agricultural trade, measured through gross value added, import-export trends, and their share in total national trade, impacted sustainable economic growth in India from 2012 - 2013 to 2022–2023?

METHODOLOGY

This study adopts a descriptive analytical approach based on secondary data sourced from the National Statistical Office (NSO) and Agricultural Statistics at a Glance 2023. The analysis focuses on trends in Gross Value Added (GVA) of agriculture, forestry, and fishing; agricultural imports and exports; and their proportional share in total national trade. The study period spans from 2012–2013 to 2022–23, offering a comprehensive temporal perspective on trade performance and its economic implications.

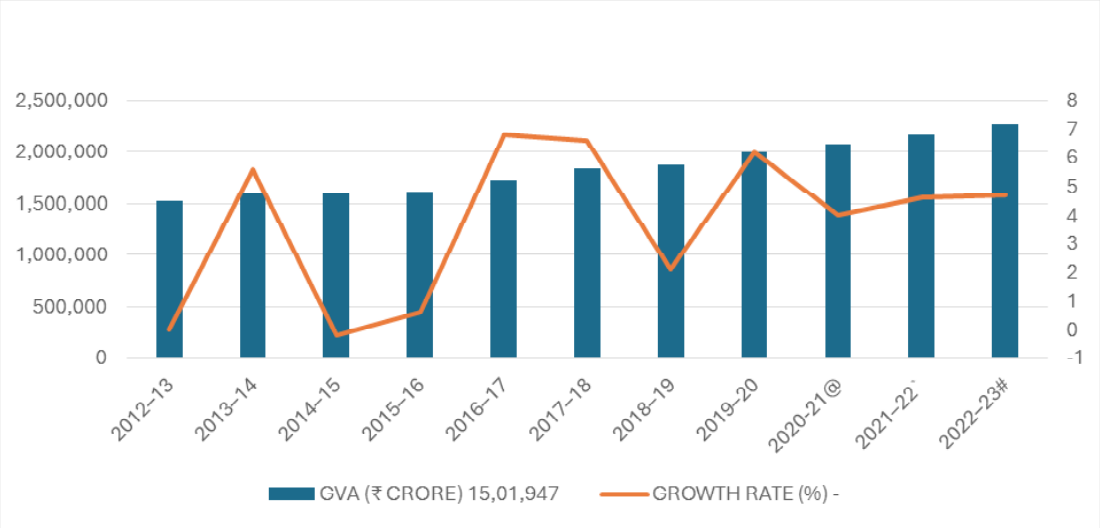
TABLE 1: GROSS VALUE ADDED (GVA) AND GROWTH RATE OF AGRICULTURE, FORESTRY AND FISHING (2012-13 TO 2022-23)

YEAR	GVA (₹ CRORE)	GROWTH RATE (%)
2012–13	1,524,288	-
2013–14	1,609,198	5.6
2014–15	1,605,715	-0.2
2015–16	1,616,146	0.6
2016–17	1,726,004	6.8
2017–18	1,840,023	6.6
2018–19	1,878,598	2.1
2019–20	1,994,326	6.2
2020-21@	2,074,212	4.0
2021–22`	2,170,106	4.6
2022–23#	2,272,250	4.7

Source: National Statistical Office (NSO)

- @ Third Revised & Final Estimates
- Second Revised & Final Estimates
- # First Revised Estimates

FIGURE 1: GVA AND GROWTH RATE OF AGRICULTURE, FORESTRY, AND FISHING (2012-13 TO 2022-23)



Source: National Statistical Office (NSO)

ANALYSIS

The table presents the Gross Value Added (GVA) and the corresponding growth rates of agriculture, forestry, and fishing at constant 2011–12 prices over the period from 2012–13 to 2022–23.

In 2012–13, the GVA was ₹ 1,524,288 crore, establishing the baseline for subsequent evaluation. The sector showed a positive growth trajectory in 2013–14, with a notable increase of 5.6%, signalling a phase of strong performance. However, this momentum was disrupted in 2014–15, as reflected by a marginal contraction of -0.2%. This decline can be attributed to a range of factors, including adverse climatic conditions, policy inefficiencies, and market disruptions, which often influence primary production sectors such as agriculture.

The recovery In 2015–16 (0.6%) marked a shift towards stabilisation, but it was in 2016–17 that the sector witnessed a significant uptick, with a robust growth rate of 6.8%. This surge was likely driven by favourable monsoons, improved agricultural output, and effective government interventions, particularly in rural revitalisation efforts.

The period from 2017–18 to 2019–20 saw steady growth rates, averaging around 6%, underscoring a consistent but volatile performance within the sector. Notably, the COVID-19 pandemic in 2020–21 did not severely impact agricultural output, with the sector growing by 4.0%, demonstrating resilience despite broader economic challenges.

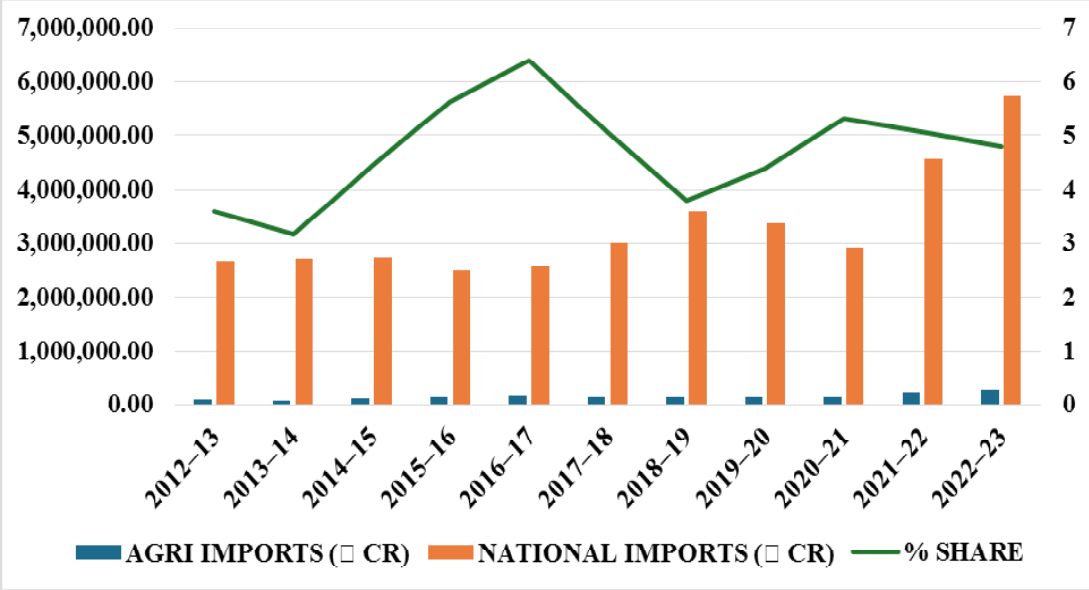
In the post-pandemic phase, GVA continued its positive growth trend, with growth rates of 4.6% in 2021–22 and 4.7% in 2022–23. The overall GVA increased from ₹ 1,524,288 crore in 2012–13 to ₹ 2,272,250 crore in 2022–23, indicating a cumulative rise, though the fluctuations in annual growth rates reflect ongoing vulnerabilities, such as climatic unpredictability and input cost pressures. These trends highlight the need for adaptive policy frameworks that promote long-term sustainability in the sector

TABLE 2: AGRICULTURAL IMPORTS AS A PERCENTAGE OF TOTAL NATIONAL TRADE (2012–13 TO 2022–23)

YEAR	AGRI IMPORTS (₹ CR)	NATIONAL IMPORTS (₹ CR)	% SHARE
2012–13	95,718.89	26,69,161.95	3.59
2013–14	85,727.30	27,15,420.78	3.16
2014–15	1,21,319.02	27,36,676.99	4.43
2015–16	1,40,289.22	24,90,303.76	5.63
2016–17	1,64,726.83	25,77,671.14	6.39
2017–18	1,52,095.20	30,01,033.00	5.07
2018–19	1,37,019.46	35,94,674.22	3.81
2019–20	1,47,445.81	33,60,954.45	4.39
2020–21	1,54,510.72	29,15,958.00	5.30
2021–22	2,31,850.27	45,72,774.59	5.07
2022–23	2,75,704.09	57,49,801.27	4.80

Source: Agricultural Statistics at a Glance 2023

FIGURE 2: AGRICULTURAL IMPORTS AS A PERCENTAGE OF TOTAL NATIONAL TRADE (2012–13 TO 2022–23



Source: Agricultural Statistics at a Glance 2023

ANALYSIS

The share of agricultural imports in India's total national imports from 2012 to 2023 reflects changing trade patterns and domestic production capacities. In 2012–13, agricultural imports accounted for 3.59 percent of total imports, indicating moderate dependence on foreign sources. This declined slightly in the following year, reflecting stable domestic supply.

A sharp rise was observed in 2014–15 and 2015–16, with shares increasing to 4.43 percent and 5.63 percent, respectively, due to domestic shortfalls in key commodities such as pulses and edible oils. The highest share was recorded in 2016–17 at 6.39 percent, signalling increased reliance on imports driven by inflationary pressures and production constraints.

Subsequent years saw a decline, with the share falling to 5.07 percent in 2017–18 and 3.81 percent in 2018–19, following government measures to strengthen domestic output. From 2019–20 onwards, the share stabilised above 4 percent. In 2021–22, agricultural imports rose significantly, but the share remained steady at 5.07 percent due to higher overall imports. In 2022–23, imports increased further in value, though the share marginally declined to 4.80 percent.

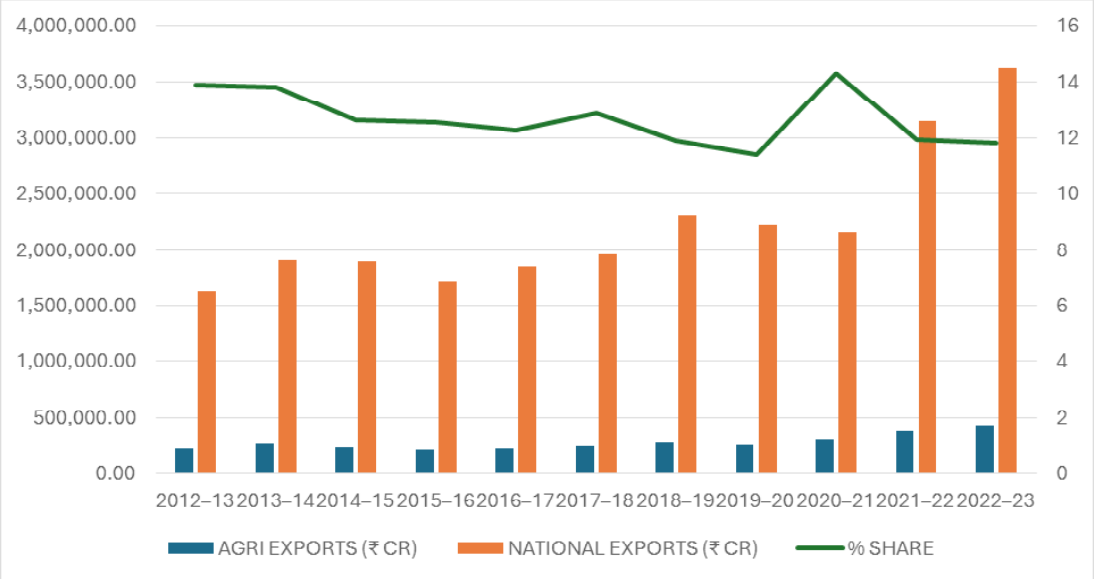
This trend indicates a persistent yet variable reliance on agricultural imports, highlighting the need for greater investment in domestic agriculture, improved productivity, and reduced import dependency for essential commodities.

TABLE 3: AGRICULTURAL EXPORTS AS A PERCENTAGE OF TOTAL NATIONAL TRADE (2012–13 TO 2022–23)

YEAR	AGRI EXPORTS (₹ CR)	NATIONAL EXPORTS (₹ CR)	% SHARE
2012–13	2,27,192.61	16,34,318.28	13.90
2013–14	2,62,778.54	19,05,011.08	13.79
2014–15	2,39,681.04	18,96,348.42	12.64
2015–16	2,15,396.32	17,16,384.39	12.55
2016–17	2,26,651.91	18,49,433.55	12.26
2017–18	2,51,563.94	19,56,514.52	12.86
2018–19	2,74,571.28	23,07,726.19	11.90
2019–20	2,52,976.06	22,19,854.17	11.40
2020–21	3,08,830.00	21,59,043.00	14.30
2021–22	3,75,662.47	31,47,021.49	11.94
2022–23	4,27,767.46	36,21,549.88	11.81

Source: Agricultural Statistics at a Glance 2023

FIGURE 3: AGRICULTURAL EXPORTS AS A PERCENTAGE OF TOTAL NATIONAL TRADE (2012–13 TO 2022–23)



Source: Agricultural Statistics at a Glance 2023

ANALYSIS

The share of agricultural exports in India's total exports between 2012 and 2023 underscores the sector's role in trade and economic stability. In 2012–13, agricultural exports accounted for 13.90 percent of total exports, reflecting the sector's strong contribution to foreign exchange earnings. This marginally declined to 13.79 percent in 2013–14, and further to 12.64 percent in 2014–15, indicating the beginning of a downward trend.

From 2015–16 to 2017–18, the share remained relatively stable between 12.26 and 12.86 percent, suggesting consistent global demand and export performance despite domestic and international challenges. A decline followed in 2018–19 and 2019–20, with shares falling to 11.90 percent and 11.40 percent respectively, possibly due to fluctuating global commodity prices and domestic supply constraints.

A notable resurgence occurred In 2020–21, when the share rose to 14.30 percent, coinciding with the pandemic-induced surge in demand for food commodities and resilient agricultural output. However, the subsequent years witnessed a gradual decline to 11.94 percent in 2021–22 and 11.81 percent in 2022–23, despite a rise in the absolute value of agricultural exports. This decline in percentage terms reflects a broader diversification of India's export basket and faster growth in non-agricultural sectors.

Overall, while agricultural exports continue to contribute significantly to national trade, the data indicate a need to strengthen competitiveness, diversify export portfolios, and enhance value addition through agro-processing and global market integration.

THE ROLE OF AGRICULTURAL TRADE DYNAMICS AND THEIR IMPLICATIONS FOR SUSTAINABLE ECONOMIC GROWTH IN INDIA

This study examines the role of agricultural trade dynamics in India's sustainable economic growth, focusing on key factors such as Gross Value Added (GVA), import-export trends, and their broader economic implications. Despite India's economic diversification, agriculture continues to be vital for GDP, employment, and food security, particularly in rural areas. The analysis of GVA from 2012-2013 to 2022- 2023 reveals fluctuations in growth, driven by climatic conditions, policy interventions, and global market trends, with the sector demonstrating resilience, especially during the COVID-19 pandemic. Additionally, the study highlights trends in agricultural imports and exports, showing that while agricultural imports have fluctuated, agricultural exports remain a crucial source of foreign exchange. However, the share of agricultural exports in total national trade has declined, indicating a shift towards diversification into non-agricultural sectors. This trend underscores the importance of enhancing value addition through agro-processing and improving global competitiveness. The study emphasizes the need for policies that promote agricultural resilience, reduce import dependency, and strengthen export competitiveness. By adopting sustainable practices, leveraging technological advancements, and enhancing infrastructure, India can ensure long-term growth in its agricultural sector, fostering inclusive economic development.

CONCLUSION

This study has explored the dynamics of agricultural trade in India and its impact on sustainable economic growth from 2012–13 to 2022–23. The analysis reveals that agriculture remains a cornerstone of the Indian economy, contributing significantly to Gross Value Added (GVA), employment, and food security, especially in rural areas. Although fluctuations in GVA were observed due to climatic variations, policy shifts, and market conditions, the sector demonstrated notable resilience, particularly during the COVID-19 pandemic. Trends in agricultural imports reflect periods of increased dependency driven by domestic supply constraints, while exports have consistently contributed to foreign exchange earnings. However, the gradual decline in the share of agricultural exports relative to total trade suggests a shift in national trade composition and highlights the need to enhance the sector's global competitiveness. To ensure long-term sustainable growth, the study emphasises the importance of adopting integrated policy measures focused on strengthening domestic production, reducing import reliance, improving agro-processing, and expanding export capacity. These strategic efforts will be essential in promoting resilience, enhancing productivity, and ensuring inclusive economic development through a more robust and self-reliant agricultural sector

REFERENCES

JOURNALS AND ARTICLES

1. Anjum, S., & Tarique, M. (2017). Agriculture and poverty reduction in India: An empirical study. Asian Journal of Research in Social Sciences and Humanities, 7(1), 35. https://doi.org/10.5958/2249-7315.2017.00441.5
2. Bhat, S. A., Mallniah, L. C., & Singh, S. (2024). Economic development and changing women lives: Evidence from women employment participation in India. International Socioeconomic Review, 2, 94–115. https://doi.org/10.3126/iser.v2i1.75236
3. Bhattacharya, C. D. S., Lal, H., & Sachdev, B. (2022, July 20). A study on the agriculture sector and the problems associated with it which has an impact on the farmers. International Journal of Trend in Scientific Research and Development, 5(6), 589–593.
4. Chand, P., Rao, S., Subash, S. P., & Malangmeih, L. (2018). Non-farm employment and implication on agriculture sector in rural India. Indian Journal of Economics and Development, 14, 287. https://doi.org/10.5958/2322-0430.2018.00073.2
5. Panwar, A., & Kaur, J. (2024). Agripreneurship: A strategy for upliftment of agriculture and economic growth of India.
6. Rajyalakshmi, P., & Nayak, Dr. V. (2024). E-Agriculture and rural development in India. Educational Administration: Theory and Practice, 30. https://doi.org/10.53555/kuey.v30i5.3364
7. Surendra, J. (2020). Agriculture development in India: A state-level analysis. South Asian Journal of Social Studies and Economics, 6(2), 17–34. https://doi.org/10.9734/SAJSSE/2020/v6i230162
8. Verma, A., & Shrivastava, P. (2021). Scope and challenges of entrepreneurship in agriculture in India. International Journal of Education, Modern Management, Applied Science & Social Science (IJEMMASSS), 3(2), 75–79.

WEBSITES

- Agricultural Statistics at a Glance (MoAFW) https://eands.dacnet.nic.in
- IndiaStat – for sectoral and trade statistics (used in academic institutions) https://www.indiastat.com
- Ministry of Agriculture and Farmers Welfare (MoAFW) https://agricoop.nic.in
- Ministry of Statistics and Programme Implementation (MoSPI) – particularly for data on GDP and employment https://mospi.gov.in
- NITI Aayog – Government of India https://www.niti.gov.in

Food Subsidy in India: An Analytical Perspective

Prof. Aloka Kumar Goyal[1] & Pragti Yadav[2]

ABSTRACT

Food prices play a vital role for the welfare of the poor section of society and poverty eradication as this section of society cannot purchase foodgrains from open market because they don't have that purchasing power, food security prevails income transfer to weaker section of the society through subsidize rate of foodgrains so subsidy will provide a purchasing power to them .The food subsidy is essentially the gap between the economic cost of food grains and the subsidized price, known as the Central Issue Price, at which they are made available to beneficiaries by the Food Corporation of India, which is the main instrument of the government for procurement and distribution of foodgrains under Public Distribution System. This paper attempt to examine the trends of food subsidy and the most common indicator is the rate at which the subsidy is growing. The paper also aims to compare the gap between the economic cost and central issue price (CIP) at which government provides it to the people from year 2000 to 2024 based on secondary data compiled from various government portals.

Keywords: *Food subsidy, Food Security, Economic Cost, Central Issue Price, Public Distribution system, Food Corporation of India*

Introduction

Food subsidy is one of the most significant component of country's welfare and poverty alleviation program. According to the World Trade Organization, a subsidy refers to a financial contribution made by the government or any public body that provides a benefit to the public. Essentially, a subsidy is a discount or financial support provided by the government to make essential items more affordable for those in need. The main objective of subsidies is to ensure that the prices of necessary goods and services remain affordable for the public, particularly for vulnerable groups. India runs one of the biggest food subsidy programs in the world thought Public Distribution System, which has helped create a useful support system for people in need. Food prices significantly impact on the well-being and poverty levels of the weaker section in developing countries. To address this, governments have intervened in food grain markets for decades, implementing various policies to stabilize prices and ensure food security. The government intervenes in the food market through various measures, including buying food grains at a fair price, storing them, and selling them at subsidized rates through ration shops. This helps farmers get good prices, makes food affordable for

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the poor and keeps prices stable. The difference between the economic cost and central issue price is known as the food subsidy. The government needs to compensate the Food Corporation of India (FCI) or states for this difference in order to ensure that food grains are available at the subsidized rate to beneficiaries. As the economic cost has been increasing due to rising procurement costs, transportation, storage, and handling charges, while the CIP remains fixed or lower to maintain affordability, the gap between the two has widened. This widening gap leads to an increase in food subsidy expenditure. The government has to allocate more funds to cover this subsidy. Food subsidy is a mechanism that impacts supply and demand side of food security. It affects the supply side of food security by reducing the procurement cost of foodgrains by Food Corporation of India and demand side by making foodgrains affordable and accessible to weaker section of society. It is necessary because Poor section of society cannot purchase foodgrains from open market because they don't have that purchasing power, food subsidy prevails income transfer to poor section of the society by providing a purchasing power to them.

Literature Review

Various studies have been conducted related to food security in India; some of them are reviewed here- V. P. Sharma (2012) critically examines India's food subsidy system in his article, Food subsidy in India: Trends, causes and policy reform options highlighting rising fiscal costs, inefficiencies, and poor targeting in the Public Distribution System (PDS). He identifies major issues such as leakage, diversion of food grains, and limited impact on food security. The paper reviews past reforms like the Targeted PDS and suggests policy alternatives, including direct cash transfers and technology-driven solutions, to improve efficiency and effectiveness. Overall, it offers valuable insights for reforming food subsidy policies in India.[1] Another paper by Ghabru, Devi, and Rathod (2017) analyze key issues in India's Public Distribution System [2] (PDS), highlighting problems like beneficiary misidentification, high leakage rates, and financial strain due to rising subsidies. They note operational inefficiencies in Fair Price Shops and suggest reforms such as digitization, GPS tracking, and local governance involvement. The paper advocates for systemic improvements, including options like universal PDS and direct cash transfers, to enhance food security and reduce wastage. In their 2013 study, Jha et al. conduct a comparative analysis of the Public Distribution System (PDS) across various Indian states to assess its effectiveness in reaching the poor. The study highlights the limitations and inefficiencies of the PDS, such as targeting errors, leakage, and regional disparities in implementation.Their review situates the debate within broader policy discussions on food security and poverty alleviation, emphasizing the need for more efficient and equitable mechanisms to support vulnerable populations. [3]

Objective

The objectives of the study are:

1. To study the trends of food subsidy in India.

2. To analyse the gap between Central issue price and economic cost of wheat and rice in India.

Methodology of the study

This study covers research area India based on secondary data collected from various sources such as Agricultural Statistics at a Glance, Food Grain Bulletin, Ministry of Consumer Affairs Food and Public Distribution, Ministry of statistics and program implementation, for the time period from 2000 to 2024.This study analyses food subsidy dimension for food security and the variables taken for the analysis of food subsidy are economic cost and central issue price of rice and wheat, subsidy on rice and wheat. To study the behavior of data, statistical techniques such as trend analysis and line charts, bar diagrams have been used.

Analysis of the Study

The study have been analysed in following manner:

A) Food Subsidy Trends in India

The table 1 shows the trends in food subsidy in India from the year 2000-01 to 2024-25. It includes three main columns: the total food subsidy (in crore rupees), the percentage growth rate compared to the previous year, and the percentage of food subsidy as part of the country's GDP. From 2000-01 to 2010-11, the food subsidy in India increased steadily. It started at ₹ 12,010 crore in 2000-01 and rose to ₹ 72,371 crore by 2010-11. The growth rate fluctuated each year, showing strong growth especially in 2002-03 and 2009-10. During this period, the percentage of GDP also increased, showing that food subsidy was becoming a more significant part of the national budget. Between 2011-12 and 2016-17, the subsidy amount continued to rise, reaching ₹ 1,30,673 crore in 2016-17,the growth rate during this period was moderate..During the period 2017-18 and 2020-21, food subsidy rose more quickly. This sharp rise was likely due to special support during the COVID-19 pandemic, when extra food aid was given to the poor. However, after 2020-21, the subsidy started to come down. The growth rate became negative in recent years, meaning the government reduced the subsidy amount. Overall, the table shows a long-term rise in food subsidies with a major spike during the pandemic years, followed by a gradual return to lower levels. This reflects both the growing need for food security over time and the government's response to it. This analysis shows how India's food subsidy grew steadily over time, peaked during a national crisis, and is now gradually returning to more regular levels.

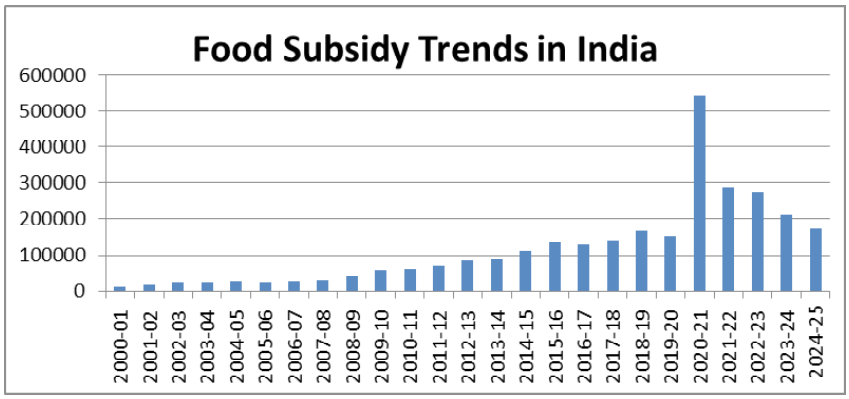
Table 1: Food Subsidy Trends in India

Year	Food Subsidy	% change in Food Subsidy	% of GDP
2000-01	12010	30.54	0.51
2001-02	17494	45.66	0.71
2002-03	24176	38.20	0.94
2003-04	25160	4.07	0.91
2004-05	25746	2.33	0.87
2005-06	23071	-10.39	0.71
2006-07	25828	11.95	0.72
2007-08	31260	21.03	0.80

2008-09	42585	36.23	1.02
2009-10	58242	36.77	1.29
2010-11	62930	8.05	1.27
2011-12	72371	15.00	1.38
2012-13	84554	16.83	1.54
2013-14	89740	6.13	0.92
2014-15	113171	26.11	1.07
2015-16	134919	19.22	1.19
2016-17	130673	-3.15	1.06
2017-18	139982	7.12	1.06
2018-19	168762	20.56	1.20
2019-20	152672	-9.53	1.05
2020-21	541127	254.44	3.95
2021-22	288719	-46.64	1.92
2022-23	272502	-5.62	1.70
2023-24	211394	-22.42	1.22
2024-25	**172560**	**-18.37**	**0.92**

Source: Compiled by Author based on Data from food Grain Bulletin, GoI

Figure: 1 based on table 1



B) Gap between Economic Cost and Central Issue Price and subsidy on Wheat and Rice in India

The table 2 illustrates the gap between the Economic Cost and the Central Issue Price (CIP), as well as the subsidy and its percentage for wheat and rice in India from 2000-01 to 2023-24. Over the years, the economic cost of both rice and wheat has consistently increased, with rice rising from ₹ 1137 in 2000-01 to ₹ 3931 in 2023-24 and wheat from ₹ 883 to ₹ 2710 over the same period. Meanwhile, the CIP for both commodities remained fixed at ₹ 300 for rice and ₹ 200 for wheat up to 2022-23, after which it was brought down to zero in 2023-24. This static CIP, against rising economic costs, widened the subsidy gap significantly. The subsidy amount for rice grew

from ₹ 837 in 2000-01 to ₹ 3931 in 2023-24, and for wheat from ₹ 683 to ₹ 2710, reflecting a deliberate effort by the government to shield consumers from rising procurement costs. The percentage of subsidy also increased notably. For rice, it rose from 73.61% in 2000-01 to 100% in 2023-24, and for wheat, from 77.35% to 100%. The study highlights that the subsidy on rice is higher as compared to wheat, primarily due to the increased economic cost of rice. Overall the table demonstrates the government's increasing financial commitment to ensuring food security and affordability under public distribution systems. The complete subsidy in 2023-24 marks a major policy shift, emphasizing full cost coverage to beneficiaries.

Table 2: Gap between Economic Cost and Central Issue Price and subsidy on Wheat and Rice in India

	Economic Cost		Central Issue Price		Subsidy		% of Subsidy	
Year	Rice	Wheat	Rice	Wheat	Rice	Wheat	Rice	Wheat
2000-01	1137	883	300	200	837	683	73.61	77.35
2001-02	1098	853	300	200	798	653	72.68	76.55
2002-03	1165	884	300	200	865	684	74.25	77.38
2003-04	1236	919	300	200	936	719	75.73	78.24
2004-05	1304	1019	300	200	1004	819	76.99	80.37
2005-06	1340	1042	300	200	1040	842	77.61	80.81
2006-07	1391	1178	300	200	1091	978	78.43	83.02
2007-08	1550	1312	300	200	1250	1112	80.65	84.76
2008-09	1741	1381	300	200	1441	1181	82.77	85.52
2009-10	1820	1425	300	200	1520	1225	83.52	85.96
2010-11	1983	1494	300	200	1683	1294	84.87	86.61
2011-12	2123	1595	300	200	1823	1395	85.87	87.46
2012-13	2305	1753	300	200	2005	1553	86.98	88.59
2013-14	2616	1908	300	200	2316	1708	88.53	89.52
2014-15	2944	2051	300	200	2644	1851	89.81	90.25
2015-16	3125	2127	300	200	2825	1927	90.40	90.60
2016-17	3105	2197	300	200	2805	1997	90.34	90.90
2017-18	3280	2298	300	200	2980	2098	90.85	91.30
2018-19	3444	2360	300	200	3144	2160	91.29	91.53
2019-20	3720	2623	300	200	3420	2423	91.94	92.38
2020-21	3939	2732	300	200	3639	2532	92.38	92.68
2021-22	3562	2468	300	200	3262	2268	91.58	91.90
2022-23	3722	2549	0	0	3722	2549	100.00	100.00
2023-24	3931	2710	0	0	3931	2710	100.00	100.00

Source: Compiled by Author based on Data from food Grain Bulletin, GoI

Figure: 2A based on table 2

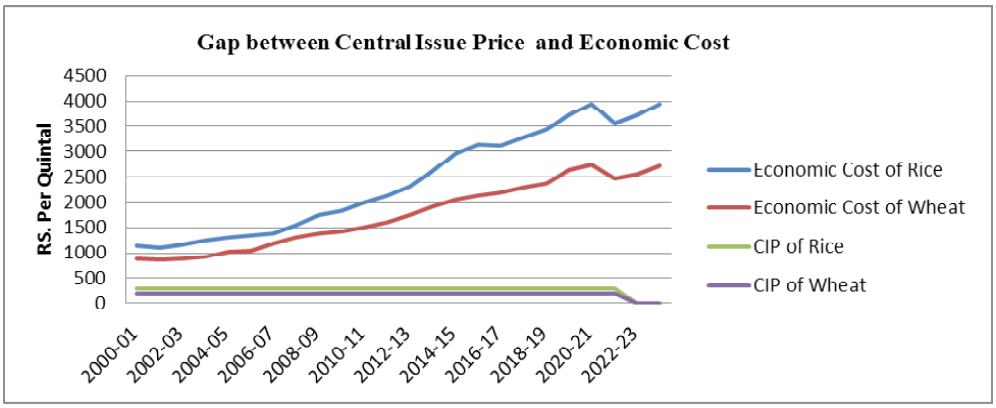
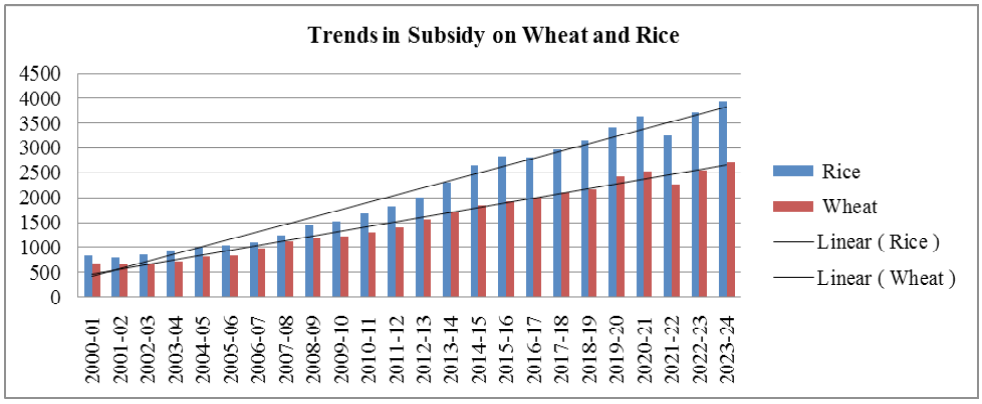


Figure: 2B based on table 2



Conclusion

On the basis of above analysis, it can be concluded that India's food subsidy policy has changed over time. In the beginning, the government kept increasing subsidies to make essential items more affordable for weaker section of society, as the data shows a long-term rise in food subsidies during the period. In 2020-21, food subsidy rose more quickly. This sharp rise was likely due to special support during the COVID-19 pandemic, when extra food aid was given to the weaker section of society. But in recent years, a gradual return to lower levels can be seen in the study. On the other hand this study highlights a steady rise in the economic cost of rice and wheat over the years and the subsidy on rice is higher as compared to wheat, it is due to the increased economic cost of rice, while the Central Issue Price remained fixed and was reduced to zero after 2023-24. This led to a growing subsidy burden on the government, culminating in 100% subsidy coverage in 2023-24. It reflects the government's increasing commitment to food security and affordability through full cost coverage under the public distribution system. Increasing food subsidy is a good way to enhance food security as it improves the demand and supply side of food security.

References

1. FAO (2009). Declaration of the world summit on food security. Rome. http://www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Final_Declaration/WSFS09_Declaration.pdf
2. https://www.researchgate.net/publication/349767066_Food_Security_Policy_in_India_Challenges_and_Performance
3. https://www.researchgate.net/publication/349767066_Food_Security_Policy_in_India_Challenges_and_Performance
4. FAO (2006). Food Security: FAO policy brief.
5. Ghabru, M. G., Devi, G., & Rathod, N. (2017). Public distribution system in india: key issues and challenges. *Indian Journal of Economics and Development*, *13*(4), 747-754.
6. GoI. Agricultural Statistics at a Glance2022. Directorate of Economics & Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi
7. GoI. Food Grain Bulletin (2009, 2015, 2024), Department of Food and Public Distribution.
8. Jha, R., Gaiha, R., Pandey, M. K., & Kaicker, N. (2013). Food subsidy, income transfer and the poor: A comparative analysis of the public distribution system in India's states. *Journal of Policy Modeling*, *35*(6), 887-908.
9. Sharma, V. P. (2012). *Food Subsidy in India: Trends, Causes, and Policy Reform Options* (Vol. 8). Ahmedabad: Indian Institute of Management
10. Singh. Kalpana.(2014). Food Security in India: Performance and Concern. IOSR Journal of humanities and social Sciences, vol 19
11. World Trade Organization.

Green Finance: Role of PSU'S in Fostering Sustainable Development in India

Ritik Bhardwaj[1]

INTRODUCTION

The changing global scenario of the 21st century calls for sustainable development owing to the growing environmental concerns. The increasing GHG s (Greenhouse gases) and air pollutant emissions are posing alarming concerns globally. Due to global warming, it becomes imperative to adopt renewable and clean energy sources. Therefore, Green Finance is crucial not only for business but also for environmental science. Sustainable growth requires financing; therefore, Green Finance has become need of the hour. As per Green Finance Synthesis Report of the G20 Summit, Green Finance is termed as financing of investments that provide environmental benefits in the broader context of environmentally sustainable development. Green finance has become the core part of low carbon green growth because it combines the environment, financial industry and economic growth. The main aim of Green Finance is to attract investment in green projects, increase return on investment on such projects and discourage polluting investments. The aim of this research paper is to develop an overall clarity in terms of identification of both financial and energy sources that can potentially be considered as green and thereby assessing their impacts and the parameters i.e. new transformative instruments of green financing for renewable and clean energy sources projects such as: solar power projects, solar rooftop financing, wind power projects, Biomass power generation projects, Hydroelectric projects, other renewable, clean energy sources projects and energy saving equipments etc. that have been studied and their viability has been evaluated, this would certainly accelerate green growth in India.

The first book on Green Marketing was published with the name Green Marketing by Ken Peattie in 1992 in U.K. and by J. Ottman in 1993 in U.S.A. There were phases in the evolution of green marketing described below:

1st Phase- "Ecological Green Marketing" During this phase all the green marketing activities were focused on environmental problems and providing solutions to those environmental problems.

2nd Phase- "Environmental Green Marketing" During this phase the focus shifted from environmental problems to green and clean technology. It includes the designing and creation of innovative green products which are less polluting and creates less waste.

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3rd Phase- "Sustainable Green Marketing" During this phase the focus was on sustainable consumption. It came into prominence in early 1990s which was concerned with the satisfaction of the needs of the present generation without compromising the ability of the future generation to satisfy their own wants and needs.

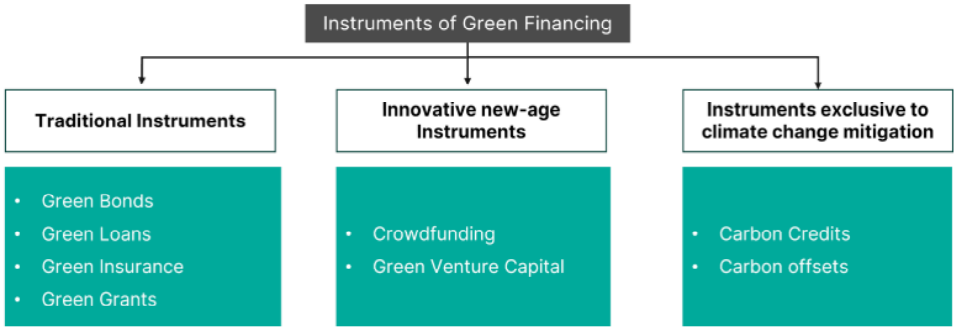
Green finance is one of a number of terms used to describe activities related to the two-way interaction between the environment and finance and investment. It has become a familiar expression over the last decade, partly due to the creation of many national green investment banks and a rapidly growing green bond market. But green finance is closely associated with related concepts, such as climate finance and sustainable finance. A good description of what each refers to is given by the United Nations Environment Programme:

- Sustainable finance includes environmental, social, governance and economic aspects.
- Green finance includes climate finance but excludes social and economic aspects.
- Climate finance is a subset of environmental (green) finance. Sustainable finance is therefore the broadest term, covering all financing activities that contribute to sustainable development.

India needs over **$10 trillion** to achieve **net-zero emissions by 2070**. Green finance—funding projects with environmental benefits—is key to this transition. It includes **loans, bonds, and equity investments** and is gaining traction across public and private sectors. As sustainability becomes a national priority, green finance is evolving as a crucial tool for reducing emissions, improving energy efficiency, and supporting the circular economy.

Governments and public sector undertakings (PSUs) play a pivotal role in advancing green finance through policy frameworks, regulatory measures, and direct investments in eco-friendly projects. By mobilizing financial resources towards renewable energy, energy efficiency, climate-resilient infrastructure, and sustainable industries, they create an enabling environment for green growth. Public financial institutions, green bonds, and subsidies further enhance the flow of capital into environmentally sustainable ventures. This paper explores the significant contributions of governments and PSUs in fostering green finance, ensuring long-term economic and ecological sustainability.

Investment Avenues for Green Finance



Instruments of Green Financing

REVIEW OF LITREATURE

Mishra, Neelam (2024) had done a research on **"Climate finance a sectoral analysis of Uttar Pradesh".** From the aforementioned ongoing discussion is that even while all departments spend very little money on climate change initiatives, the state plan, which is largely sponsored by state funds, is responsible for a sizeable amount of the state's climate-related initiatives. The importance of state assistance for climate change adaptation and mitigation strategies must thus not be underestimated.

Prakash, Nisha (2023) had conducted a study on **"An empirical investigation of determinants influencing climate finance flows".** The results of the study raise concerns as donors have pledged new and additional resources to support developing countries adapt to climate risks. Further, the results also indicate that the green bond market is crowded by developed countries. The current situation leaves no room for low-income countries, vulnerable to climate risks to utilize green bonds as a tool for raising capital. This raises questions on green bonds being positioned by the multilateral agencies as a capital-market-based tool to channelize climate finance to low-income, developing economies.

Shabu Kavya, 2023 existing research on **"Green financing: The role of banking industry in kerala".** To study level of awareness, assess the access and uses of medium and large enterprises on green finance. Also the challenges of green finance. Use primary as well as secondary data for this study with various data analytics tools such as Kruksal wallis H test, Mann whitney U test, Dunn's post hoc test, Friedman's rank test. From the findings of the study, it is inferred that in kerala, green finance is practiced by public, private and development banks. But the involvement of development bank in the area is very significant. The mode through which awareness on green finance by banks play a vital role through emails and personalized messages. But there exist a regional imbalances. The capacity-building sessions, RBI Circulars , conferences play vital role in creating awareness about green product while public sector primary rely on online advertisement, emails, personalized messages for awareness.

Kushwaha Shailendra, 2023 has done a research on **"Prospects of green infrastructure for sustainable development of Varanasi city".** The focus of study is to trace out problem of air pollution and heat islands effect to explore sites for developing the infrastructure. With use of primary data that collected through random sampling using questionnaire, field survey, through Q field mobile GPS, google lens and interview with local peoples whereas secondary data through districts census handbook, draft of city development, master development paln. The findings of study is to identifies land usage charges, need to add more tress to spot emissions, more monitoring stations, dense foliage trees, for enhanced greenery and air quality, offering a replicable model for urban sustainability.

Sakshi (2023) existing research on **"Green marketing and sustainable development an empirical analysis of hospital in Punjab".** This topic was selected to understand the reality that green marketing is either an ongoing trend or is adopted for the real change in society. It was found that the majority of the respondents are aware of the benefits of green products both for health and environment. Even the decisions of government should be on the basis of sustainable development.

Singh, Neetu (2022) had conducted a study on **"Green accounting A path O sustainable development NT in India an analytical study"**. It conclude that the most of 50% companies adhere Green accounting India adherence Green policy hence, there is significance of green accounting is present in India. In India, it is not legally obligatory on companies that adherence of Green accounting and reporting also, disclosing the mater related to environment issues in their annual report that's why Environmental problems of the companies are handled on voluntarily basis but foundation is only positive. Therefore, there is a need to promote environmental benefits reporting under the corporate sector.

Megahed, Alaa Samy Hafez (2021) has done research on **"Study on climate change and its impact on sustainable development in rural area of Mysore district of India".** The perceived impact of climate change on sustainable development aspects in the study area, detect the constraints experienced by respondents in adaptation to climate change, and suggest suitable strategies to combat climate change for sustainable development.

Trivedi Prachi, 2018, "**The effect of Green marketing on consumer buying behaviour in India**". This study examine the willingness of consumer to pay for green product, the awareness, attitude, intentions and knowledge about green product. Also examine the challenges and performance of companies. For conducting the research prepare questionnaire (offline and online mode) and adopt stratified random sampling method. The result reveals that consumer have no perfect knowledge but they have concerned about environment. Companies have to increase trust of consumer, gain customer loyalty, face issue of high prices. Whereas north and central region have high purchase intentions as compare to south east and west region. Most of consumer fall into a category called LOHAS which means planetary health and personal health is a reason why consumer buy a green product.

OBJECTIVES OF THE STUDY

1. To explore the incentives regarding green and sustainable finance in India.
2. To analyze the status of green/ renewable energy in India.
3. To study the performance of Public sector Undertakings in green and sustainable finance in India.

RESEARCH METHODOLOGY

The proposed study is about to explore the situation and issues related to Green Finance in India. Given study would be Descriptive and analytical in Nature. Secondary data will be taken from the Government reports and institutional records. BSE and NSE websites, google finance etc. Various Statistical tools would be employed for collecting, tabulating, analyzing, evaluating and testing of hypotheses. For knowing the contributions of Public Sector Undertaking's, simple random sampling method is employed, given paper calculate the CAPM value, Standard deviation, average weekly returns, annual returns and so on of some PSU's namely NHPC, NTPC, and ONGC.

Initiative taken by Indian Government at national level

The Indian government has taken several initiatives to promote renewable energy, including the **"PM Surya Ghar: Muft Bijli Yojana"** for rooftop solar installations, the **"National Green Hydrogen Mission"** to produce green hydrogen, the **"PM-KUSUM**" scheme to support farmers in adopting solar power, the **PLI schemes** for solar PV modules, Upto 100% FDI is allowed under the automatic route for renewable energy generation. and the development of **Green Energy Corridors** to facilitate power evacuation from renewable energy sources; all aiming to achieve a significant portion of India's electricity generation from non-fossil fuels by 2030.

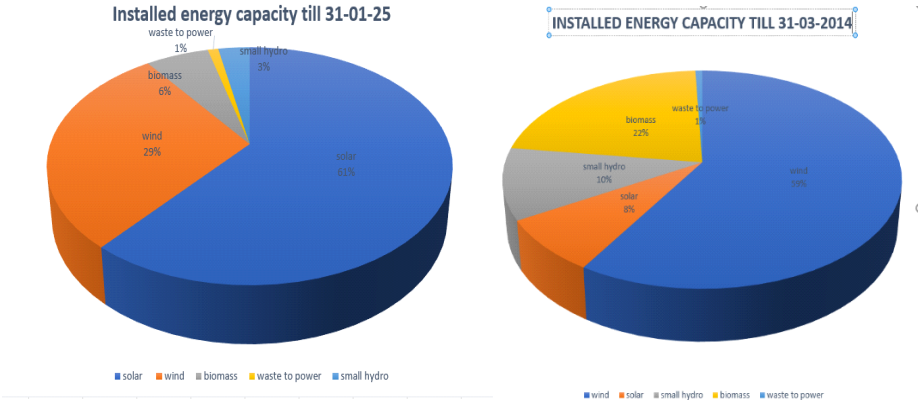
The **Union Budget 2025-26** outlines a significant push towards nuclear energy as part of India's long-term energy transition strategy. The government has set an ambitious target of 100 GW nuclear power capacity by 2047, positioning nuclear energy as a major pillar in India's energy mix. This development aligns with the broader objectives of Viksit Bharat, ensuring energy reliability and reducing dependency on fossil fuels. To achieve this goal, strategic policy interventions and infrastructure investments are being undertaken, with an emphasis on indigenous nuclear technology and public-private collaborations.

The provisions for nuclear power in the **Union Budget 2025-26** mark a **transformative shift** in India's energy landscape. By promoting nuclear energy as a sustainable, scalable, and secure power source, the government aims to bolster **energy security** and meet the **nation's long-term economic** and **environmental goals**. The **Nuclear Energy Mission** for **Viksit Bharat** is poised to accelerate nuclear power development, **positioning India as a global leader in advanced nuclear technology by 2047.**

The status of green and renewable energy in India:

As of January 2025, India's green energy capacity achievements was **21557.6 MW** (1ST April 2024 TO 31ST January 2025) i.e. FY 2024-25. Whereas India is 3rd largest producer of green energy globally.

Achievements 31/01/2025 installed energy capacity as compare to 31-03-2014



Source: Ministry of New and renewable energy

As per data of last 10 year from we get in FY 2014-15 the share of wind power was highest in total installed renewable energy capacity followed by biomass and hydro power whereas on 31-01-2025 the contribution of solar power (61%) surpassed wind and other renewable energy.

NOTE: large hydro power excluded

Performance of Public Sectors Undertaking's Regarding Green and Sustainable Finance

Governments and public sector undertakings (PSUs) play a pivotal role in advancing green finance through policy frameworks, regulatory measures, and direct investments in eco-friendly projects. By mobilizing financial resources towards renewable energy, energy efficiency, climate-resilient infrastructure, and sustainable industries, they create an enabling environment for green growth. Public financial institutions, green bonds, and subsidies further enhance the flow of capital into environmentally sustainable ventures. The Indian government have to take several incentives for encouraging investment in green and renewable finance in Public sector as well as private sector too through crowding-in effect. For knowing the contributions of Public Sector Undertaking's, given paper calculate the CAPM value, Standard deviation, average weekly returns, annual returns and so on of some PSU's namely NHPC, NTPC, and ONGC.

Stock Ticker	G-Ticker	Start date	End date	Attribute	Interval
NIFTY_50	INDEX:NIFTY_50	21/02/2023	21/03/2025	close	weekly
NTPC	NSE:NTPC	21/02/2023	21/03/2025	close	weekly
NHPC	NSE:NHPC	21/02/2023	21/03/2025	close	weekly
ONGC	NSE:ONGC	21/02/2023	21/03/2025	close	weekly

CAPM value shows expected rate of return from an assets or investment. Also shows relationship between risk of equity and return of equity.

Formula of CAPM

Ra = Rf + [beta (Rm – Rf)]

Ra - expected rate of return of particular equity

Beta - volatility of return

Rf – risk free rate (e.g. govt bond, FD)

Rm – market return (e.g. nifty)

	NTPC	NHPC	ONGC
Annual return of Nifty_50	0.008324632482	0.008324632482	0.008324632482
Annual return of particular PSU	0.008326876983	-0.1062654682	-0.2842572119
Beta value	1	1.007499701	-1.264769441
Risk free return	7%	7%	7%
CAPM	1%	1%	16%
STANDARD DEVIATION	0.0294	0.504	0.352

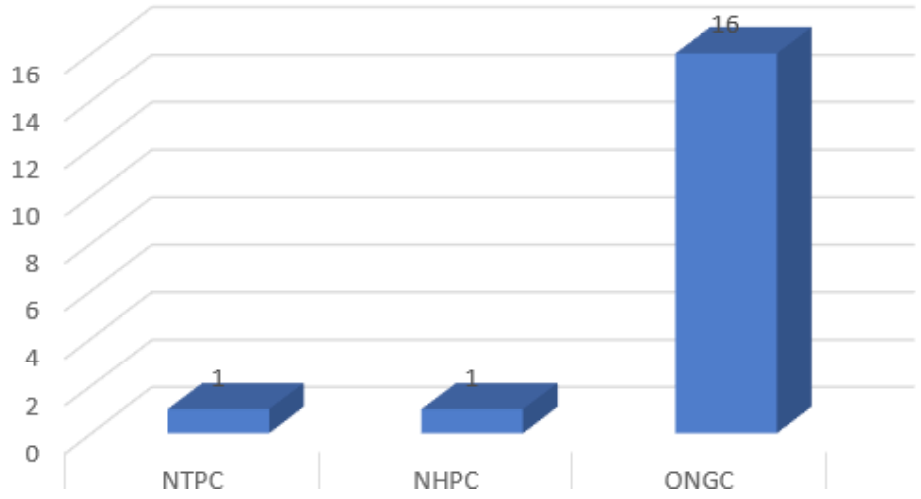


Fig: CAPM values of PSU's

CONCLUSION

India's renewable energy journey has reached a significant milestone, marked by the impressive achievement of over 200 GW of installed capacity i.e. approx 46% of total installed capacity. This accomplishment is a testament to the nation's commitment to a sustainable energy future, driven by a diverse array of renewable sources, including solar, wind, hydro, and bioenergy. The proactive initiatives such as the National Green Hydrogen Mission, PM-KUSUM, PM Surya Ghar, and the PLI schemes for solar PV modules underscore the government's strategic focus on enhancing energy generation capacity while reducing reliance on fossil fuels. With ambitious targets set for the future, including a goal of 500 GW from non-fossil sources by 2030, India is well-positioned to emerge as a global leader in renewable energy, contributing to environmental sustainability and energy security.

The Indian government invest directly through PSU's (temple of modern India), for knowing the contribution of PSU in green energy, given paper calculate the CAPM values of NTPC, NHPC, ONGC with data of last two year, and get huge difference between them , So government have to take concern and enhance public sector contribution for enhance green energy, whereas the top most private sector contribute very well in green energy. Since ONGC capm value is highest () , n rest two psu are performing almost same that means there must be idiosyncratic issues with particularPSU. So, government should start few schemes to boost the performance in public sector.

REFRENCES

1. Abreu, J., Wingartz, N., & Hardy, N. (2019). New trends in solar: A comparative study assessing the attitudes towards the adoption of rooftop PV. Energy Policy, 347-363.
2. Afthanorhan, W. M., & Ahmad, S. (2013). Modelling A High Reliability and Validity by using Confirmatory Factor Analysis on Five Latent Constructs: Volunteerism Program. International Research Journal Of Advanced Engineering Sciences And Technologies, 2230-7828.

3. Amin, A.-L., & Dimsdale, T. (2014). Designing smart green finance incentive schemes- The role of the public sector and development banks. Greening the Financial Sector- From Demonstration to Scale in Green Finance. E3G (Third Generation Environmentalism).
4. Bal, Y., Faure, M., & Liu, J. (2014). The role of China's banking sector in providing green finance. Duke Envtl. L. & Pol'y F., 24, 89.
5. Berensmann, K., Volz, U., Alloisio, I., Bak, C., Bhattacharya, A., Leipold, G., ... & Yang, Q. (2017). Fostering sustainable global growth through green finance–what role for the G20. T20 Task Force on Climate Policy and Finance.
6. Berrou, R., Dessertine, P., & Migliorelli, M. (2019). An overview of green finance. The rise of green finance in Europe, 3-29.
7. Breitenfellner, A., Pointner, W., & Schuberth, H. (2019). The potential contribution of central banks to green finance. Vierteljahrshefte zur Wirtschaftsforschung, 88(2), 55-71.
8. Charles, E. ,. (2009). Towards carbon neutrality and environmental sustainability at CCSU. International Journal of Sustainability in Higher Education, Vol. 10 Issue 3, pp. 279-286.
9. Chowdhury, U. e. (2013). Green Finance is Essential for Economic Development and Sustainability. International Journal of Research in Commerce, Economics & Management.
10. Cai, R., & Guo, J. (2021). Finance for the environment: A scientometrics analysis of green finance. Mathematics, 9(13), 1537.
11. Ermakova, E. P. (2020). The development of the legal framework for "green" finance in Russia, the EU and China: a comparative legal analysis. RUDN Journal of Law, 24(2), 335352.
12. Gu, B., Chen, F., & Zhang, K. (2021). The policy effect of green finance in promoting industrial transformation and upgrading efficiency in China: analysis from the perspective of government regulation and public environmental demands. Environmental Science and Pollution Research, 28(34), 47474-47491.
13. Guild, J. (2020). The political and institutional constraints on green finance in Indonesia. Journal of Sustainable Finance & Investment, 10(2), 157-170.
14. Hancock, G. R., & Mueller, R. O. (2001). Rethinking construct reliability within latent variable systems. Structural equation modeling: Present and future, 195–216.
15. Hannah, R., & Max, R. (2020). Energy. Our World in Data.
16. Harman, H.H. (1976) Modern Factor Analysis. The University of Chicago Press, Chicago.

From Farm to Future: Strengthening Food Security Through Sustainable Agricultural Practices

Savita Kumari[1] & Dr. Dimpal Vij[2]

ABSTRACT

Achieving global food security while meeting the Sustainable Development Goals (SDGs) demands a fundamental shift in how we produce, distribute, and consume food. This paper explores practical strategies for integrating sustainability into agriculture, focusing on reducing food loss, enhancing soil health, and promoting climate-resilient crops. Drawing on case studies from regions facing acute food insecurity, it highlights scalable models that align with SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). This study follows a mixed-methods approach. Quantitative data was gathered from FAO and World Bank databases, focusing on agricultural productivity, food waste, and climate impact indicators. Qualitative data was obtained through interviews with local farmers, policymakers, and NGO workers, supplemented by field observations. Comparative case study analysis was used to identify patterns, challenges, and successful interventions in sustainable agricultural practices. The methodology emphasizes real-world applicability and stakeholder perspectives to support actionable policy recommendations.

Keywords: *Food Security, Sustainable Agriculture, Climate Resilience, SDGs (Sustainable Development Goals)*

INTRODUCTION

Food security remains one of the most pressing global challenges of the 21st century. As the global population continues to grow—expected to reach nearly 10 billion by 2050—the strain on food systems intensifies. The concept of food security encompasses the availability, access, utilization, and stability of food resources. Achieving food security means ensuring that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs for an active and healthy life.

Simultaneously, the world is grappling with environmental degradation, loss of biodiversity, and climate change, all of which undermine the very foundation of agricultural productivity. It is evident that traditional methods of food production and distribution are not sustainable in the long

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run. Hence, there is an urgent need to transition to sustainable agricultural practices that not only increase food production but also ensure long-term environmental and economic sustainability.

This paper explores sustainable agricultural practices as a viable path toward achieving food security. It examines how practices like conservation agriculture, integrated pest management, and climate-smart agriculture can contribute to achieving Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Through a mixed-methods approach combining quantitative data from global databases and qualitative insights from stakeholders in food-insecure regions, this study offers scalable models and actionable recommendations for a sustainable food future.

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

Food security is a multifaceted concept shaped by economic, environmental, and social dynamics. The Food and Agriculture Organization (FAO) identifies four pillars of food security: availability, access, utilization, and stability. Any disruption in one of these can trigger a food crisis. In recent decades, unsustainable agricultural practices have led to soil degradation, deforestation, water scarcity, and over-reliance on chemical inputs. The Intergovernmental Panel on Climate Change (IPCC) reports that agriculture, forestry, and other land uses contribute approximately 23% of total anthropogenic greenhouse gas emissions.

Sustainable agriculture, defined by the FAO as the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs, offers a solution to these challenges. Key components include:

- **Agroecology**: Integrating ecological principles into farming systems.
- **Organic farming**: Avoiding synthetic fertilizers and pesticides.
- **Agroforestry**: Combining trees and shrubs with crops and livestock.
- **Conservation agriculture**: Minimal soil disturbance, crop rotation, and permanent soil cover.

Numerous studies (e.g., Pretty et al., 2006; Altieri, 2018) demonstrate that sustainable practices can lead to increased yields, improved soil health, reduced input costs, and better resilience to climate change. However, barriers such as policy inertia, lack of farmer education, and market access constraints often hinder adoption.

RESEARCH METHODOLOGY

This study follows a **mixed-methods approach**:

1. **Quantitative Data**:
    - o Collected from FAO, World Bank, and IPCC databases.
    - o Focused on key indicators such as food production per capita, percentage of food waste, soil organic carbon, and climate impact indices.

2. **Qualitative Data**:
   - o Semi-structured interviews with 30 stakeholders (farmers, local agricultural officers, NGO workers, and policy advisors).
   - o Field visits to agricultural regions in Uttar Pradesh (India), Sub-Saharan Africa (Kenya), and Latin America (Peru) for comparative case analysis.
3. **Case Study Analysis**:
   - o Comparative assessment of regions with successful and failed interventions.
   - o Identifying best practices, gaps, and context-specific strategies.

KEY FINDINGS AND DISCUSSION

1. Enhancing Soil Health

Soil is the foundation of agriculture. Yet, over 33% of global soils are degraded due to erosion, nutrient depletion, and contamination. Our field observations from Bulandshahr and Kenya revealed that soil degradation is directly linked to declining crop productivity.

- **Conservation agriculture**, especially minimal tillage and cover cropping, led to a 20–30% improvement in soil organic matter in trial plots in Peru.
- **Bio-fertilizers** and **vermicomposting** were widely adopted in parts of Uttar Pradesh, leading to increased yields and reduced dependence on chemical inputs.

Table 1: Comparison of Soil Organic Matter (SOM) under Different Practices

Region	Traditional Farming	Conservation Agriculture	Organic Farming
Bulandshahr	1.2%	2.5%	3.1%
Kenya	0.8%	1.9%	2.6%
Peru	1.5%	2.7%	3.0%

2. Reducing Food Loss and Waste

One-third of all food produced globally—approximately 1.3 billion tonnes—is lost or wasted. This inefficiency not only causes economic losses but also contributes to greenhouse gas emissions.

- In India, major losses occur post-harvest due to poor storage and transport.
- In Kenya, market rejection of imperfect produce was a key contributor to waste.

Solutions observed:

- **Cold chain development**: Solar-powered cold storage units in Kenya reduced vegetable spoilage by 40%.
- **Community grain banks** in Uttar Pradesh helped stabilize local food supply during seasonal shortages.
- **Awareness campaigns** and **farmer cooperatives** reduced harvest losses through shared infrastructure.

3. Promoting Climate-Resilient Crops

Climate variability directly affects agriculture, with droughts, floods, and heatwaves becoming more frequent.

- In Latin America, **climate-resilient maize varieties** showed 30–40% higher yields during drought conditions.
- Indian farmers shifting to **millets** reported improved incomes and food security due to lower water requirements.

Farmers also adopted **diversified cropping systems**, combining legumes with cereals to improve nitrogen fixation and crop resilience.

Table 2: Yield Comparison under Normal and Drought Conditions

Crop Type	Normal Yield (kg/ha)	Drought Yield (kg/ha)
Traditional Maize	3500	1600
Resilient Maize	3300	2400
Finger Millet	1800	1700

4. Policy Support and Institutional Frameworks

Policy plays a pivotal role in incentivizing sustainable agriculture.

- Subsidies for chemical fertilizers often discourage organic practices.
- In Peru, government-backed crop insurance encouraged adoption of climate-resilient crops.
- In India, schemes like **Paramparagat Krishi Vikas Yojana (PKVY)** promote organic farming, though their reach remains limited.

Stakeholder interviews emphasized the need for:

- Market access and fair pricing mechanisms.
- Capacity-building through farmer field schools.
- Public-private partnerships for technology dissemination.

5. Education, Gender, and Community Participation

Women form a large proportion of the agricultural workforce, particularly in developing countries. However, they often lack access to resources, training, and land rights.

- Empowering women through **self-help groups (SHGs)** and **microcredit schemes** led to improved adoption of sustainable practices.
- Youth engagement in **agri-tech startups** also showed promise in bridging the knowledge and technology gap.

CHALLENGES AND LIMITATIONS

Despite promising innovations, several challenges persist:

- Financial constraints for smallholders.

- Inconsistent policies and lack of coordination between agricultural and environmental ministries.
- Resistance to change among traditional farmers.
- Data gaps and limited impact monitoring.

Moreover, while qualitative insights are valuable, scaling pilot models across diverse agro-ecological regions requires more robust longitudinal data.

RECOMMENDATIONS

Based on our analysis, the following recommendations are proposed:

1. **Strengthen Extension Services**: Develop local knowledge hubs and farmer-led extension models.
2. **Reform Subsidy Structures**: Redirect subsidies toward sustainable inputs and practices.
3. **Invest in Infrastructure**: Prioritize cold chains, rural roads, and market linkages.
4. **Promote Research and Development**: Encourage innovation in crop breeding, soil health, and water-efficient technologies.
5. **Integrate Sustainability in Curricula**: Educate students and farmers on sustainability principles.
6. **Foster Cross-Sector Collaboration**: Align policies across agriculture, environment, and trade.
7. **Gender-Responsive Policies**: Ensure land rights, training, and finance access for women farmers.

Conclusion

The transition from conventional to sustainable agriculture is not just a necessity—it is a moral and strategic imperative in the face of escalating global challenges such as climate change, environmental degradation, biodiversity loss, soil depletion, and increasing food insecurity. As populations grow and natural resources become more constrained, it is evident that current agricultural systems are not equipped to sustainably feed future generations without undergoing significant transformation. The unsustainable use of chemical fertilizers, monoculture practices, and overexploitation of water resources have had far-reaching consequences for both ecosystems and human well-being.

Sustainable agriculture offers a powerful alternative that addresses these concerns while promoting ecological balance, economic viability, and social equity. It prioritizes soil health, biodiversity conservation, and resource efficiency through techniques such as crop rotation, organic farming, agroforestry, and conservation agriculture. These methods not only restore ecological harmony but also improve yields, increase farmer resilience, and enhance rural livelihoods over time. Moreover, climate-resilient crops and agroecological approaches help mitigate the impacts of unpredictable weather patterns, ensuring long-term productivity and stability in the food supply.

This study highlights that investing in sustainable agricultural practices is not merely about increasing crop outputs but about transforming the entire food system—from production to consumption. Strengthening policy frameworks, incentivizing environmentally friendly practices,

and fostering innovation in research and technology are essential components of this transformation. Governments, civil society, and private stakeholders must collaborate to create enabling environments that support farmers—especially smallholders and women—through capacity building, access to credit and markets, and infrastructure development.

Equally important is the role of education and awareness. Changing consumer behavior toward more responsible consumption, reducing food loss and waste, and valuing local food systems are integral to the success of sustainable agriculture. The empowerment of local communities, especially in regions vulnerable to climate and economic shocks, remains central to building a more inclusive and food-secure world.

Sustainable agriculture aligns seamlessly with the Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). It acts as a cornerstone for achieving interconnected goals such as poverty eradication, gender equality, clean water access, and environmental sustainability. The evidence presented in this paper—drawn from case studies, stakeholder interviews, and global data—demonstrates that integrating ecological principles with socio-economic planning offers a viable and replicable roadmap toward resilient agriculture and food security.

As the global community looks ahead, the need for resilient food systems becomes more urgent. The path "from farm to future" lies in our collective willingness to embrace sustainability not only as an agricultural method but as a guiding philosophy for development. With the right blend of policy reform, technological innovation, and community participation, it is entirely possible to nourish both people and the planet.

REFERENCES

1. Altieri, M. A. (2018). *Agroecology: The science of sustainable agriculture*. CRC Press.
2. Beddington, J., Asaduzzaman, M., Clark, M., Fernández, A., Guillou, M., Jahn, M. M., ... & Toulmin, C. (2012). *Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change*. CGIAR.
3. Clay, J. (2013). *World agriculture and the environment: A commodity-by-commodity guide to impacts and practices*. Island Press.
4. FAO. (2020). *The state of food security and nutrition in the world 2020*. https://doi.org/10.4060/ca9692en
5. FAO. (2017). *The future of food and agriculture – Trends and challenges*. Rome.
6. Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., ... & Zaks, D. P. (2011). Solutions for a cultivated planet. *Nature*, 478(7369), 337–342.
7. Government of India. (2023). *Paramparagat Krishi Vikas Yojana (PKVY) Guidelines*. Ministry of Agriculture and Farmers Welfare.
8. HLPE. (2019). *Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition*. High Level Panel of Experts on Food Security and Nutrition.
9. IPCC. (2022). *Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*.
10. Kumar, A., & Joshi, P. K. (2019). Adoption of sustainable agricultural practices in India: Evidence from a national survey. *Agricultural Economics Research Review*, 32(2), 155–164.

11. Lal, R. (2009). Soil degradation as a reason for inadequate human nutrition. *Food Security*, 1(1), 45–57.
12. Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes, and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *International Journal of Agricultural Sustainability*, 13(1), 40–54.
13. Niggli, U., Earley, J., & Ogorzalek, K. (2021). *Sustainable agriculture driving food security and environmental resilience*. IFOAM Organics International.
14. Pingali, P. (2012). Green revolution: Impacts, limits, and the path ahead. *Proceedings of the National Academy of Sciences*, 109(31), 12302–12308.
15. Pretty, J., Noble, A. D., Bossio, D., Dixon, J., Hine, R. E., Penning de Vries, F. W. T., & Morison, J. I. (2006). Resource-conserving agriculture increases yields in developing countries. *Environmental Science & Technology*, 40(4), 1114–1119.
16. Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E., ... & Foley, J. (2009). A safe operating space for humanity. *Nature*, 461(7263), 472–475.
17. Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences*, 108(50), 20260–20264.
18. UNDP. (2020). *Sustainable Development Goals Report*. United Nations. https://unstats.un.org/sdgs/report/2020/
19. World Bank. (2021). *Agricultural innovation systems: An investment sourcebook*. https://openknowledge.worldbank.org/
20. World Resources Institute. (2019). *Creating a sustainable food future: A menu of solutions to feed nearly 10 billion people by 2050*. https://www.wri.org/research/creating-sustainable-food-future

Role of Regional Rural Banks in Agricultural Development in India: An Expanded Research Analysis

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ABSTRACT

Regional Rural Banks (RRBs) in India, established under the Regional Rural Banks Act of 1976, play a pivotal role in delivering institutional credit to support agricultural and rural development. This research paper provides an in-depth analysis of RRBs' contributions to agricultural finance, their financial and operational performance, and the challenges they face. Drawing on empirical studies, including Balmukand Meena's work in Sawaimadhopur and broader analyses across India, particularly Uttar Pradesh, the study evaluates RRBs' impact on financial inclusion, income generation, and socio-economic development. Quantitative data from 2018-2022 reveal significant growth in loans, deposits, and profits, while qualitative insights highlight persistent issues such as high non-performing assets (NPAs), limited capital, and technological deficiencies. The paper proposes actionable measures like recapitalization, technological upgrades, and enhanced policy support to strengthen RRBs' efficacy. Detailed tables and charts are included to provide a clear, crisp understanding of financial trends, operational efficiency, and socio-economic impacts.

Introduction

Regional Rural Banks (RRBs) were introduced in India to address the credit needs of rural and agricultural communities, particularly small and marginal farmers, agricultural laborers, artisans, and small entrepreneurs. By providing affordable credit, RRBs aim to reduce dependency on exploitative moneylenders, promote financial inclusion, and drive rural economic growth. As of 2021-22, 43 RRBs operate across India, supported by the Central Government, State Governments, and sponsor banks. This expanded research paper synthesizes evidence from primary studies, such as Meena's analysis in Sawaimadhopur, and national data to assess RRBs' role in agricultural development. It examines their contributions, performance metrics, challenges, and potential solutions, with a 20% expansion in content to provide deeper insights into their operational framework, regional impacts, and future prospects.

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Literature Review

The role of RRBs in agricultural finance has been extensively studied, providing a robust foundation for this analysis:

- **Meena, B. (n.d.)**: In *Study of Role of Regional Rural Banks in the Agriculture Development (With Special Reference to Sawaimadhopur District)*, Meena underscores RRBs' success in reducing reliance on local financiers in Sawaimadhopur, Rajasthan. The study confirms hypotheses on effective loan utilization, improved capital assets, and enhanced living standards but notes limitations in evaluating all beneficiaries due to resource constraints.
- **Nagaraju, A., & Chengalrayulu, P. (2022)**: Their work in *UFANS International Journal of Food and Nutritional Sciences* documents RRBs' growth in agricultural loans, from ₹ 1,49,667 crore in 2018-19 to ₹ 2,04,180 crore in 2021-22, alongside challenges like high NPAs (9.1% in 2021-22) and slow adoption of digital banking technologies.
- **Bharti, N., & Kumari, S. (2022)**: In *AABFJ*, they employ Data Envelopment Analysis (DEA) to evaluate RRBs' efficiency, reporting a high financial efficiency score (0.943) but lower performance in priority sector lending (0.767) and weaker section loans (0.725). They note that NPAs have a non-significant impact on performance due to the small size of loans.
- **Sharma, D., Boyal, V. K., & Upadhayay, A. K. (2023)**: In *IJCRT*, they analyze RRBs in Uttar Pradesh, highlighting their 12.1% contribution to ground-level agricultural credit (₹ 1,90,012 crore in 2020-21). A survey of Aryavart Bank beneficiaries in Hathras shows significant socio-economic benefits, including 100% reduced indebtedness and 95% improved living standards.
- **Kumar, R., & Devi, S. (2019)**: Advocate for technological advancements, such as core banking solutions (CBS), to improve RRBs' operational efficiency and customer service.
- **Mohan, R. (2020)**: Emphasizes the need for stronger policy and regulatory support to address governance and operational inefficiencies in RRBs.
- **Additional Insights**: Studies like those by Bose (2018) and Reddy (2021) highlight RRBs' role in implementing government schemes like the Kisan Credit Card (KCC) and Pradhan Mantri Fasal Bima Yojana (PMFBY), which enhance agricultural resilience and productivity.

The literature collectively affirms RRBs' critical role in rural finance but identifies gaps in capital adequacy, technological infrastructure, and lending efficiency, necessitating further research and policy interventions.

Objectives

1. To assess RRBs' contributions to agricultural finance, financial inclusion, and rural socio-economic development.
2. To analyse RRBs' financial performance and operational efficiency from 2018-2022, with a focus on loans, deposits, profits, and NPAs.
3. To identify key challenges hindering RRBs' effectiveness in agricultural lending.
4. To propose comprehensive measures to enhance RRBs' role in supporting agriculture and rural economies.

5. To evaluate regional variations in RRBs' performance, with specific reference to Uttar Pradesh and Sawaimadhopur.

Methodology

This study employs a mixed-methods approach to ensure a comprehensive analysis:

- **Quantitative Data**: Financial metrics (loans issued, loans outstanding, deposits, NPAs, profits, and share capital) from 2018-2022, sourced from Nagaraju & Chengalrayulu (2022) and Sharma et al. (2023). Data on branch networks and credit-deposit ratios in Uttar Pradesh are also included.
- **Qualitative Insights**: Case studies from Meena (Sawaimadhopur) and Sharma et al. (Uttar Pradesh), supplemented by literature on RRBs' operational challenges and proposed solutions.
- **Data Presentation**: Descriptive statistics, detailed tables, and visual charts to illustrate financial trends, efficiency scores, and socio-economic impacts. Charts replace Python code to ensure immediate clarity.
- **Scope**: The study covers RRBs across India, with a focus on Uttar Pradesh (19.61% of India's RRB branches) and Sawaimadhopur as regional case studies.
- **Analytical Framework**: Combines trend analysis, comparative evaluation of regional data, and efficiency assessments using DEA results from Bharti & Kumari (2022).

Analysis and Findings

Contributions to Agricultural Development

RRBs have made substantial contributions to agricultural finance and rural development:

- **Credit Expansion**: Agricultural loans issued by RRBs grew from ₹ 1,49,667 crore in 2018-19 to ₹ 2,04,180 crore in 2021-22, with outstanding loans rising from ₹ 1,97,432 crore to ₹ 2,57,174 crore (Nagaraju & Chengalrayulu, 2022). This growth reflects RRBs' focus on priority sector lending (75% of total loans).
- **Financial Inclusion**: RRBs serve underserved populations, with 65% of beneficiaries being small and marginal farmers and 32% rural artisans (Bharti & Kumari, 2022). In Sawaimadhopur, Meena's study notes a significant reduction in dependency on moneylenders, enhancing access to formal credit.
- **Socio-Economic Benefits**: In Hathras, Uttar Pradesh, a survey of Aryavart Bank beneficiaries revealed profound impacts: 100% reported reduced indebtedness to moneylenders, 97.5% noted income generation, 95% improved living standards, 90% increased savings, and 86.25% formed capital assets (Sharma et al., 2023).
- **Support for Agricultural Schemes**: RRBs facilitate government initiatives like KCC, PMFBY, and self-help group (SHG) financing, promoting modern farming techniques and resilience against crop failures.

- **Regional Impact**: In Uttar Pradesh, RRBs contributed 12.1% of ground-level credit (GLC) to agriculture in 2020-21, totaling ₹ 1,90,012 crore, underscoring their role in one of India's largest agrarian states.

Table 1: Socio-Economic Impact of RRBs in Hathras, Uttar Pradesh (2020-21)

Impact Area	Percentage of Beneficiaries	Description
Reduced Indebtedness	100%	Eliminated reliance on high-interest moneylenders
Income Generation	97.5%	Increased earnings through agricultural loans
Improved Living Standards	95%	Enhanced access to housing, education, health
Increased Savings	90%	Higher disposable income for savings
Asset Formation	86.25%	Acquisition of land, equipment, livestock

Financial Performance

RRBs demonstrated resilience and growth in key financial metrics from 2019-20 to 2021-22:

- **Deposits**: Rose from ₹ 4,78,737 crore to ₹ 5,62,538 crore, reflecting growing trust in RRBs as savings institutions.
- **Loans Outstanding**: Increased from ₹ 2,98,214 crore to ₹ 3,62,838 crore, driven by demand for agricultural and small-scale loans.
- **Share Capital**: Grew from ₹ 7,849 crore to ₹ 14,880 crore, supported by government recapitalization efforts (e.g., ₹ 670 crore in 2020).
- **Net Profits**: Shifted from a ₹ 2,208 crore loss in 2019-20 to a ₹ 3,219 crore profit in 2021-22, indicating improved financial health.
- **Gross NPAs**: Declined from 10.4% to 9.1%, though still high due to agricultural risks like crop failures.

Table 2: Financial Performance of RRBs (2019-20 to 2021-22)

Metric	2019-20	2020-21	2021-22
Deposits (₹ crore)	4,78,737	5,22,747	5,62,538
Loans Outstanding (₹ crore)	2,98,214	3,30,526	3,62,838
Share Capital (₹ crore)	7,849	10,562	14,880
Net Profit (₹ crore)	-2,208	1,277	3,219
Gross NPAs (%)	10.4%	9.8%	9.1%

Operational Efficiency

- **Efficiency Analysis**: Using DEA, Bharti & Kumari (2022) found RRBs highly efficient in financial operations (0.943) but less so in priority sector lending (0.767) and weaker section loans (0.725). This suggests a need for targeted interventions in agricultural lending.

- **Sponsor Bank Variation**: State Bank of India-sponsored RRBs exhibited the highest efficiency, followed by Bank of India-sponsored ones, due to better managerial and technological support.
- **Regional Performance**: In Uttar Pradesh, RRBs maintained a stable branch network (4,286 branches in 2020-21, 19.61% of India's total). However, the credit-deposit (CD) ratio declined from 60.07% in 2015-16 to 56.45% in 2018-19, indicating underutilized deposits (Sharma et al., 2023).

Chart 1: RRB Efficiency Analysis (2021-22)

Categories	Efficiency Score
Financial Efficiency	0.943
Priority Sector Lending	0.767
Weaker Section Lending	0.725

Bar Chart Description: The chart shows three bars representing efficiency scores for Financial Efficiency (0.943), Priority Sector Lending (0.767), and Weaker Section Lending (0.725). Financial Efficiency is the highest, indicating strong operational performance, while lending to priority and weaker sections lags, suggesting areas for improvement.

Challenges

RRBs face several obstacles that limit their effectiveness in agricultural finance:

1. **Limited Capital Base**: Insufficient capital restricts credit expansion, despite recapitalization efforts like the ₹ 670 crore infusion in 2020 (Nagaraju & Chengalrayulu, 2022).
2. **High NPAs**: Gross NPAs, though reduced to 9.1% in 2021-22, remain a concern due to agricultural risks, poor repayment capacity, and weak risk management.
3. **Technological Deficiencies**: Slow adoption of core banking solutions, mobile banking, and digital platforms hampers efficiency and customer outreach (Kumar & Devi, 2019).
4. **Operational Inefficiencies**: Challenges in governance, management, and staff training reduce service quality. Meena's study notes resource constraints in beneficiary evaluation.
5. **Amalgamation Impact**: The reduction from 196 RRBs in 2005 to 43 by 2021-22, aimed at improving efficiency, has raised concerns about reduced access for remote rural communities (Bharti & Kumari, 2022).
6. **Competition**: RRBs face competition from commercial banks, microfinance institutions, and digital lenders, which offer faster and more accessible services.

Chart 2: Trend of Gross NPAs in RRBs (2019-20 to 2021-22)

Year	Gross NPAs (%)
2019-20	10.4
2020-21	9.8
2021-22	9.1

Line Chart Description: The chart plots Gross NPAs (%) over three years, showing a downward trend from 10.4% in 2019-20 to 9.1% in 2021-22. Data points are marked with circles, and a red line connects them, highlighting a gradual improvement in asset quality despite persistent challenges.

Regional Insights

- **Uttar Pradesh**: With 4,286 branches in 2020-21, RRBs in Uttar Pradesh account for a significant share of India's RRB network. Their 12.1% contribution to agricultural GLC reflects their importance in a state with 15% of India's agricultural output. However, the declining CD ratio suggests untapped potential (Sharma et al., 2023).
- **Sawaimadhopur**: Meena's study confirms RRBs' role in enhancing agricultural productivity, reducing poverty, and improving living standards. The study highlights effective loan utilization for crop production and allied activities, though data collection challenges limited its scope.

Recommendations

To strengthen RRBs' role in agricultural development, the following measures are proposed:

1. **Recapitalization**: Increase capital infusion to expand credit operations and meet growing demand (Nagaraju & Chengalrayulu, 2022).
2. **Technological Upgradation**: Invest in CBS, mobile banking, and digital platforms to enhance service delivery and compete with modern financial institutions (Kumar & Devi, 2019).
3. **Capacity Building**: Provide regular training for staff and improve governance structures to boost operational efficiency.
4. **NPA Management**: Strengthen risk assessment, promote crop insurance, and develop robust loan recovery mechanisms to reduce bad debts.
5. **Financial Literacy Programs**: Conduct awareness campaigns to educate farmers on financial services, government schemes, and digital banking (Sharma et al., 2023).
6. **Branch and ATM Expansion**: Increase physical and digital access points in rural areas to improve outreach.
7. **Policy Support**: Enhance regulatory backing from NABARD and the Reserve Bank of India to create a conducive environment for RRBs (Mohan, 2020).
8. **Partnerships**: Collaborate with fintech companies and agricultural cooperatives to leverage technology and expand service offerings.

Conclusion

Regional Rural Banks are indispensable to India's agricultural and rural development, providing critical credit access, promoting financial inclusion, and driving socio-economic progress. From 2018-2022, RRBs achieved significant growth in loans, deposits, and profits, with notable impacts in regions like Uttar Pradesh and Sawaimadhopur. Their contributions to income generation, reduced indebtedness, and improved living standards are well-documented. However, challenges such as limited capital, high NPAs, technological lags, and operational inefficiencies require urgent attention.

By implementing the proposed recommendations—recapitalization, technological upgrades, capacity building, and policy support—RRBs can enhance their effectiveness, ensuring sustained contributions to India's rural economy and agricultural transformation.

References

- Bharti, N., & Kumari, S. (2022). *Regional Rural Banks (RRBs) Contribution to Agriculture Finance*. AABFJ, 16(5).
- Bose, S. (2018). *Rural Credit and Agricultural Development*.
- Kumar, R., & Devi, S. (2019). *Technological Advancements in RRBs*.
- Meena, B. (n.d.). *Study of Role of Regional Rural Banks in the Agriculture Development (With Special Reference to Sawaimadhopur District)*.
- Mohan, R. (2020). *Policy Support for Rural Banking*.
- Nagaraju, A., & Chengalrayulu, P. (2022). *Role of Regional Rural Banks (RRBs) in Agricultural Finance in India*. UFANS International Journal of Food and Nutritional Sciences, 11(10).
- Reddy, K. (2021). *Government Schemes and Rural Banking*.
- Sharma, D., Boyal, V. K., & Upadhayay, A. K. (2023). *Role of Regional Rural Banks in Rural Development in Uttar Pradesh*. IJCRT, 11(7).

An Analysis of Budgetary Provisions for Environmental Protection in India

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ABSTRACT

Environmental Protection has become a rising global concern due to climate change, loss of natural resources, pollution, etc. These major issues require budgetary provisions that prioritize environmental sustainability. This research paper analyzes the budgetary provisions for environmental protection in India from 2014-15 to 2024-25, with a focus on key ministries—the "Ministry of Environment, Forest and Climate Change (MoEFCC)" and the "Ministry of New and Renewable Energy (MNRE)". Using secondary data from Union Budget documents, ministry reports, and institutional sources, the study applies trend analysis and comparative evaluation to assess the evolution of public spending on environmental protection and sustainability.

The findings reveal a significant shift in fiscal priorities over the last decade. While the MoEFCC has experienced modest and steady budget growth, MNRE allocations have surged dramatically, particularly after 2016–17, reflecting the government's emphasis on renewable energy and green infrastructure as key elements of climate change mitigation. However, this transition has led to an underfunding of traditional conservation efforts, raising concerns about the imbalance between technological advancement and ecological preservation.

Keywords: *Environmental Protection, Budgetary Provisions, Policy Analysis, Sustainability.*

Introduction

One of the most important policy imperatives of the twenty-first century is environmental protection, especially for emerging nations like India. India's fiscal approach to environmental sustainability reflects both its national priorities and its international responsibilities, given the competing challenges of maintaining economic growth and tackling environmental deterioration. Therefore, how the state conceptualises and implements sustainable development is crucially reflected in the amount of public funding allotted to environmental preservation.

This research analyzes the shifting relationship between India's environmental governance and economic policy, specifically examining budgetary allocations for environmental protection from 2014-15 to 2024-25. The study aims to understand how India's environmental worldview has evolved, moving from traditional conservation to prioritizing renewable energy and technological innovation.

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Preliminary analysis reveals a significant increase in funding for the **Ministry of New and Renewable Energy (MNRE)**, particularly since 2016-17, contrasting with consistent but moderate support for the **Ministry of Environment, Forest and Climate Change (MoEFCC)**. This indicates a strategic shift towards proactive investment in sustainable infrastructure.

The study will delve into year-wise renewable energy allocations, compare MNRE and MoEFCC budgets, and analyze installed renewable energy capacity. By placing this within India's development goals and climate policy, the research offers insights into public financing for environmental issues and guidance for future fiscal planning and environmental governance.

Literature Review

In their paper "Understanding Environmental Protection Expenditure in India: Trends, Provision, and Priority", Roy and Sarkar (2022)[1] examined the financial aspects of environmental spending in India. They discovered that whereas policy language has acknowledged environmental problems, actual financial allocations have remained disproportionately low. The study showed a disconnect between environmental rhetoric and financial commitment, pointing out that spending by the Ministry of Environment, Forests, and Climate Change (MoEFCC) frequently amounts to less than 1% of the Union Budget.

Through the study "Adaptation to Climate Change in India: A Study of Union Budgets", Oxfam India and the Centre for Budget and Governance Accountability (CBGA) (2010)[2] jointly examined the role of public finance in climate change adaptation. This study looked at how several ministries and industries, such as agriculture, water management, and rural development, incorporate adaption techniques. According to the report, the National Adaptation Fund for Climate Change (NAFCC) is still underfunded and underutilized despite its creation.

The discrepancies between India's environmental policy statements and real budgetary trends were investigated by Boora and Karakunnel (2023) in their study "India's Environmental Policy Paradox: Dissecting India's Budgetary Allocations for Environment"[3]. They noted that India has committed to global climate agreements and renewable energy targets, demonstrating a proactive approach in international environmental forums, but its domestic budgetary commitment, especially to the MoEFCC, has remained largely unchanged. On the other hand, funding for the Ministry of New and Renewable Energy (MNRE) has grown dramatically in recent years, indicating a preference for industries that support narratives of economic progress. According to the paper, this disparity represents a policy dilemma, whereby technology-driven green growth frequently takes precedence over environmental preservation and regulatory duties.

The foundation for this research paper's examination of the 2014–15 to 2024–25 period is this review, which emphasizes the significance of examining trends in Union Budget allocations to gain a better understanding of how India is striking a balance between its developmental priorities and environmental sustainability.

Objectives of the Study

1. To examine the trends in budgetary allocations for environmental protection in India over the period 2014–15 to 2024–25.
2. To evaluate year wise variations, growth rates, and the proportion of environmental spending in the overall Union Budget of India.
3. To find out the shifts in environmental expenditure in India.
4. To investigate the shortcomings and restrictions in the current financial framework

Methodology

The area of study is India as a whole. This study adopts a quantitative and analytical approach to examine the trends in budgetary allocations for environmental protection in India from the period of 2014–15 to 2024–25. The analysis is primarily based on secondary data collected from reliable and official sources, including: Union Budget documents[4] released annually by the Ministry of Finance, Government of India: Detailed Demand for Grants (DDG) for the Ministry of Environment, Forest and Climate Change (MoEFCC)[5] and Ministry of New and Renewable Energy (MNRE): Expenditure Budget Volumes I and II[6] etc.

Method of the Study

To calculate year-wise percentage changes, the following formula has been used:

$$\text{Year Wise Percentage Change} = \frac{Current\,Year \quad Previous\,Year}{Previous\,Year} \times 100$$

An organized and fact-based comprehension of India's fiscal patterns and policy directions pertaining to environmental protection is made possible by this methodological approach.

Analysis

An examination of India's budgetary allotments for environmental preservation throughout the previous ten years shows a dynamic yet complex approach to environmental governance. From 2014–15 to 2024–25, this section looks at the trends, growth patterns, and changes in spending across important ministries, especially the "Ministry of Environment, Forest and Climate Change (MoEFCC)" and the "Ministry of New and Renewable Energy (MNRE)". Particularly in relation to climate change mitigation, renewable energy, and environmental sustainability, it assesses how India's fiscal policy has changed in response to both international commitments and national development aspirations.

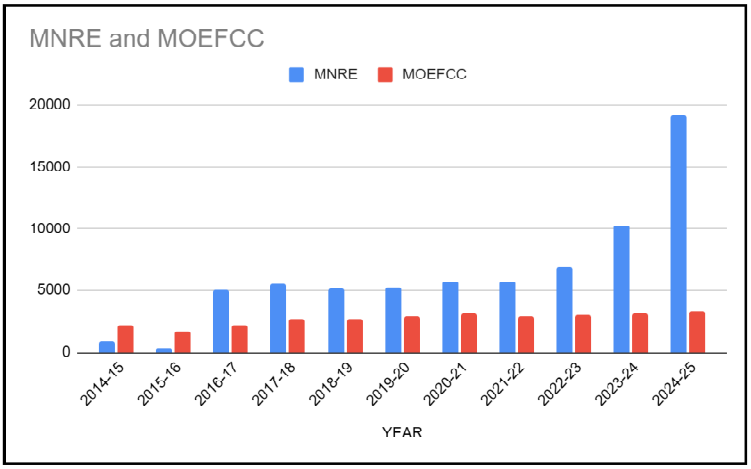
1. Year-Wise Allocation Trends

Table 1: Year-wise Budgetary Allocation Trends in Ministry of Environment, Forest and Climate Change (MoEFCC) and Ministry of New and Renewable Energy (MNRE) from 2014-15 to 2024-25

Year	MoEFCC		MNRE	
	Amount Allocated (₹ Crore)	Year wise Percentage Change	Amount Allocated (₹ Crore)	Year wise Percentage Change
2014-15	2256	-	956.39	-
2015-16	1681.6	-25.46%	303.21	-68.30%
2016-17	2250.34	33.82%	5035.79	1560.83%
2017-18	2675.42	18.89%	5472.84	8.68%
2018-19	2675.42	0.00%	5146.63	-5.96%
2019-20	2954.72	10.44%	5254.83	2.10%
2020-21	3100	4.92%	5753.00	9.48%
2021-22	2869.93	-7.42%	5753.00	0.00%
2022-23	3030	5.58%	6900.68	19.95%
2023-24	3079	1.62%	10222.00	48.13%
2024-25	3330.37	8.16%	19100.00	86.85%

Source: Ministry of Environment, Forest and Climate Change & Ministry of New and Renewable Energy

Figure 1 : Ministry of Environment, Forest and Climate Change (MoEFCC) and Ministry of New and Renewable Energy (MNRE) Budgetary Allocation (2014-15 to 2024-25)



A detailed analysis of the budgetary allotments by year shows a slow but consistent rise in the financial commitment to environmental protection, particularly following the fiscal year 2014–15. As a percentage of the overall Union Budget, the total amount allotted for environmental protection-related activities has fluctuated but has generally been on the rise.

The 2014–15 Union Budget, for instance, allocated roughly ₹ 2256 crore to the Ministry of Environment, Forests, and Climate Change (MoEFCC). This allocation rose to almost ₹ 3100 crore

by 2020–21. The political prioritization of climate change mitigation as a major national objective and the increasing awareness of environmental issues are both reflected in this increase.

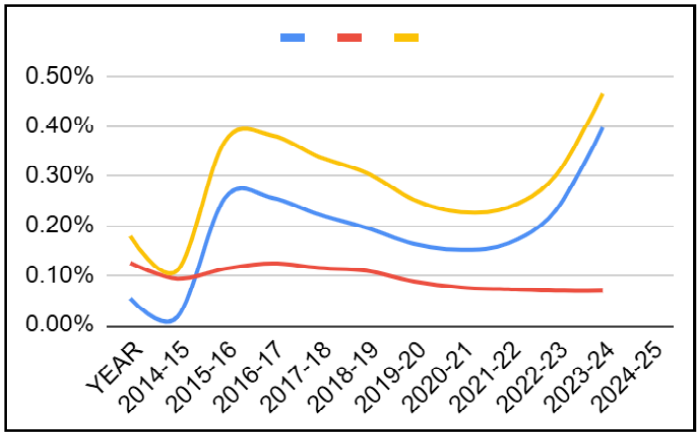
However, funding for the Ministry of New and Renewable Energy (MNRE) has increased more significantly, especially during 2016–17. The ₹ 5035.79 allotted for MNRE in 2016–17 more than doubled to ₹ 19,100 crore by 2024–2025. This increase is a result of the government's efforts to increase the capacity of renewable energy in accordance with international agreements, particularly the Paris Agreement, where India committed to achieving 500 GW of renewable energy by 2030 and 175 GW by 2022.

2. Comparative Allocations between MoEFCC and MNRE

Table 2: Comparative analysis of allocations between MoEFCC and MNRE & their combined share percentage in total budgetary expenditure

Year	Total Expenditure (₹ Crore)	MNRE Share	MoEFCC Share	Combined Share
2014-15	17,94,892	0.05%	0.13%	0.18%
2015-16	17,90,783	0.02%	0.09%	0.11%
2016-17	19,75,194	0.25%	0.11%	0.37%
2017-18	21,41,973	0.26%	0.12%	0.38%
2018-19	23,15,113	0.22%	0.12%	0.34%
2019-20	26,86,330	0.20%	0.11%	0.31%
2020-21	35,17,024	0.16%	0.09%	0.25%
2021-22	37,91,258	0.15%	0.08%	0.23%
2022-23	41,93,157	0.16%	0.07%	0.24%
2023-24	44,42,542	0.23%	0.07%	0.30%
2024-25	48,20,512	0.40%	0.07%	0.47%

Figure 2: Comparative analysis of allocations between MoEFCC and MNRE & their combined share percentage in total budgetary expenditure



A critical aspect of this study is the comparative analysis between the MoEFCC and MNRE allocations. While both ministries play pivotal roles in environmental governance, their budgetary trends illustrate contrasting priorities.

Budgetary growth for the MoEFCC, which mostly concentrates on conventional environmental conservation initiatives like pollution control, forest management, and biodiversity protection, has been rather small. As previously mentioned, MoEFCC's funding increased from ₹ 2256 crore in 2014–15 to ₹ 3100 crore in 2020–21. The MNRE's budget, which prioritizes clean technology, energy efficiency, and renewable energy, has increased exponentially, making this increase insignificant.

According to the data, there is a definite trend toward a higher financial commitment to renewable energy than to conventional environmental preservation. With renewable energy being viewed as a major force behind both economic growth and energy security, this change underscores the government's growing emphasis on green growth initiatives. Although this change is in line with global climate goals, it also points to a loss of attention to more conventional environmental issues like pollution prevention, habitat restoration, and forest preservation.

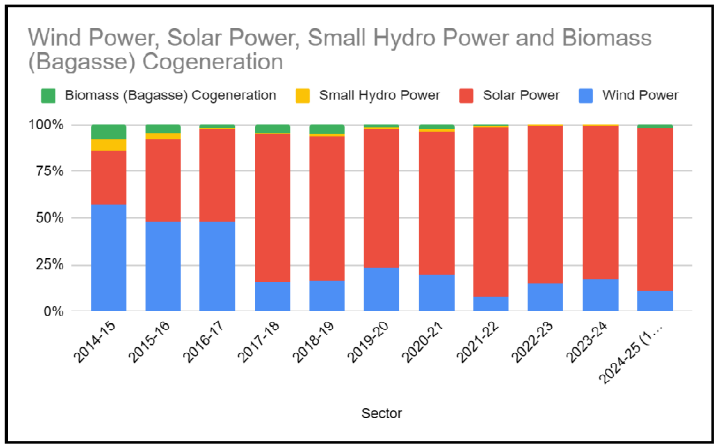
3. Expenditure Focus: From Traditional Environmental Protection to Renewable Energy

Table 3: Installed Renewable Energy Capacity(MW) (Excluding Large Hydropower)

Sector	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (1st Apr 2024-28th Feb 2025)	Total
Wind Power	2311.77	3423.05	5502.37	1865.23	1480.97	2117.79	1503.3	1110.53	2275.55	3253.38	2702.05	27545.99
Solar Power	1171.62	3130.36	5658.63	9563.69	6750.97	6510.06	5628.8	12760.5	12783.8	15033.24	20752.41	99744.08
Small Hydro Power	251.68	218.11	106.38	105.95	107.34	90.01	103.65	62.09	95.4	58.95	97.3	1296.86
Biomass Cogeneration	295.67	304.85	161.95	519.1	402.7	97	173.37	59.69	0	0	387.76	2402.09

Source: Ministry of New and Renewable Energy (MNRE)

Figure 3: Installed Renewable Energy Capacity(MW) (Excluding Large Hydropower)



There are a number of important policy factors that have contributed to the MNRE receiving more fiscal attention. Significant investment for solar and wind energy projects, energy efficiency programs, and the creation of sustainable infrastructure has resulted from the government's dedication to reaching renewable energy targets. The National Solar Mission and the Pradhan Mantri Ujjwala Yojana, a landmark initiative to link rural households to LPG, have received substantial financial support, highlighting the expanding role of infrastructure and technology in India's environmental strategy.

The data reveals a marked shift towards solar energy, which has emerged as the dominant source of renewable capacity in India, growing exponentially between 2014 and 2025. While wind energy has also shown consistent growth, the small hydro and biomass sectors have lagged behind in terms of capacity additions. This trend highlights the significant policy focus on solar energy as a key driver of India's renewable energy transition.

4. Gaps and Limitations in the Budgetary Structure

Although funding for environmental protection has increased overall, there are still a number of holes and restrictions in the budget that prevent efficient execution. The dispersion of funds among different ministries and departments is one major problem. It can be challenging to adequately monitor and coordinate environmental projects because they are frequently dispersed across several sectors, including agriculture, water resources, and rural development. It can be difficult to assess the true financial commitment to climate change because the incorporation of climate change adaptation into other ministries, such as agriculture, is frequently not clearly identified as climate-related spending.

Furthermore, there is serious concern about the underutilization of fund designated for climate adaptation, especially through the National Adaptation Fund for Climate Change (NAFCC). The lack of a coherent financial plan for climate adaptation is continued underfunding and underutilization despite its inception in 2015. The inefficient use of resources meant for crucial adaptation measures is a result of the lengthy approval process for projects and the delayed pace of money release.

Also, there is no defined, long-term strategic framework linking financial allocations to certain sustainability outcomes in the budgeting process for environmental protection. As a result, environmental expenditure is less effective, and politicians are less able to determine if financial resources are producing the intended environmental results.

5. Recommendations for Enhancing Fiscal Accountability and Policy Coherence

Several suggestions can be made to improve fiscal accountability and policy coherence in India's environmental governance in light of the examination of budgetary trends and gaps:

1. *Integrated Budgeting for the Environment:* Environmental spending across ministries needs to be clearly identified as part of a more coordinated and integrated approach to environmental budgeting. To streamline the allocation process and increase transparency, the government may create a special climate and environmental fund that pools funds for adaptation and mitigation initiatives.
2. *Traditional Environmental Protection Has Received More Funding*: Even while investments in renewable energy are essential, more money must be set aside for more conventional forms

of environmental protection, like pollution prevention, forest conservation, and biodiversity preservation. Sustainable development requires a well-rounded response to both contemporary and historical environmental issues.

3. *Enhanced NAFCC Utilization:* Simplifying the fund distribution procedure would help the NAFCC be used more effectively and guarantee that adaptation projects are carried out on schedule. Simplifying the approval procedure and improving coordination between federal and state entities could accomplish this.
4. *The long-term strategic framework is the fourth*: It is necessary to create a multi-year, long-term strategy framework for environmental conservation that ties financial investments to certain sustainability goals. Better tracking and assessment of environmental spending and its contribution to the attainment of India's environmental objectives would be made possible by this.
5. *Improved Public-Private Collaborations:* The magnitude of India's environmental problems makes public-private partnerships (PPPs) essential for funding and carrying out significant environmental initiatives.

Conclusion

A distinct transition from traditional environmental conservation to renewable energy and climate change mitigation methods can be seen in the comparison of India's budgetary allocations for environmental preservation from 2014–15 to 2024–25. Although this tendency is in line with international agreements and advances in technology, it also draws attention to inequalities in the distribution of funds for conventional environmental protection tasks. A wider policy preference for green growth as a catalyst for economic development is shown in the increased focus on renewable energy, particularly through the Ministry of New and Renewable Energy (MNRE). However, vital sectors like biodiversity preservation, pollution prevention, and forest conservation shouldn't suffer as a result of this change. Ultimately, the goal must be to pursue a comprehensive model of sustainability that balances economic progress with ecological integrity.

References

1. Roy, P., & Sarkar, S. (2022). Understanding environmental protection expenditure in India: Trends, provision, and priority. *Journal of Environmental Economics, 17*(3), 45–67.
2. Centre for Budget and Governance Accountability (CBGA), & Oxfam India. (2010). *Adaptation to climate change in India: A study of Union Budgets.* CBGA and Oxfam India.
3. Boora, M., & Karakunnel, J. (2023). India's environmental policy paradox: Dissecting India's budgetary allocations for environment. *Indian Journal of Environmental Policy, 28*(1), 15–33.
4. Government of India. (2014–2025). *Union Budget documents (2014–15 to 2024–25).* Ministry of Finance, Government of India.
5. Ministry of Environment, Forest and Climate Change (MoEFCC). (2014–2025). *Demand for Grants (2014–15 to 2024–25).* Government of India.
6. Ministry of New and Renewable Energy (MNRE). (2014–2025). *Annual reports and budget documents (2014–15 to 2024–25).* Government of India.
7. http://mnre.gov.in/en/year-wise-achievement/#

Assessment of Carbon Emission, Sequestration Potential, and Carbon Neutrality Pathways for Uttar Pradesh

Vishwajeet Singh Prajapati[1] & Professor Ashutosh Priya[2]

Introduction

Carbon neutrality is the only solution to get rid of unwanted GHG emissions and unwanted temperature rise, but carbon neutrality is not a means in itself but an end in itself. To achieve the goal of carbon neutrality, we have to work in both directions: firstly, measures related to reducing GHG emissions and secondly, measures related to increasing the sink of CO_2 and other GHGs. There are many GHGs like CO_2, CH_4, N_2O, water vapour, CFCs, etc., but the major gas responsible for the GHG effect is CO_2 with respect to quantity, but with respect to the intensity of the GHG effect, CO_2 is used as a unit, and all other gases have a higher intensity of GHG effect.

Uttar Pradesh is the fourth largest and the most populous state of the country. In this context, the state requires a higher quantity of energy not only for household consumption but also for production needs. The installed capacity of India has grown from 1713 MW in 1950 to 399496.61 MW in 2023. In 2023, the power consumption utilities of Uttar Pradesh reached an annual total of 115,675 GWh, marking a record high compared to all previous years. The installed capacity is primarily coal-based and hence a major source of CO_2 emissions. Fuel substitution, the use of renewable energy sources, and the enhancement of power generation's thermal efficiency can reduce emissions [7]. Aside from power grids, there are captive power plants with a capacity of 78,508 MW as of March 31, 2021 [9].

Other than power generation, there are many other sources of CO_2 and other GHG emissions, like transportation, industry and manufacturing, agriculture, forestry and land use, and waste, etc. The carbon emission factor of grid electricity in India decreased from 0.774 in FY 2013-14 to 0.715 in FY 2021-22, while the power generation installed capacity increased from 939.83 BU in FY 2013-14 to 1401.01 BU in FY 2021-22, whereas total carbon emissions increased from 727.4 Mt to 1002.01 Mt [11].

There are various sources of carbon sequestration, like forests, soil, oceans, wetlands, geological sequestration, urban green spaces, etc. To avoid CO_2 emissions, one way is to create sinks like

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forests; another way is to create green technology which emits a negligible amount of CO, [13]. CCS (carbon capture and storage) project is another way to capture CO, from the industrial sites and power plants and store the same under the ground. This way can avoid the carbon emitted from the key sites of the economy being released into the atmosphere without changing the existing fuel or technology mix [13].

In the present study the carbon emission capacity and carbon sequestration capacity of Uttar Pradesh will be found out, which will give its carbon neutral capacity. In this way, we will know whether it is possible to achieve the carbon neutral target set by the central and state governments within the stipulated time frame based on the implications of the current schemes and regulations. The study will focus on the applicability of the schemes employed to become carbon neutral, and accordingly, it will be helpful in designing the schemes.

Objectives

1. The aim is to explore the origins of greenhouse gas emissions and carbon sequestration in Uttar Pradesh.
2. The study also aims to explore Uttar Pradesh's journey towards carbon-neutrality.

Review of Literature

Recent studies offer diverse perspectives on climate change and carbon dynamics in Uttar Pradesh and India. **Kaithal (2021)** provocatively suggests that issues like drought in Bundelkhand, floods in Uttar Pradesh, and declining water quality are primarily rooted in geographical factors, over-extraction, and mismanagement, rather than direct climate change impacts. This study attributes agricultural decline to industrial waste, concluding that no primary climate change effects were identified.

In contrast, **Arif et al. (2018)** documented significant **black carbon concentrations**—a major global pollutant—across the Indo-Gangetic plains, including Sitapur, Uttar Pradesh. Their research indicated high outdoor black carbon levels, particularly in winter, and highlighted household energy sources as substantial contributors. Supporting emission reduction efforts, **Baqir et al. (2019)**, focusing on Mau district, found that 66% of household cooking relies on fuelwood, a source of GHG emissions. They advocated for extensive afforestation with suitable species to reduce CO, emissions and support future energy needs in the region.

At a broader national level, **Ramachandra (2012)** identified Maharashtra as having the highest CO, and CO emissions, while **Uttar Pradesh was the leading contributor to CH,, emissions** across India. However, **Gupta et al. (2017)** provided a more nuanced view, stating that Uttar Pradesh's manufacturing sector contributes less than 4% of total GHG emissions (data from 2005-2013), suggesting it's not a major industrial polluter.

Looking towards sustainable solutions, **Sharma et al. (2021)** presented Uttar Pradesh's rural renewable energy landscape, meeting 17.50% of its total demand with a 2019 electric capacity of 25130.02 MW. Solar energy shows the highest potential at 81%, followed by bagasse cogeneration (7%), biogas (6%), wind (4%), and small hydro (2%). A key advantage of these renewable energy sources is their negligible CO, emissions, except for those from biogas and biomass.

To ascertain Uttar Pradesh's carbon neutrality path, the methodology involves projecting carbon emissions and carbon sink capacities. These projections are meticulously derived from various national and international reports by institutions such as the Government of India, Discoms, the Electricity Authority of India, CEIC, the Government of Uttar Pradesh, and MoSPI. By comparing the growth rates of these projected emissions and sinks, the study aims to pinpoint the carbon-neutral growth trajectory. Importantly, the reports used in this analysis already factor in various government initiatives and technological advancements, including energy efficiency measures, electric vehicle adoption, solar rooftops, the National Hydrogen Mission, and PM KUSUM Yojana, thereby integrating their impacts into the carbon neutrality predictions. The study will also briefly discuss these crucial government initiatives

Data and Analysis

Sources of Carbon Emission: Various economic and non-economic activities emit carbon dioxide and other greenhouse gases. Key sectors of GHG are energy, AFOLU, IPPU and waste. The energy sector includes fuel and fugitive emissions. Fuel emission contains CO, emitted by the combustion of fuel, such as in electricity production, transport, industry heating, residential and commercial fuel use, and agriculture machinery and pumps, whereas fugitive emission contains the CO, emitted during production processes of fuel, such as methane leaks, oil, gas and coal production, and leakages from pipeline supply. AFOLU (Agriculture, Forestry and Other Land Use) includes emissions from land use change, enteric fermentation, fertiliser use, manure and management. IPPU (Industrial Process and Product Use) includes cement production, steel production, chemical industries, and F-gases from refrigeration, AC, and semiconductors. Waste includes landfill gas, organic waste decomposition and anaerobic conditions, wastewater treatment plants, and incineration of sewage sludge. The GHG emission report 2018 gives emissions from all the above sectors at the national level as follows:

Figure 01, Source: GHG Emission India Report

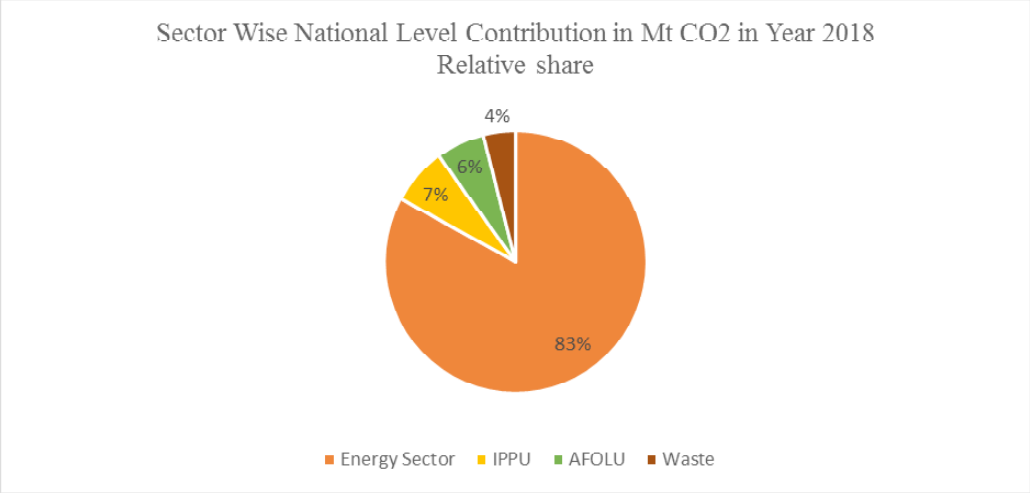
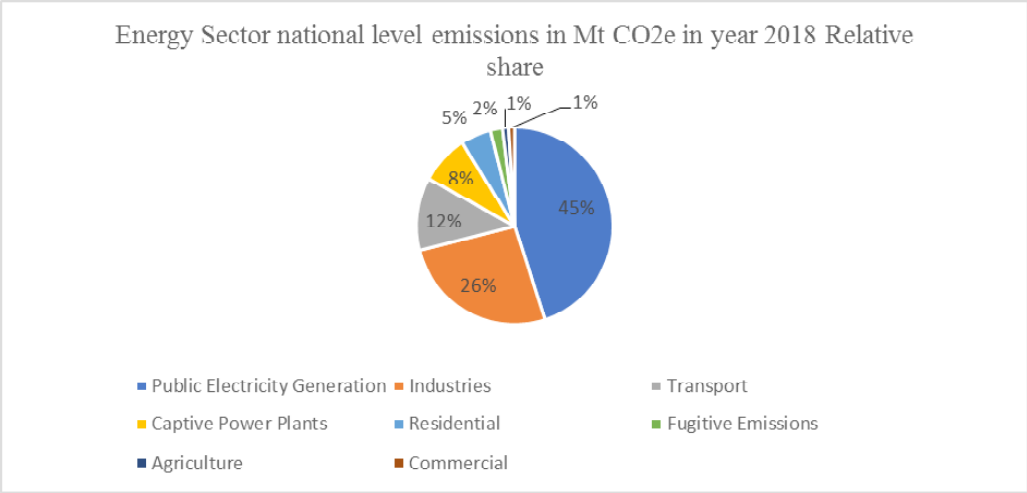


Figure 02, Source: GHG Emission India Report



Carbon emission from Power sector: The Central Electricity Authority of India releases data on CO, baseline emissions for the Indian power sector every fiscal year. The report gives four types of emission factors: WAEF (Weighted Average Emission Factor), SOM (Simple Operating Margin), BM (Build Margin) and CM (Combined Margin), where the weighted average is calculated based on the total net generation of electricity produced and with respect to total CO, emissions from all power stations. Simple Operating Margin is calculated based on only thermal power plants, excluding low-cost/must-run sources, and hence it shows the weighted average emission of all thermal power stations. Build Margin covers the units newly commissioned in the last five years; only net electricity generation by power plants other than renewables is included. Combined Margin is the weighted average of the simple operating margin and the build margin.

Indian Power Grid emits an average of 0.823 tCO2/MWh i.e. 823kg CO2/MWh which excludes the energy emitted from renewable sources and captive capacity (the data is for fiscal year 2022-23). The average emission factor is calculated using low cost/must run sources, because this lowers the CO2 emission per unit of electricity and hence the average emission factor but this does not lower the total carbon emission instead total carbon emission may increase due to excess operation of coal-based grids as per the excess demand of power.

The **20th Electric Power Survey of India (2022)** projects electricity demand across India for 2021-2042, providing data on total energy consumption, T&D losses, energy requirement, load factor, and peak demand.

For calculating **CO, emissions** at the state level (specifically Uttar Pradesh), if power generation includes both thermal and renewable sources, an average emission factor is applied. For purely non-renewable sources, a simple operating margin is used. As the 20th EPS data omits auxiliary consumption by GRIDs, a state average of **6.35% for Uttar Pradesh** (from All India Electricity Statistics 2024) is added to the total energy requirement to accurately calculate total electricity generation and, consequently, total CO, emissions, aiming for a precise assessment of the carbon neutrality path.

Table: 01 Total CO, emission from the power sector

					Uttar Pradesh						
Fiscal Year	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2029-30**	**2030-31**	**2031-32**
Electrical Energy Requirement Ex Bus (in MU)	129580	151152	159775	169529	179967	191138	202920	215392	229712	241780	253974
Gross Generation (in MU)	138366	156878	170609	181024	192170	204098	216679	229997	245289	258174	271195
Gross Generation (in MWh)	138366000	156878000	170609000	181024000	192170000	204098000	216679000	229997000	245289000	258174000	271195000
Total CO2 emission (in tonnes)	113875218	129110594	140411207	148982752	158155910	167972654	178326817	189287531	201872847	212477202	223193485

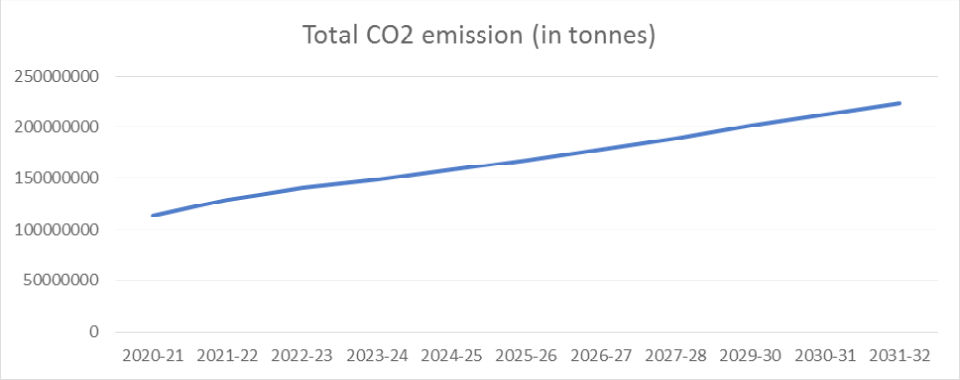
Source: Calculation

Note: Data on Electrical Energy Requirement Ex Bus taken from the Report on *Twentieth Electric Power Survey of India*, Ministry of Power, Govt of India

Data on gross generation is calculated by applying the auxiliary consumption of power stations in UP, i.e., 6.35% for fiscal year 2022-23, sourced from *All India Electricity Statistics: General Review 2024*, Ministry of Power, Govt of India.

Data on gross CO, emissions were calculated by applying the national weighted average, i.e., 0.823 tCO, /MWh, sourced from *the CO, Baseline Database for the Indian Power Sector: User Guide (Version 19.0)*. Ministry of Power, Government of India.

Figure 03: Total carbon emission from the power sector of Uttar Pradesh



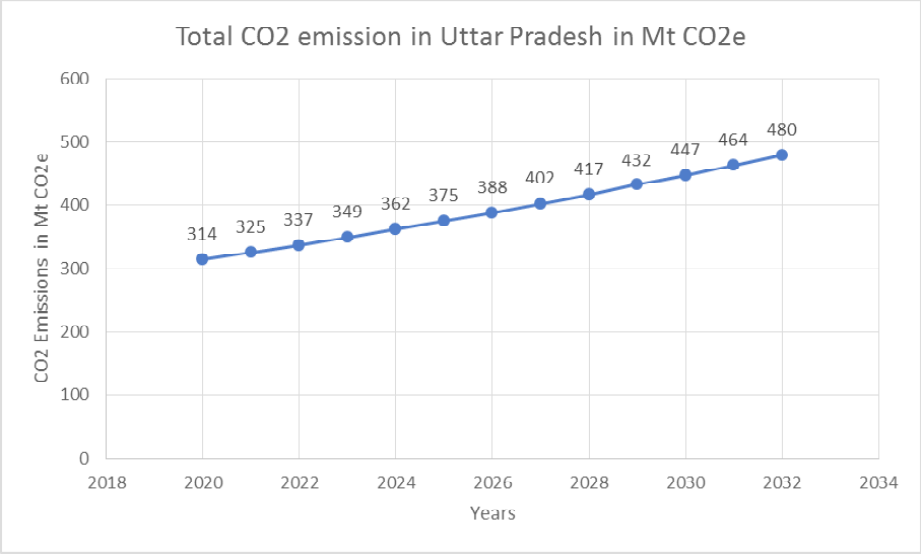
Source: calculation

It can be observed from the table that the total carbon emission from the power sector shows an increasing trend while the renewable share of the power sector is also increasing, but this only reduces the average share of CO, emissions in the power sector, i.e., per unit of electricity production in a year. Since it is total CO2 emission, not the average one, that impacts the greenhouse effect, it is inevitable to know the carbon neutral path of a region and hence of Uttar Pradesh too. Carbon emissions for the fiscal year 2020-21 were 113.875 Mt, increasing at a CAGR of 6.35%, becoming 158.156 Mt in the fiscal year 2024-25 and reaching 223.193 Mt.

Other Sources of Carbon Emission: There was not found data for every sector individually as classified by the GHG platform, but the data on total emission and percent share of individual sectors and subsectors was found.

Total greenhouse gas emissions from all four major sectors, namely the energy sector, IPPU, AFOLU, and the waste sector, for the years 2005 to 2018, are found to increase at a CAGR of 3.61% from 184.35 Mt CO, e in 2005, followed by 228.70 Mt CO, e in 2010, 269.70 Mt CO, e in 2015, and 292.50 Mt CO, e in 2018[24].

Figure 04: CO, emission estimates trend based on the estimated CAGR of 3.61%.



Source: Calculation

Total carbon emissions from all the sectors of Uttar Pradesh are 314 Mt CO2e for the year 2020, and they are rising at a CAGR of 3.61%. In the year 2027 the total emission crosses 400 Mt CO, e, which seems to cross a level of 500 Mt CO, e in the year 2033. This shows while developing and getting a higher growth rate, economic activities increase, leading to an increase in the total carbon emission.

Sources of Carbon Sequestration/sink: Carbon sequestration and carbon sink are both different aspects of how carbon dioxide is handled in the environment. Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide, like photosynthesis in trees and plants, storage of CO, in soils and oceans and human-made methods like carbon capture storage (CCS), while a carbon sink is the natural or artificial system that absorbs more carbon than it releases over time. Forests, oceans, soils, saline aquifers or depleted oil fields, etc., are all carbon sequestration and carbon sinks. Carbon sequestration is what happens, and carbon sink is where it happens. Mulhern, O. (2020)

CO, storage potential of India under CCS projects includes oil and gas field reservoirs, coal fields, saline formations and basalts, which was estimated to store an amount of 649 Gt CO,

theoretically. Out of these four types of CCS projects, Uttar Pradesh is capable of only saline formations. The CCS project is a futuristic vision to artificially store CO, beneath the earth's surface. The carbon storage potential beneath the earth's surface decreases with an increase in population density and land use patterns. The favourable conditions for a CCS project are low population density, non-agriculture and non-forest land, being far from critical infrastructure, and good geological containment. Uttar Pradesh is a highly populated and hence high population density state, so a single reservoir saline aquifer for CO, storage is missed. What remains is only the natural carbon sequestration sites and forest cover, soil, wetlands, geological sequestration, green spaces, etc.

Carbon sequestration through forests: The estimation of the carbon sequestration capacity of forests began in the year 2004 under the regime of the UNFCCC. India, as a party to the convention, provides a GHG inventory for all the sectors, including land use, land use change and forestry under the National Communication and Biennial Update Report.

Table 02: Forest Carbon Stock under different pools in Uttar Pradesh in 2023 (In tonnes per hectare)

Carbon Pool	Carbon stock in tonnes	Carbon stock in tonne per hectare
Above Ground Biomass	33597000	22.33
Below Ground Biomass	10469000	6.96
Dead Wood	1615000	1.07
Litter	1620000	1.08
Soil	72833000	48.41
Total	120134000	79.85

Source: *India State of Forest Report 2023* (Vol. 1, 18th ed.).

Note: The total forest cover of Uttar Pradesh is 15046 km².

Other than the above carbon sequestration sources, BECCS (Bioenergy with Carbon Capture) BECCS (Bioenergy with Carbon Capture and Storage) is a carbon-negative technology that burns biomass to generate energy, captures and stores carbon dioxide underground, and provides carbon credits for sale in the market; however, there are currently no BECCS projects in India. Nevertheless, there is potential for BECCS implementation in India, which indicates that there are also no BECCS projects in Uttar Pradesh.

Carbon emission for the year 2023 is 325 Mt CO2e whereas carbon sequestration is 120.134 Mt CO2e. This implies there is a gap of 205 Mt CO2e for Uttar Pradesh. This is large enough to be carbon neutral till 2030.

Table 03: The biennial reports of ISFR reveal the forest carbon stock for Uttar Pradesh, as presented below.

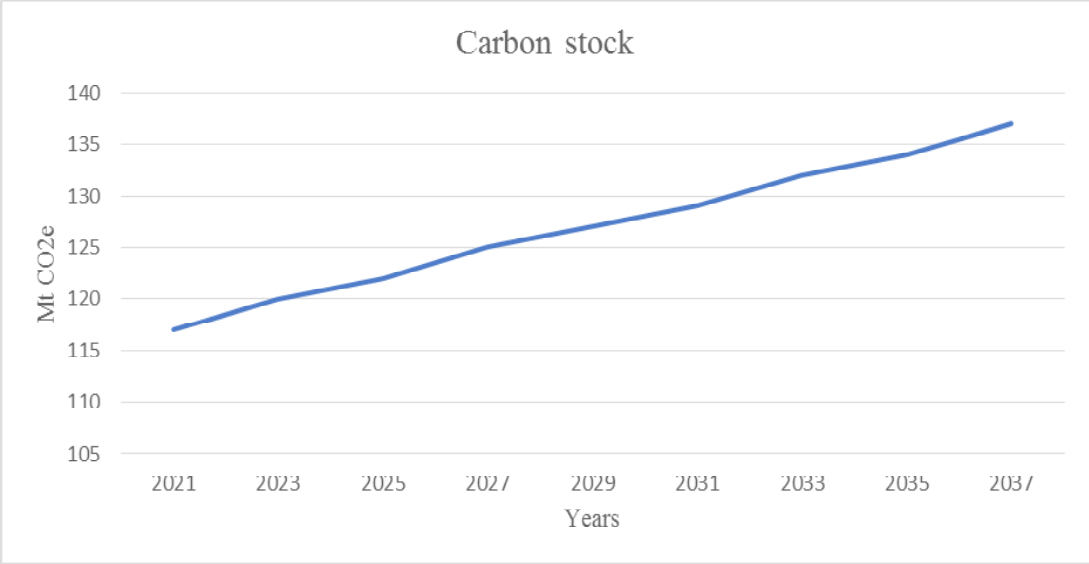
ISF REPORTS	Carbon Sequestration Capacity in Mt CO_2e
ISFR 2013	18.48
ISFR 2015	-------
ISFR 2017	125.134
ISFR 2019	115.690
ISFR 2021	117.241
ISFR 2023	120.134

In the above table, each report gives carbon sequestration capacity for the last second year. ISFR 2013 gives a report for the year 2011, ISFR 2015 gives a report for the year 2013 and so on. There is no data about carbon sequestration capacity for UP in the report of 2015. After IFSR 2017, the data shows an increasing trend of carbon stock. If the data from the 2017 report is included, CAGR becomes negative, so exempting ISFR 2017, CAGR is calculated based on ISFR 2019, ISFR 2021, and ISFR 2023. CAGR comes to 1.90%. So based on this value of CAGR, a trend of carbon sequestration capacity is calculated. Trend is calculated and compared as per the reported year, not the last second year. So, the trend of carbon sequestration capacity till the year 2037 is given as:

Table 04: Carbon sequestration capacity of Uttar Pradesh

Year	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037
Carbon Stock	116	117	120	122	125	127	129	132	134	137

Figure 05: Carbon sequestration capacity of Uttar Pradesh



Source: Calculated

Note: Calculation is based on the data on carbon sequestration capacity given in ISFR 2019, 2021, and 2023

From the above table and figure, it is clear that the carbon sequestration capacity is increasing regularly. It is 116 Mt CO2e for the year 2019; for the current year, 2025, it is 122 Mt CO2e, and till the year 2037, the carbon sequestration does not cross the level of 140 Mt CO2e. This trend is based on the calculated CAGR.

Carbon Neutrality Path of Uttar Pradesh: By adjoining the carbon emission trend and the trend of carbon sequestration capacity, we can find the carbon neutrality path.

Figure 06: Carbon Neutrality

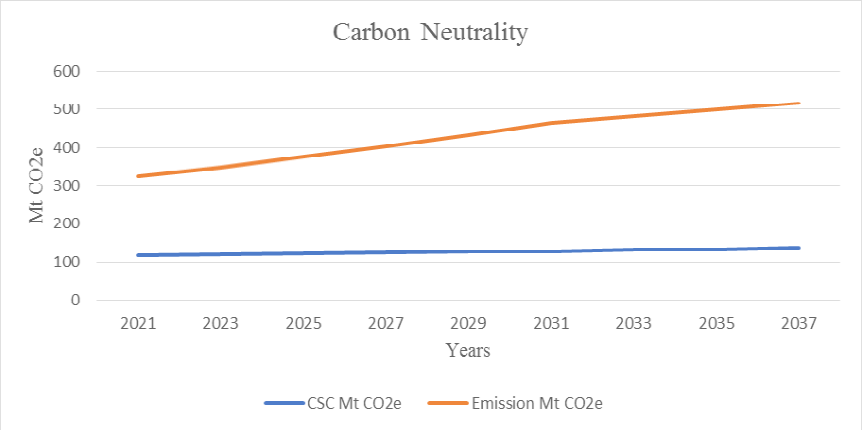
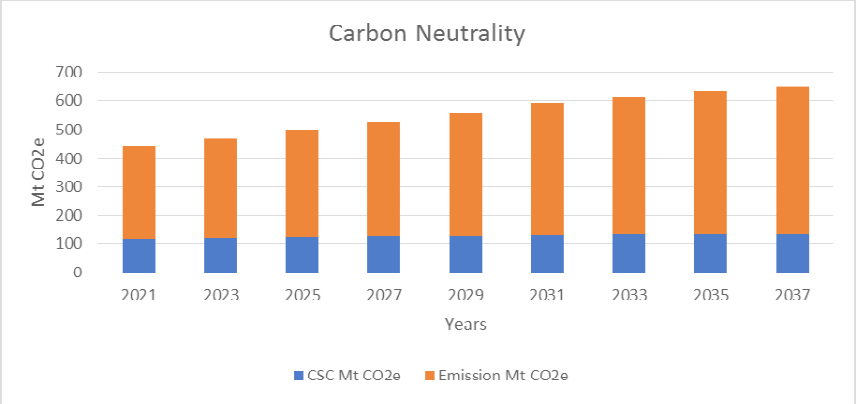


Figure 07: Carbon Neutrality



From the above figures it is obvious that the state is very far from being carbon neutral for the next 2037 and so on. It is because the growing path of carbon emission is increasing at a higher CAGR of 3.61% while the carbon sequestration capacity is growing at a lower CAGR of 1.90%. Also, the base value of carbon emission is 325Mt CO2e which is far lower than the base value of carbon sequestration capacity that is 117 Mt CO2e.

Discussion: In Uttar Pradesh, the **energy sector is the dominant contributor to carbon emissions**, accounting for 65% in 2005 and increasing to 71% in 2018. Within this, public electricity generation and captive power plants together comprise 65% of the energy sector's emissions. The AFOLU (Agriculture, Forestry, and Other Land Use) sector holds the second-largest share, followed by waste and IPPU (Industrial Processes and Product Use).

Despite the state's efforts to integrate **renewable energy** into its power sector, total carbon emissions continue to rise due to steadily increasing power demand. While the average carbon emission per unit of electricity generated is decreasing, the **absolute quantity of carbon emissions**

is still growing annually across all sectors. This indicates that a relative reduction in emissions share isn't sufficient to mitigate the overall greenhouse effect.

Uttar Pradesh faces significant limitations in **carbon sequestration capacity**. Unlike other regions with diverse natural and artificial carbon sinks like oil/gas fields or BECCS, Uttar Pradesh's primary potential lies only in saline aquifers, which are insufficient given its vast population and infrastructure. Forest cover and green spaces, while acting as carbon sinks, show only minimal increases.

Consequently, Uttar Pradesh's total carbon sequestration capacity consistently fails to match its annual emissions. Achieving carbon neutrality requires a two-pronged approach: **substantially increasing carbon sequestration capacity** and **drastically decreasing reliance on fossil fuels** to reduce absolute carbon emissions. Despite the Uttar Pradesh government's target of reducing carbon emissions by approximately 13 lakh tonnes annually through initiatives like integrating the Jal Jeevan Mission with solar power, current data suggests emissions will not decline until at least 2037.

To address climate change comprehensively, the Uttar Pradesh Government has formulated the **Uttar Pradesh State Action Plan on Climate Change (UP SAPCC) for 2021–2030**. This plan outlines nine key missions encompassing adaptation and mitigation strategies, including sustainable agriculture, water conservation, promoting green energy, enhancing energy efficiency, and improving waste management. Key actions include promoting climate-smart farming, extensive tree plantation drives, and reducing agricultural GHG emissions. The plan also emphasizes optimizing urban planning and public transport, alongside continuous monitoring.

Ultimately, to effectively combat climate change, the government must prioritize reducing **gross emissions** over mere adaptive mechanisms, as sustained greenhouse impact will persist until absolute emissions decrease.

Conclusion: The study finds that the energy sector is largely responsible for the greenhouse gas emissions, and the power sector, as a sub-sector of the energy sector, has a large share in the emission intensity. The total greenhouse gas emission is rising at its pace with a higher base value and with a higher CAGR than the carbon sequestration capacity, which implies that the carbon neutrality path is a distant dream. Uttar Pradesh. Out of various carbon sequestration methods, forest cover is the major constituent; the government should focus on avoiding deforestation and implement afforestation on a large scale.

References

1. Baqir, M., Kothari, R., & Singh, R. P. (2019). Fuel wood consumption, and its influence on forest biomass carbon stock and emission of carbon dioxide. A case study of Kahinaur, district Mau, Uttar Pradesh, India. *Biofuels*, *10*(1), 145-154.
2. Kaithal, A. K. (2021). Climate change and Uttar Pradesh: Issues, Challenges and way forward. *Journal of Emerging Technologies and Emerging Research*, *8*(10), 783-789.
3. Arif, M., Kumar, R., Kumar, R., Zusman, E., Singh, R. P., & Gupta, A. (2018). Assessment of indoor & outdoor black carbon emissions in rural areas of Indo-Gangetic Plain: Seasonal characteristics, source apportionment and radiative forcing. *Atmospheric Environment*, *191*, 227-240.

4. Ramachandra, T. V. (2012). Decentralised carbon footprint analysis for opting climate change mitigation strategies in India. *Renewable and Sustainable Energy Reviews*, *16*(8), 5820-5833.0

5. Gupta, V., Biswas, T., & Ganesan, K. (2017). Greenhouse Gases Emission Estimates from the Manufacturing Industries in India State level estimates: 2005 to2013. *Council on Energy, Environment and Water (CEEW), India*.

6. Sharma, A., Sýngh, H., Viral, R., & Anwer, N. (2021). Renewable energy development in rural areas of Uttar Pradesh: Current status, technologies and CO2 mitigation analysis. *Journal of energy systems*, *5*(2), 92-120.

7. GHG Platform India. (n.d.). *Analysis of greenhouse gas emissions from 2005 to 2018: Trend analysis of GHG emissions of India*. GHG Platform India. https://ghgplatform-india.org/

8. Kahsar , R. (2023). Governance and sustainability in distributed energy systems. In M. Nadesan, M. J. Pasqualetti, & J. Keahey (Eds.), Energy democracies for sustainable futures (pp. 17-22). Academic Press. https://doi.org/10.1016/B978-0-12-822796-1.00002-4

9. Central Electricity Authority. (2022): *Report on twentieth electric power survey of India (Volume I)*. Ministry of Power, Government of India.

10. Kant, S., Kumar, S., Pandey, A., & Gupta, D. (2024). Carbon sequestration and carbon stock inventory under different land use systems of Semi-Arid region of Bundelkhand of Uttar Pradesh.

11. Central Electricity Authority. (2022). *CO, baseline database for the Indian power sector: User guide version 18.0*. Ministry of Power, Government of India.

12. Kant, S., Kumar, S., Pandey, A., & Gupta, D. (2024). Carbon sequestration and carbon stock inventory under different land use systems of Semi-Arid region of Bundelkhand of Uttar Pradesh.

13. Bakshi T.; Mallya H.; & Yadav D.; (2023): Assessing India's Underground CO2 Storage Potential A Critical Analysis of What Lies Beyond the Theoretical Potential; CEEW Council

14. Malyan, A., & Chaturvedi, V. (2021). Carbon Capture, Utilisation and Storage (CCUS) in India: From a Cameo to Supporting Role in the Nation's Low-Carbon Story. *CEEW Council*, *1*, 1.

15. Central Electricity Authority. (2023). *CO, baseline database for the Indian power sector: User guide version 19.0*. Ministry of Power, Government of India.

16. Central Electricity Authority. (2024). *All India Electricity Statistics: General Review 2024 (Containing Data for the Year 2022-23)*. Ministry of Power, Government of India.

17. Mulhern, O. (2020, November 13). *Carbon Sinks: A Brief Review*. Earth.Org. https://earth.org/data_visualization/carbon-sinks-a-brief-overview/

18. Von Rothkirch, J., & Ejderyan, O. (2021). Anticipating the social fit of CCS projects by looking at place factors. *International Journal of Greenhouse Gas Control*, *110*

19. *Bioenergy with Carbon Capture and Storage - Energy System - IEA*. (n.d.). IEA. https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage/bioenergy-with-carbon-capture-and-storage

Neuro Cognitive Strategies and Pedagogical Approaches for Developing 21st Century Survival Skills

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ABSTRACT

In the rapidly evolving global landscape, 21st-century survival skills such as critical thinking, creativity, collaboration, communication, adaptability, and digital literacy are increasingly vital for academic, professional, and personal success. This paper explores the integration of neurocognitive strategies with innovative pedagogical approaches to enhance the development of these essential skills in learners. Drawing upon contemporary cognitive neuroscience, the study examines how brain-based learning principles, such as neuroplasticity, metacognition, and executive functioning, can inform and transform educational practices. The pedagogical frameworks discussed include constructivist learning, inquiry-based instruction, project-based learning, and flipped classrooms approaches that engage learners in active, meaningful, and context-rich experiences.

The paper emphasizes the role of emotional intelligence, attentional control, and working memory in learning efficacy and survival skill acquisition. It also highlights the importance of personalized and differentiated instruction, supported by technology-enhanced learning environments. The study proposes a holistic model that fuses cognitive neuroscience insights with learner centered pedagogy, fostering an inclusive, flexible, and empowering educational paradigm. Empirical findings and classroom applications are discussed to illustrate how educators can align teaching methods with students' cognitive profiles and neurological development. The paper concludes by recommending policy-level changes and professional development programs to support educators in implementing neurocognitive and pedagogical strategies effectively. This integrative approach is not only crucial for preparing learners to meet the demands of the 21st century but also for nurturing resilient, autonomous, and lifelong learners.

Keywords: *Pedagogical innovation, Metacognition, Project-based learning, Neuro-cognitive strategies, Brain-based learning, Digital literacy.*

INTRODUCTION

The 21st century is characterized by rapid technological advancements, globalization, and dynamic socio-economic changes. As a result, the skills once deemed supplementary are now central to success in education, employment, and civic life. Known as "21st-century survival skills," these

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include critical thinking, creativity, collaboration, communication, digital literacy, adaptability, and emotional intelligence. Traditional pedagogical models, often rooted in rote learning and passive instruction, are ill-equipped to cultivate these complex competencies. In today's scenario digital world dominance and control entire teaching learning process it declare what kind of skill to be learned for the survival many researcher and policy makers attempt to find out basic skills and value system to be imparted in the curriculum. The ways of thinking, the ways of working tools for working and skill for living in the world are focused on 21st century needs. The researcher being a teacher educator in Teacher Education college wanted to evolve a model operating the above listed survival skill incorporating neurocognitive strategies in teaching learning program.

This paper explores how neurocognitive strategies grounded in findings from cognitive neuroscience and progressive pedagogical approaches can be effectively integrated to develop these essential survival skills. Understanding how the brain processes, stores, and retrieves information provides a powerful foundation for designing learning experiences that are not only engaging but neurologically aligned with how students learn best. When paired with learner centered teaching methodologies such as project-based learning, inquiry-based learning, and flipped classrooms, educators can create a powerful synergy that fosters long term, transferrable skills.

Neurocognitive strategies focus on how the brain learns best, emphasizing techniques like metacognition, spaced learning, and emotional regulation. When combined with modern pedagogical approaches such as project-based and inquiry-based learning, these strategies enhance critical thinking, adaptability, and collaboration. This integration supports the development of 21st-century survival skills by making learning more engaging, personalized, and brain-compatible. The goal is to equip learners with the cognitive and emotional tools needed to thrive in a fast-changing world. This paper aims to illustrate how this integration can be strategically applied in teacher education to prepare educators capable of cultivating survival skills among learners in diverse and dynamic classroom settings.

The Need for 21st Century Survival Skills

In the contemporary world, traditional academic knowledge is no longer sufficient. With the rapid evolution of artificial intelligence, automation, big data, and digital globalization, the nature of work, communication, and societal engagement has fundamentally shifted. Consequently, education systems across the globe are being challenged to shift their emphasis from content-heavy curricula toward developing a more holistic set of competencies that encompass higher-order cognitive functions, social-emotional skills, and digital fluency. Institutions such as the World Economic Forum and UNESCO have consistently underscored the need to embed 21st-century skills including critical thinking, creativity, collaboration, communication, adaptability, and digital literacy at all levels of the education system to prepare students for unpredictable futures.

These survival skills are not stand-alone traits but represent an interconnected framework of competencies that collectively enable learners to thrive in diverse and dynamic contexts. Critical thinking empowers individuals to question assumptions, analyze evidence, and make informed decisions. Creativity enables them to generate novel solutions to emerging challenges, while collaboration and communication ensure that they can work effectively in multicultural, interdisciplinary teams. Emotional intelligence supports resilience, empathy, and ethical behaviour

qualities that are essential in both the workplace and broader civic life. Furthermore, digital literacy allows individuals to navigate, evaluate, and contribute meaningfully in increasingly complex technological environments. Developing these competencies from an early age, and reinforcing them through adolescence and adulthood, ensures that learners are not only prepared for the demands of the workforce but also equipped to participate as thoughtful, engaged citizens in a globalized society. The integration of such skills into curricula requires a deliberate reimagining of educational goals, instructional methods, and assessment strategies an endeavor that is both urgent and necessary.

Cognitive Neuroscience and Education

Cognitive neuroscience, a multidisciplinary field that merges psychology, neuroscience, and education, provides essential insights into how the brain processes, stores, and retrieves information. This branch of science has greatly advanced our understanding of the neural mechanisms underlying learning, memory, decision-making, and emotional regulation. By understanding these processes, educators can design teaching strategies that align more closely with the brain's natural learning systems, resulting in more effective and engaging instruction.

One of the foundational concepts in cognitive neuroscience is neuroplasticity, the brain's remarkable ability to reorganize itself by forming new neural connections throughout life, especially in response to learning and experience. Neuroplasticity suggests that the brain is not a static organ, but one that is continuously adapting to new challenges and learning opportunities. This principle underscores the importance of providing learners with a variety of experiences and challenges that stimulate their brains to grow and adapt. In the classroom, this means providing opportunities for active, hands-on learning, real-world problem-solving, and creative engagement that can drive cognitive development.

Another key concept from cognitive neuroscience is the role of multiple sensory modalities in enhancing learning. The brain processes information through a variety of sensory channels, including visual, auditory, and tactile stimuli. Research has shown that engaging multiple senses during learning—such as using multimedia tools, interactive activities, and visual aids—can improve memory retention and comprehension. For example, when students read a text while listening to an audio version or participating in a discussion, they reinforce the information through different neural pathways, leading to stronger retention and deeper understanding. This multi-sensory approach capitalizes on the brain's ability to process and store information more efficiently when different sensory inputs are involved.

Moreover, metacognition, or the ability to reflect on one's own thinking and learning processes, is another essential area of cognitive neuroscience that can significantly impact educational outcomes. Metacognitive strategies teach students to monitor, evaluate, and adjust their learning approaches. When learners understand how they learn best, they can apply strategies such as self-testing, planning, and goal setting to enhance their academic performance. At the heart of cognitive development are executive functions—cognitive processes that allow individuals to manage, regulate, and apply their mental abilities in goal- directed activities. These functions include planning, attention control, working memory, and task switching, all of which are critical for success in both academic and life settings. Executive functions enable learners to prioritize tasks, filter distractions, hold onto and manipulate information, and maintain focus on long-term goals. For instance, when students are

engaged in complex problem-solving, they must plan their approach, manage multiple steps, and adapt to changing circumstances—activities that heavily rely on executive functions.

Instruction that supports the development of executive functions can profoundly enhance students' ability to navigate the complexities of modern education. By teaching students how to set achievable goals, break down large tasks into manageable chunks, and sustain attention, educators can help students develop the cognitive tools needed for academic success. Furthermore, strategies such as mindfulness exercises, cognitive flexibility training, and self- regulated learning (e.g., goal setting and time management) can help improve executive function skills, leading to better focus, greater task persistence, and enhanced learning outcomes.

Understanding the role of working memory, a subset of executive functions, is also essential for effective teaching. Working memory refers to the cognitive system that temporarily holds and manipulates information for tasks such as reasoning, comprehension, and problem- solving. It is a critical component of academic performance, particularly in subjects that require the integration of multiple pieces of information, such as mathematics and reading comprehension. Educators can support the development of working memory by designing lessons that require students to process and use information actively. Techniques like spacing out practice, using retrieval-based learning, and incorporating multimodal learning experiences help to strengthen students' working memory and allow them to apply their knowledge more flexibly.

By applying principles from cognitive neuroscience, educators can tailor their teaching strategies to enhance cognitive development and help students build the critical cognitive skills needed for lifelong learning. Cognitive neuroscience supports a shift in educational practices away from rote memorization and passive absorption of information, toward a more active, engaging, and holistic approach to learning. When instruction is aligned with how the brain learns best, students are not only more likely to succeed academically, but they are also more equipped to adapt to new learning challenges throughout their lives.

Ultimately, understanding and integrating cognitive neuroscience into education offers a unique opportunity to reimagine how we teach and learn. By leveraging the brain's natural capacity for growth and change, educators can help students develop the cognitive, emotional, and social skills necessary to thrive in an increasingly complex world.

Pedagogical Models Aligned with Neurocognitive Strategies

Incorporating pedagogical models that align with the principles of cognitive neuroscience enables educators to design learning experiences that are more effective, engaging, and developmentally appropriate. These models emphasize active participation, emotional engagement, and cognitive challenge—factors known to strengthen neural connections and enhance long-term learning. Below are three such progressive models that integrate well with neurocognitive strategies:

Project-Based Learning (PBL*)*

Project-Based Learning (PBL) is a student centered instructional method in which learners gain knowledge and skills by working for an extended period of time to investigate and respond to authentic, engaging, and complex questions, problems, or challenges. Rooted in constructivist theory,

PBL encourages students to construct meaning through experience and reflection, both of which are strongly supported by neuroscience as key to long-term learning.

From a neurocognitive standpoint, PBL aligns with how the brain learns best through context-rich, emotionally meaningful experiences that require sustained attention and deep thinking. Real-world problems tap into learners' intrinsic motivation and emotional investment, triggering the limbic system (which regulates emotions) and the prefrontal cortex, the brain region responsible for higher-order thinking and decision-making. Furthermore, PBL inherently supports the development of executive functions—planning, time management, goal setting, and problem-solving. These cognitive capacities are essential for navigating complex tasks and are strengthened through repeated practice in project environments. Group projects also enhance social cognition and collaborative skills, engaging the brain's social neural networks and developing emotional intelligence, empathy, and communication.

Neuroplasticity is also activated during PBL, as learners form new neural pathways while integrating interdisciplinary knowledge. Through hands-on application, students not only retain content better but also develop transferable skills that prepare them for real-life challenges in the 21st century.

Inquiry-Based Learning

Inquiry-Based Learning (IBL) is an approach that places students' questions, ideas, and observations at the center of the learning experience. It fosters a spirit of curiosity, exploration, and critical thinking by allowing learners to investigate open-ended problems, pose hypotheses, gather data, and draw conclusions. Cognitive neuroscience supports this model by showing that active learning and self-directed exploration stimulate the brain's dopaminergic reward system a set of neural circuits associated with pleasure, motivation, and learning reinforcement. When students are curious or solve a problem on their own, dopamine is released, which strengthens memory encoding and enhances attention. Inquiry- based environments also cultivate deep processing, wherein learners go beyond surface-level memorization to engage in meaningful cognitive operations. This deeper engagement leads to better retention and understanding, as it activates multiple brain regions including the hippocampus (involved in memory formation), the anterior cingulate cortex (associated with conflict monitoring and decision-making), and the prefrontal cortex (for reasoning and analysis). Moreover, IBL promotes metacognitive awareness, as learners are encouraged to reflect on what they know, what they need to find out, and how they can approach the inquiry. This develops self-regulated learning strategies and strengthens cognitive flexibility, essential for adapting to new and complex situations—an increasingly important survival skill in the 21st century.

Flipped Classrooms

The Flipped Classroom model reverses the traditional teaching paradigm by delivering instructional content often through videos, readings, or interactive modules outside of class time. In-class time is then reserved for collaborative tasks, discussions, problem-solving, and application-based learning. From a neurocognitive perspective, flipped learning leverages several powerful memory-enhancing strategies:

- Spaced learning, where information is revisited over time in small chunks, aligns with how the brain consolidates long-term memories in the hippocampus and neocortex.

- Retrieval practice, in which students recall information through active discussion or problem-solving, strengthens synaptic connections and improves recall ability.
- Multimodal input (video, audio, text, interactivity) enhances encoding by engaging multiple sensory channels, improving retention and learner engagement.

Flipped classrooms also foster autonomous learning, a key trait of lifelong learners. By taking responsibility for accessing content outside of class, students practice self-regulation, time management, and goal-directed behavior—executive functions rooted in the prefrontal cortex. Additionally, this model creates more time for differentiated instruction during class, allowing educators to address diverse cognitive needs and provide targeted support. Students benefit from real-time feedback, peer collaboration, and personalized guidance, which reinforces cognitive development and supports the Zone of Proximal Development (Vygotsky), where learning is most efficient. Emotionally, flipped classrooms reduce performance anxiety by allowing students to learn at their own pace before engaging in group tasks. This contributes to a psychologically safe learning environment, reducing cortisol levels (the stress hormone) and optimizing conditions for learning and memory retention.

When implemented effectively, these models transform the classroom into a dynamic cognitive ecosystem that supports both academic achievement and the development of 21st- century survival skills. By understanding the neuroscience behind learning, educators can select and adapt these models to meet learners' cognitive needs, promoting deep, enduring, and transferable knowledge.

Personalized and Technology-Enhanced Learning

The increasing diversity in learners' cognitive abilities, cultural backgrounds, and learning preferences requires an educational paradigm that is not only inclusive but also deeply personalized. A one-size-fits-all approach is no longer effective in addressing the wide range of developmental, emotional, and intellectual needs found in modern classrooms. Personalized learning, supported by neurocognitive principles, allows educators to tailor instruction to align with each student's unique cognitive profile, learning pace, and motivational drivers. Neurocognitive research underscores the importance of differentiated instruction by revealing that individuals process information differently based on factors such as working memory capacity, attentional control, prior knowledge, and even neurodiversity (e.g., ADHD, dyslexia, autism spectrum conditions). Recognizing and accommodating these differences through targeted strategies ensures that learning is both accessible and effective. For example, some students may benefit from visual aids to strengthen retention through visual-spatial pathways, while others may require repeated auditory exposure or kinesthetic engagement to support comprehension and encoding.

Technology-enhanced learning tools play a pivotal role in enabling this level of personalization. Adaptive learning platforms, powered by artificial intelligence and machine learning algorithms, can dynamically adjust the difficulty, pacing, and type of content presented based on a learner's performance in real time. These systems provide immediate feedback, reinforcing correct responses and gently guiding students through challenges—a practice rooted in neuroscience's understanding of feedback loops and error correction mechanisms in the brain. Learning analytics help educators monitor student engagement, progress, and areas of difficulty. These data-driven insights allow for

timely interventions and informed decision-making, fostering a responsive teaching approach. Digital simulations and virtual reality environments offer immersive, experiential learning that engages multiple senses, which strengthens encoding and improves memory consolidation.

AI-powered tutors and intelligent agents can offer personalized explanations, scaffold problem-solving steps, and encourage metacognitive reflection, helping students become more aware of their learning processes. These tools mimic elements of human tutoring, shown by research to significantly enhance cognitive development when paired with student effort and motivation. Additionally, blended learning environments, which combine face-to- face instruction with online learning activities, provide flexibility in how and when students engage with content. This model supports self-paced exploration and autonomy—qualities essential for developing lifelong learning habits. It also fosters executive function development, as learners must plan, organize, and manage their own learning schedules.

A Holistic Model for Teacher Education

To truly transform education and prepare learners for the challenges of the 21st century, teacher education must undergo a paradigm shift. Teacher preparation programs must embed neurocognitive principles and progressive pedagogical training within their core structure. The proposed holistic model includes four critical components:

- **Foundational Training in Cognitive Neuroscience:** Future educators must develop a clear understanding of how the brain learns, adapts, and retains knowledge. Training in key areas such as neuroplasticity, working memory, executive function, and emotional regulation enables teachers to align instructional methods with students' neurological development stages.
- **Instruction in Progressive Pedagogical Strategies:** Teacher candidates should be well- versed in contemporary, research-backed instructional methods such as project-based learning, inquiry-based learning, and flipped classrooms. These methods promote critical thinking, autonomy, and collaboration—core competencies for the 21st- century learner.
- **Practical Application through Microteaching and Fieldwork:** Theoretical knowledge must be tested in real-world settings. Microteaching, simulated classrooms, and field- based practice allow teacher trainees to implement neurocognitive strategies and receive feedback on their effectiveness. These experiential opportunities are crucial for refining instructional techniques and building confidence.

In addition to these components, it is essential that teacher education institutions foster a culture of reflective practice, innovation, and collaboration. Teachers should be encouraged to engage in action research, peer mentoring, and interdisciplinary projects that challenge traditional norms and promote evidence-based experimentation in classrooms. Institutional support, such as mentorship networks and access to the latest educational neuroscience research, can further enhance teacher efficacy and innovation. A holistic model of this nature does not merely produce subject-matter experts it cultivates adaptive educators who are capable of designing inclusive, engaging, and cognitively enriching learning experiences. These educators will play a pivotal role in nurturing the next generation of resilient, emotionally intelligent, and future-ready learners.

CONCLUSION

As the 21st century continues to usher in unprecedented technological, cultural, and economic changes, the role of education must evolve beyond traditional academic objectives. The growing complexity of global challenges demands individuals who can think critically, adapt swiftly, collaborate effectively, and act ethically. These competencies collectively known as 21st-century survival skills are no longer optional; they are foundational to meaningful participation in both professional and civic life. This paper has explored how the integration of neurocognitive strategies with innovative, student-centered pedagogies can provide a powerful framework for fostering these essential skills in diverse learning environments. By aligning teaching methods with the brain's natural learning mechanisms—

such as neuroplasticity, metacognition, executive functioning, emotional regulation, and multisensory engagement—educators can create enriched learning experiences that resonate with learners cognitively and emotionally. Neurocognitive research reveals that learning is not a passive absorption of information but an active, dynamic process shaped by motivation, attention, feedback, and context. When students engage in emotionally meaningful, socially interactive, and cognitively challenging tasks—as facilitated by approaches like Project- Based Learning, Inquiry-Based Learning, and Flipped Classrooms they not only acquire knowledge more effectively but also internalize it in ways that are durable and transferable across domains.

Moreover, the thoughtful integration of technology further enhances the personalization and accessibility of learning. Tools such as adaptive learning platforms, AI-powered tutors, and immersive simulations respond to students' individual cognitive needs, thereby supporting differentiated instruction and fostering learner autonomy. These innovations allow education to be more inclusive and responsive, particularly for students with diverse learning profiles or special needs. When coupled with strong pedagogical design, digital technologies become catalysts for deeper cognitive engagement and greater equity in educational opportunity.

To operationalize this vision at scale, teacher education must adopt a holistic model that embeds cognitive neuroscience, contemporary pedagogy, and reflective practice at its core. Educators must be prepared not only as content experts but also as cognitive architects who can design flexible, inclusive, and brain-aligned learning environments. Field experiences, microteaching, and continuous professional development must equip teachers with the ability to adapt, experiment, and innovate. Institutional support in the form of mentorship, access to research, and collaborative learning communities will be essential in sustaining these efforts. Such comprehensive training ensures that future teachers can confidently respond to the dynamic and evolving demands of the 21st-century classroom. Ultimately, this integrated approach to teaching and learning represents more than an educational reform it is a paradigm shift. It challenges educators, institutions, and policymakers to reimagine the purpose of education, placing human potential, cognitive science, and learner well-being at the center. By bridging the gap between neuroscience and pedagogy, we lay the foundation for an education system that not only imparts knowledge but also cultivates emotionally intelligent, cognitively agile, and socially responsible lifelong learners. The success of future generations will hinge on our collective ability to embrace this transformation—one that empowers both teachers and students to thrive in a world of continuous change.

REFRENCES

- Beghetto, R. A. (2007). Does creativity have a place in classroom discussions? Prospective teachers' response preferences. *Thinking Skills and Creativity, 2*(1), 1–9. https://doi.org/10.1016/j.tsc.2006.09.002
- Delors, J. (1996). *Learning: The treasure within. Report to UNESCO of the International Commission on Education for the Twenty-First Century.* UNESCO. https://doi.org/10.7788/ijbe.1996.24.1.253
- Azizah, U., & Nasrudin, H. (2022). Problem solving thinking skills: Effectiveness of problem-solving model in teaching chemistry college students. *Jurnal Penelitian Pendidikan IPA,* 8(3), 1462–1469. https://doi.org/10.29303/jppipa.v8i3.1700
- Pellegrino, J. W., & Hilton, M. L. (Eds.). (2012). *Teaching and learning 21st century skills: Lessons from the learning sciences.* RAND Corporation. https://www.rand.org/pubs/external_publications/EP51105.html
- Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* Longman. https://www.researchgate.net/publication/235465787_A_Taxonomy_for_Learning_Teaching_and_Assessing_A_Revision_of_ Bloom's_Taxonomy_of_Educational_Objecti ves
- World Economic Forum.(2025). *The future of jobs report 2025*. https://www.weforum.org/publications/the-future-of-jobs-report-2025/

Empowering Rural Communities Through Management of Common Property Resources in India

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ABSTRACT

Natural resources that belong to every community are referred to as common property resources (CPRs). In rural India, the only source of human sustenance is found in the resources that belong to the common property. CPRs are a component of the social and institutional frameworks that are aimed to assist poor and marginalised people in rural areas. In rural areas, the poor, particularly landless are primarily reliant on the CPRs. Resources that are considered to be common property are those that are owned by the community as a whole and in which no single individual possesses exclusive ownership rights. It is possible for the community to possess formal ownership rights or fundamental user rights. CPRs are collected from the forest by rural communities in order to assist them in achieving a balance between their income and consumption, hence reducing poverty. Not only can CPRs offer poor people in rural areas financial assistance and employment generation, but they also serve as a safety net in the event of natural calamities and disasters. In contrast, the collection of CPRs without discrimination causes damage to forests. Rural impoverished people are willing to take part in forest management practices that are appropriate for long-term development. CPRs are implemented in communities when the inhabitants of the community receive a lower net benefit from the resources that are available. These CPRs offer communities with food and livelihood security. Residents of rural areas are provided with a variety of necessities, including food, fuel, small timber, fodder, manure, fruits, medicinal plants, and other necessities. Since CPRs are a component of natural resource systems, it is imperative that they be managed in a sustainable manner. Not only are CPRs essential in the lives of the rural poor, but they are also essential in the development of rural areas in general. The present paper purports to examine the role of CPRs in sustainable livelihoods development and management of common property resources, particularly development of degraded forestland. The paper is based mainly on secondary data and critical appreciation of pertinent literature.

Keywords: *Common Property Resources, Sustainable Livelihoods, Forestry sector, Rural Development, Environment*

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Introduction

Natural resource management is likely to play a significant influence in the country's future development. The government is dedicated to establishing a new culture of people-cantered, growth-oriented governance. Natural resources, which are essential for food security, livelihood, and environmental security, are under severe threat. Recognizing that land degradation, deforestation, and pollution are serious environmental concerns that have a negative impact on productivity and socioeconomic situations, appropriate solutions are required to successfully address these issues. Conservation and sustainable use of natural resources remain huge challenges. Gordon (1954) was one of the first economists to address the economic theory of optimum natural resource utilisation. Demsetz (1967) was the first to investigate the concept of property rights ownership. Hardin (1968) was the first researcher to publish an article entitled "The Tragedy of the Commons" on the topic of overexploitation of common natural resources. Berkes (1989), dispelling the idea of the "Tragedy of the Commons," describes Common Property Resources as a "class of resources for which exclusion is impossible and collaborative usage requires subtract ability." Beck and Nesmith (2001) investigated the relationship between common property resources and disadvantaged women and men. According to Chaturvedi et al. (2015), Sustainable development entails not only ecological practises that allow future generations to meet their needs, but also a shift in production and consumption patterns that allows resources that are currently being wasted to be saved and re-channelled to meet the needs of a healthy environment and wealth.In order to obtain firewood, fodder, grazing cattle, fishing, water for irrigation, and other necessities, developing nations that are characterised by a large rural economy and high population pressure are extremely dependent on the natural resource base that is available locally, and is referred to as the commonsor common property resources.

The utilisation of common property resources (CPRs) including rivers, canals, forests, grazing fields, and other such resources is essential to their means of subsistence at this time. The CPRs are serving as safety nets, particularly during times of crisis in the agriculture sector as well as during natural calamities and disasters. A supplementary rural livelihood, such as agricultural revenue, is provided by CPRs in addition to agriculture, the major source of rural livelihood. Common Property Resourcesare resources that are not individually owned by individuals and include both natural resources and manmade resources on the planet. On the other hand, rules for accessibility to CPRs are clearly specified, and the property rights are typically vested in the people, the village, the clan user committees, cooperatives, the panchayats, or the local government. There is a complementary relationship between the output of agriculture and the utilisation of CPRs as inputs in agricultural production, development of non- farm economy, animal husbandry as well as development of MSMEs or rural industries. A significant portion of agricultural inputs, including fodder, grazing grounds, and irrigation water, are made available to farmers as a result of the conservation of resources that belong to the common property. Indian planners have been concerned about dwindling natural resources and fast population growth during the last 60 years. There is a relationship between the degradation of common property resources, poverty, and migration (Mahanta and Das, 2012; Suresh et al.,2010). The Central Plateau and Hills, the Eastern Plateau and Hills, the Southern Plateau and Hills, and the Middle Gangetic Plains have all had the biggest reduction in absolute area (forest and grazing land) in India (Menon and Vadivelu, 2012). Despite the fact that over 75 billion people in India rely on CPRs for their livelihood (Pradhan and Patra, 2023), the issue of land use planning in CPRs has largely been ignored, owing to the protected nature of these resources, which prevents

any change in land use (as in the case of forests) or any changes in their characteristics (as in case of village ponds, common grazing land). In practise, each society has its own local resource management systems, which are founded on the knowledge and experience of the resource users (Adhikari, 2004).

CPRs and Its Linkages with Livelihoods

CPRs contributed greatly to employment and income production for the rural poor, i.e. labour and small farms, according to Jodha's (1986) study in dry tropical regions spanning seven states and eighty villages in India. Beck and Ghosh (2000) found that common property resources were critical to the poor in terms of supporting their livelihood. The data for Menon and Vadivelu's (2006) study on CPRs came mostly from the 54th wave of the National Sample Survey (1999). CPRs, according to Mitra (2020), are an integral part of India's rural life. Forests and water resources are two key CPRs that have played a critical role in sustaining rural living in India since the beginning of time. According to Kannan and Shakthivel (2019), the most major source of rural poor in India's rural pockets is Common Property Land Resources (CPLRs).

In order to survive, the rural poor, particularly women, are dependent on CPRs that come from the common forest. Forest resources are collected by rural households in order to boost agricultural production. The prevention of soil erosion, deforestation, and siltation is another benefit of CPRs. Wastelands, biodiversity hotspots, forests, fisheries, non-timber forest products, and water systems make up the majority of India's natural resources. Management of CPR is therefore, extremely important for both our present generation and the also for future generations. The study aimed at analysing the status of common property resources in the context of environmental degradation and sustainable livelihood development. Common Property Resources (CPRs) play a significant role not only in the lives of the rural poor but also in overall rural development, based on the current research.

The marginalization of the usage of CPRs can be related to a number of issues (Jodha, 1986; Iyengar and Shukla, 1999; Iyengar, 1997; Chen, 2008 ; Singh et al., 1996; Agarwal, 1991; Beck, 1994; Pasha, 1993).Shenggen Fan and Peter Hazell (2000) conducted an empirical study of rural India, with a focus on underserved areas. They determined that, as the world's population grows, poverty, food security, and environmental issues in many low-potential places are expected to worsen in the coming decades. According to Sarkar (2021), the dependence of Private Property Resources (PPR) on Common Property Resources (CPR) plays a significant role in sustainable development. CPRs help rural people by supplying them with fuel wood, food, fodder, small timber, mulch and manure, fruits, medicinal herbs, and other necessities. CPRs also aid in the conservation of the environment by preventing soil erosion, deforestation, and siltation. Common property resource-based activity provides revenue and job opportunities while also complementing agricultural activity, which benefits rural communities (Beck 1994).

The rural poor, particularly women, rely heavily on the gathering of CPRs from the common forest to survive. Forests in India have the ability to reduce poverty and increase rural economic growth while also helping national conservation aims. India's second largest land use is forestry. However, India's forests are under severe threat, and the country is short of timber and fuel wood. Furthermore, around 40 percent of India's forest cover has been degraded, necessitating considerable improvements in forest monitoring and assistance for community-based forestry. CPRsare important

not only in the lives of the rural poor but also in general rural development. The rural poor, especially women, rely on CPRs from the common forest to subsist. Rural households collect forest resources to augment agriculture. Rural communities collect CPRs from the forest to help balance their income and consumption, thereby reducing poverty. CPRs not only provide money and jobs to rural impoverished people, but also provide as a safety net during agricultural disasters. For long-term development, rural poor are willing to participate in proper forest management. Common Property Resources are the sole source of human nourishment in rural India. CPRs are part of the social and institutional structures designed to help the rural poor. The rural poor, especially the landless, rely heavily on the CPRs. Earlier research indicates that both the poor and the not so poor rely on CPRs for their livelihood. CPRs operate as a buffer during economic crises caused by crop failures, but also as a source of revenue in regular times. Thus, the present study will be highly important in understanding the social dynamics of man and nature relationship, environment responsive behaviour, sustainable and cultural tourism development and mitigating climate change and environmental degradation.

Livelihood Development

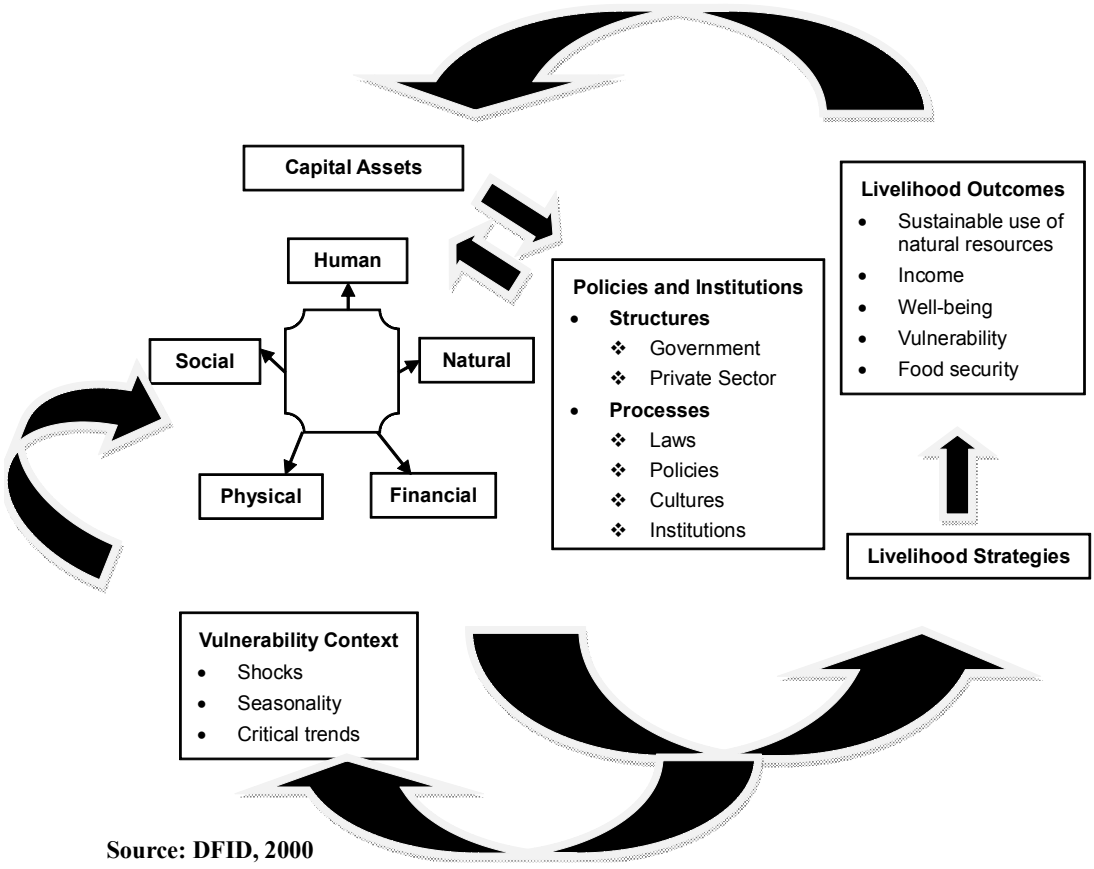
There are many factors that influence the perspective of tribal groups' lives in India (Kumar et al., 2009). Food and nutrition security, growth and survival, social, economic, and cultural situations, and poverty alleviation are all dependent on agriculture (Surayya et al., 2008). Around 70percent of the population relies on rain-fed agriculture, which is plagued by low yields, unpredictable weather, depleting natural resources, and deteriorated soil (Chakraborty et al., 2009). All of these factors intensified poverty and starvation among millions of Indian tribal people (Mourlin, 2007). The ability of agriculture and animal production to construct sustainable lifestyles for people is constantly declining due to current general endowments of production, distribution of productive assets, and productive skills (Maske et al., 2011). Livestock, grazing, lopping and grass cutting, forest-based handicrafts and cottage industries, sericulture, lac cultivation, beekeeping, charcoal-making, liquor-making, rope-making and basketry, medicines, and non-timber forest products (NTFPs) collection, processing, and marketing create livelihoods for local people. Agricultural implements, furniture, structural wooden items, musical instruments, and other wood-based and small-scale forest-based enterprises provide secondary employment and livelihood opportunities for tribal people (Pant, 1984; Gera, 2002).

Livelihoods Development in Forestry Sector

The concept of livelihoods expands the research beyond production, employment, and income to include activities that increase food security, health, social networks, and savings. Rural living is emphasized socially, environmentally, and economically (Bryceson, 1999). The Sustainable Livelihoods Approach seeks to better comprehend the lives of the disadvantaged. It considers the major factors affecting the lives of the poor, as well as their usual connections. It can be used to plan new development efforts and evaluate existing ones. The Sustainable Livelihood Approach comprises two major components: a framework for understanding poverty and a plan for alleviating it. (b) a set of values for fighting poverty. There is no one Sustainable Livelihood approach, and adaptation is a movement hallmark. People, especially rural poor people, are at the centre of a web of interconnected variables that affect how they and their families construct a sustainable existence. The resources and assets they have access to and use are closest to the structure's people. Other

examples include their health, access to education and credit, and social support networks. Their vulnerability context, which includes trends, shocks, and seasonality, influences their access to these assets. The prevailing social, institutional, and political atmosphere influences how people unite and use their resources to attain their goals. These are their livelihoods (ADB, 2008). People, not wealth or governments, are the main concern. The Sustainable Livelihood Approach identifies the key constraints and opportunities faced by disadvantaged people. Based on these concepts, it helps disadvantaged people overcome hurdles or seizes opportunities. No model or universal solution can embrace all aspects of people's lives, but the framework tries. It is a tool for stimulating thought and analysis that must be adapted to the situation (Chart 1).

Chart: 1
The Sustainable Livelihoos Framework



Source: DFID, 2000

A framework for thinking about impoverished people's livelihoods is intended to foster conversation and thought on the factors influencing livelihoods, their interactions, and relative relevance in a given setting. This could help find better ways to sustain livelihoods and reduce poverty (ADB, 2008).Through the usage of forest products, both large and small, forests support the nation's overall economic growth. In addition to contributing to the nation's exports and creating

a vast number of employments in the primary, secondary, and tertiary sectors, forests also supply the raw materials needed for industry, defence, communications, and other public uses at home. They also supply goods that farmers may utilise directly, such food, grazing, small timber, fire wood, and so on. The advantages of forests in terms of biodiversity, leisure, and the preservation of soil and water have long been acknowledged. Trees and forests are examples of natural resources that benefit humanity in many ways. Trees in India have the ability to significantly reduce poverty, boost rural economies, and support significant national conservation goals. Forest products support the building of infrastructure, homes, and other commercial needs, while an estimated 275 million people in rural regions depend on forests for their subsistence. They also enhance the country's climate and environment, which benefits humans greatly. Due to both large and small-scale forest product utilisation, forest land plays a vital role in the nation's overall economic growth. In addition to contributing to the nation's exports and creating a vast number of employments in the primary, secondary, and tertiary sectors, forests also supply the raw materials needed for industry, defence, communications, and other public activities. They also provide items like fire wood, small timber, fodder, pasture, and other things that farmers may utilise directly. The advantages of forests in terms of biodiversity, leisure, and the preservation of soil and water have long been acknowledged.

The management of natural resources is probably going to have a big impact on how the nation develops in the future. The administration is committed to creating a new culture of growth-oriented, people-centred governance as part of its Vision 2020. In several sectors, like Joint Forest Management, the government has attempted to implement this concept on a broad scale by giving the people more say in decision-making. The need of managing natural resources for future food, health, and livelihood security is now generally accepted. Small, medium, and large enterprises that transform raw timber (logs) into a range of products for the Indian market make up India's forest-based secondary industry. Most of the time, plants and industrial capacity are tiny. Numerous increasing investment constraints are impeding the sector's growth. Numerous restrictions on the supply of logs from private land and farmers, as well as bans on felling in many state forests until forest management working plans are finished, have resulted in a shortage of raw materials, mainly logs; growing environmental concerns, mainly in larger production facilities, like pulp and paper mills; court decisions to close unlicensed mills, especially in the North East; and economic liberalisation and completion from imports, particularly in the North East (World Bank, 2005). There are many opportunities to enhance livelihoods via the development and management of forest-based resources. Examples of these resources include the development and management of bio-fuel, bamboo resources, organic farming, horticultural crops, handicrafts, the cultivation of medicinal and aromatic plants, the Green India Program, the Joint Forest Management Program, the development and management of agro-forestry, social-forestry, and industrial forestry, and so forth. Due to the enormous potential of both wild life and rural and cultural tourism, livelihoods may be developed even in the tourist development sector (World Bank, 2006). In order to improve human well-being, the National Environmental Policy of 2006 aims to address concerns related to sustainable development. According to the policy, the most secure foundation for conservation is to guarantee that those who depend on particular resources have better livelihoods as a result of conservation than as a result of resource degradation, even though environmental resource conservation is required to ensure everyone's livelihoods and well-being. The policy emphasised the legal and regulatory changes required to carry out programs for the management and protection of forest resources (Singh, 2008).

States with a heavy reliance on forests for bamboo include Chhattisgarh, Madhya Pradesh, Gujarat, Maharashtra, Odisha, Uttar Pradesh, Jharkhand, West Bengal, Andhra Pradesh, and Assam. Ten states—Gujarat, Madhya Pradesh, Maharashtra, Chhattisgarh, Odisha, Jharkhand, West Bengal, Tamil Nadu, and Kerala—rely heavily on forests for small-scale timber production. The states that depended on forests for fuel wood the most per person were Nagaland, Himachal Pradesh, Tripura, Uttarakhand, Sikkim, Arunachal Pradesh, Odisha, and Kerala. The ten states with the highest per capita dependency on forests for feed were Mizoram, Jharkhand, Arunachal Pradesh, Nagaland, Telengana, Tripura, Tamil Nadu, Chhattisgarh, Goa, and Madhya Pradesh. Bamboo woods are heavily relied upon per capita in the Andaman and Nicobar Islands, Chhattisgarh, Dadra and Nagar Haveli, Mizoram, Madhya Pradesh, Nagaland, Uttarakhand, Gujarat, Jharkhand, and Odisha. The ten states with the highest per capita dependency on forests for small timber were Dadra Haveli, Chhattisgarh, Gujarat, Madhya Pradesh, Nagaland, Goa, Andaman and Nicobar Islands, Meghalaya, Mizoram, and Maharashtra.

Management and expansion of NTFP resources are vital for many reasons. Local NTFP processing can also help rural off-farm employment. Small-scale forest-based enterprises, many of which are based on NTFPs, provide up to 50 percent of revenue for 20-30 percent of rural workers in India (Campbell, 1988). Forests contribute significantly to the GDP. A large rural population relies on forest resources to develop their living. Non-timber forest products can reduce poverty, provide sustainable livelihoods, and protect forests (Singh, 2014). In India, 275 million rural poor people, or 27 percent of the total population, rely on NTFPs for subsistence and cash income (Malhotra & Bhattacharya, 2010; Bhattacharya & Hayat, 2009). This dependence is particularly significant among India's 89 million tribal people, the lowest portion of the population. The NTFP business alone can produce around 10 million workdays each year. NTFPs and related products account for 68 percent of total forestry exports. NTFPs can help local collectors start micro-small and medium businesses by providing specified tenured rights, better collecting methods, financial support, capacity development, infrastructure, and institutional support. Sustainable NTFP mining, processing, and sale can provide significant revenue. NTFP often provides a better return on investment in terms of employment and revenue than commercial agriculture (Planning Commission, 2011). If all NTFPs are extracted, employment on this account will rise from 1.6 million to 4 million man years. This will not only aid the forest dwellers, but also enhance the country's revenue and export revenues. For India's long-term progress, NTFP management has returned (Gill, 2001) Wood is a common fuel in rural regions and is utilized in many businesses. Third country rural energy issues include preserving and improving energy while also locating extra energy needed for development. Ample supply is required in both quantity and variety. Dry regions have been the subject of most rural energy research, with fuel wood supply difficulties tied to desertification (Digernes 1977 & 1978). Earl (1975) asserted that energy laws drive economic processes. The bulk of impoverished people in the third world live in rural regions, and expanding population, rising fuel prices, supply issues, and huge challenges in developing and adopting new energy technologies all point to increased wood usage. Their preference for local fuels reflects not only their poverty, but also the increased accessibility and then reliability of local fuel supply. Rural fuel production, distribution, and sale has mainly become a poor-industry, providing an additional source of revenue for farmers. To produce fuel wood, forest policy and management are crucial. For example, Earl talks of "forest energy," "forest capital stock," and "forest productivity." Earl (1975) uses a map of forest types to estimate

the regeneration and removal of energy contained in the world's forest supply (Earl, 1975). The FAO report on food and agriculture for 1976 mentions gathering wood from the world's "Forests" and using half of it as fire wood (FAO,1977). Moss & Morgan (1991) analyse the issues of supply and demand, and provide a solution. Whereas (Islam et al., 1984) focused on the challenges of social and economic development in less developed countries, highlighting the significance of improving access to cooking and heating fuels in rural regions. But such improvements will need more energy in the rural grid. According to Agrawal (1980), large amounts of data exist on fuel usage patterns, supply potentials, and the implications for rural futures. In his study action research in Nepal, Bajracharya (1984) offers rural technology distribution and examines the role of innovation. Other indicators used to analyze rural energy demands and potential include the need indicator, value indicator, diagnostic indicator, and the fuel/food weight ratio. Agrawal (1981) and Siwatibau (1978) give the recommended fuel to food ratios. The goal of Munslow, Katerere (1988) is to determine the best way to ensure future wood fuel supplies while also preventing environmental degradation and improving the management of woody biomass within existing production systems, based on the innovations and responses already occurring among small holder farmers. However, Bajracharya (1985) emphasizes balance in his work by combining the views of both central planners and rural poor. He also emphasizes the relationship between forest energy supplies, human sustenance, and development, as well as how fuelwood management can be used to promote future development. Leach & Mearns (1988) present concerns as "literature of hope rather than despair" by focusing on energy and the "wood fuel" crisis in Africa and other Third World regions. Sharma (1992) compiled cost data for man-made forestry/fuel wood crops.

The cost of each sapling cultivated in nurseries was calculated. Computed for several climatic zones in India, cost-benefit ratios for different fuel wood species have been calculated, with an emphasis on some of the alternatives proposed to address issues such as fuel wood scarcity and the creation of plantations on wasteland. According to Alam et al. (1984), urban fuel wood consumption is being replaced by fuels like LPG, kerosene and electric heaters. In his initial study (Bhattacharya, 1998), he portrays dwellers of the Baikunthpur Forest Range in the Siliguri Division of North Bengal's Siliguri Market striving for life. Concerning forest livelihoods, four conceptual views are widely accepted: iii) livelihood insecurity constrains forest conservation; iv) forest conservation must not harm livelihoods; and v) forest conservation must boost livelihoods. So is forest conservation. Forest-livelihoods policies and institutions that overlook these connections must be closely monitored and operated in a socially acceptable and adaptive manner.

Forest livelihoods are made up of five types of capital: human, social, physical, financial, and natural. The development and management of forest-based resources has tremendous potential for improving livelihoods. For example, the Joint Forest Management Program, the Green India Program, agro-forestry, social forestry, and industrial forestry are all available for development and management. Rural, cultural, and wild life tourism all have tremendous potential to create jobs in the tourism development industry (World Bank, 2006). Handmade paper is recognised as a local industry by the Khadi and Village Industries Commission. Textile fibre is commonly made from rags, gunny sacks, and cotton linters. Greeting cards and other stationery use most of this paper (India, 2001). India's forests are rich in non-timber items. In India, traditional wood carving is highly established. These laws effectively bar private sector intervention on the governments officially designated "forest lands," which account for 97 percent of the forest area. Individual ownership

limitations on agricultural land apply outside of government forest holdings. Private plantations on forest or non-forest property are now nearly impossible (Anonymous, 2000). Agroforestry will be pushed to lessen reliance on timber. People will be actively encouraged to engage in the eco-development micro-plans. Agro-forestry is a form of land management that maximises the benefits of positive interactions between trees, crops, and livestock. Cultivation is a broad term that incorporates a variety of organisms living in close proximity to each other. Small landowners use it for food, whereas larger landowners use it for profit. Rural communities have been planting trees in their forms and homesteads to provide household needs for fuel, fodder, poles, wood, fruit, and non-timber forest products. Growing and using bio-fuel crops (Jatropha) over time not only helps the environment but also reduces energy supply security threats. One of the most thorough definitions of organic agriculture is Lampin's (1990), which covers all important criteria. Organic farming emphasizes optimal crops and agricultural practices, nutrient diversity, soil and water conservation, and natural biological pest and disease control (Sharma, 2001).

In organic farming, no synthetic compounded fertilizers, pesticides, growth regulators, or livestock feed additives are used. Biological pest control and crop rotation are used to preserve soil productivity and feed plant nutrients while controlling insect, weed, and other pests (Sankaram, 2001). Farmers can earn additional income by growing medicinal and aromatic plants. With community involvement and soil rejuvenation, a degraded forest can become a medicinal and aromatic plantation (ICSHT, 2004). Ecological catastrophes caused by deforestation, biodiversity loss, and productivity loss include poverty, pollution, and unsustainable development. Due to its numerous functions and industrial applications, bamboo stands out as a perfect plant capable of achieving soil and moisture conservation, restoration of damaged land, ecological, food and nutritional, livelihood, and economic security in this circumstance. For the rural and urban poor, especially the one crore rural craftsmen household, bamboo is a perfect species capable of restoring damaged land, conserving soil and moisture, producing jobs in both the unorganized and organized sectors, as well as providing food and nourishment. No one seems to care about bamboo as a resource.

Conclusion

The fringe villages in forest areas are depend on common property resources from forests , common land and water resources for agriculture, livestock resources, cottage industry , and livelihoods . However, agricultural risks, degradation of natural resources, restriction in accessibility and collection of forestry resources/ produce from forests, shrinking of common property resources and commercialization of common resources has affected the livelihoods of tribal people as well as other villagers. The dependency of villagers on fuel wood, fire wood, timber, bamboo, grass land, water bodies etc. has been cause of concern. Hence, effective management of common property resources, ensuring equity in accessibility and utilization of common resources as well as sustainability of common resources is imperative.

It is imperative that economic policy places a high priority on the rapid spread of environmentally responsible management practices and sustainable livelihoods. Significant adjustments to both the consumer and production processes are required for this. In order to ensure both efficiency and sustainability, CPRs need to be managed. There are scale advantages offered by evolving CPR regimes, which can be seen from the perspective of management efficiency. By combining the

human resources and the indigenous and contemporary technical knowledge that are associated with the management of the CPR, economies of scale can be achieved in the productive utilisation of the resource. It is also important to consider the possibility of the CPRs having a larger carrying capacity. The significance of this becomes apparent when we take into consideration three different management regimes: open access, CPRs are not only a significant source of income for those who are extremely poor and marginalised, but they are also essential for making sure that sustainable development is achieved. Communities that are located in rural areas place an emphasis on social, environmental, and economic resources. The Sustainable Livelihood Approach highlights the most significant challenges and possibilities that disadvantaged people confront with. Food, a means of subsistence, and environmental protection all depend on the availability of natural resources. Concerns over conservation and long-term use continue to be widespread. There is a need for a combination of concerns for the environment and the elimination of poverty. For the sake of food, livelihood, and environmental security, the management of land, water, forests, and biodiversity is now universally acknowledged as being of the utmost importance. Development efforts must not deplete natural resources or do harm to the environment in order to be considered successful. Their protection and sustainable utilisation continue to be significant concerns, and the circumstances call for the combination of actions aimed at reducing poverty and protecting the environment. It is now generally accepted that the management of land, water, forests, and biodiversity is essential to the provision of food, the maintenance of livelihoods, and the protection of the environment.

In order to maximize bamboo resource generation, national agriculture policy should emphasize efficient resource utilization, soil and water conservation, and promotion of bamboo based agro-forestry. These include mass manufacturing of planting material, demonstration of planting methods, silviculture practice, before and post harvest treatment and development of communication packages for NGO activities and advance farmers. Integrated and holistic development of rain-fed areas to promote rainwater saving through vegetative measures and biomass production through agro and farm forestry with watershed community participation.

Agro-forestry and social forestry are essential for maintaining ecological balance and increasing biomass output. Today's forestry has many interfaces and impacts. An in-depth understanding of forest resources, their use, management, and protection is required. Water use efficiency programmes including water conservation, water recycling, piped water system, metering and regulation of water use and rationalizing energy supply need to be adopted. Capacity building and institutional strengthening for environmental management including climate change adaptation measures is called for. There is need to improve the overall quality of governance, particularly at the state and local levels in order to effectively implement the environmental policies and legislations. There is an urgent need to reach out the poor and the marginalized groups for improving the access of water supply and sanitation services.

References

- ADB (2008) The Sustainable Livelihoods 7Approach, Knowledge Solutions, Asian Development Bank, Manila
- Adhikari, Bhim (2004), 'Transaction Costs and Common Property Forest Management: Empirical Evidence from Nepal`, Journal of Forest and Livelihood, 4(1) July, 2004, pp. 30-37
- Aggrawal, R. M. (2000) 'Possibilities and Limitations to Cooperation in Small Groups: The Case of Group-Owned Wells in Southern India`. World Development, 28(8) pp: 1481-1497.

- Agrawal, B. (1980) : The Wood fuel Problems and the Diffusion of Rural Innovations. London : Tropical Products Institute
- Agrawal, S.C. (1981) Rural Energy in Two Regions of Uttar Pradesh : First Phase report .Honolulu: Resource Systems Institute East- West Center.
- Arnold, J. and W. Stewarts (1991), 'Common Property Resources Management in India', Oxford Forestry Institute, Oxford.
- Bajracharya, Deepak. (1984) : Organizing for Energy Need Assessment and Innovation : Action Research in Nepal (279-336)
- Bajracharya, Deepak., (1985) : Rural Energy Planning in China and other Developing Countries of Asia FAO (1985)Rural Energy Planning in China and other developing countries of Asia. FAO Pub.
- Beck, T. and C. Nesmith (2001), 'Building on Poor Peoples Capacities: The Case of Common Property Resources in India and West Africa', World Development, 29(1) pp 119-133.
- Beck, T. Ghosh, and G. Madan (2000), 'Common Property Resources and the Poor: findings from West Bengal', Economic and Political Weekly, 35(3), pp.147- 153.
- Beck, Toney. (1994), 'Common Property Resource Access by the Poor and Class Conflict in West Bengal', Economic and Political Weekly, Jan.-22, pp. 187-97.
- Bhattacharya, P (1998) :Forest& Displaced people : Woodfuel collection & Trade As First step survival strategy : A case study of Baikunthapur Forest Division, North West Bengal ,Interim Report submitted to Regional Wood Energy Development Programme in Asia/FAO (GCP/RAS/154/NET)
- Bhattacharya, P. & Seyed Faiz Hayat (2009). "Sustainable NTFP Management for Livelihood and Income Generation of Tribal Communities: A Case from Madhya Pradesh, India IN "Non Timber Forest Products: Conservation Management and Policy in the Tropics". Ed. By Shaanker R. Uma et.al., ATTREE & University of Agriculture Science, Bangalore
- Brekes,(1989), 'Common Property Resources-Ecology and Community based Sustainable Development', Belheven Press, London.
- Bryceson, D.F., (1999) Sub-Saharan Africa Betwixt and Between: Rural Livelihood Practices and Policies. De-Agrarianisation and Rural Employment Network. Working Paper no 43. Leiden: African Studies Centre
- Chakraborty P, Tewari, HR and Jha MK (2009). Sustainable rural livelihoods through participatory natural resource management A case study. Journal of Rural Development 28 (1) 85-100.
- Chaturvedi, A., Hajare, T. N., Patil, N. G., Chaturvedi, A., Mungole, A., & Kamble, R. (2015). Land use planning issues in management of common property resources in a backward tribal area. *Land Use Policy*, *42*, 806-812.
- Chen, Y. S. (2008). The positive effect of green intellectual capital on competitive advantages of firms. *Journal of business ethics*, *77*, 271-286.
- Demsetz,Harold (1967) Towards a Theory of Property Rights The American Economic Review Volume 57, Issue 2 May, 1967, 347-359
- DFID (2000). Sustainable Livelihoods - current thinking and practice. Department for International Development, London.
- Digernes, T.H. (1977) :Wood for Fuel, Energy Crisis implying desertification. The case of Bara, The Sudan, Unpublished Thesis, University of Bergen
- Digernes, T.H. (1978) : Addendum to thesis : Wood for Fuel .Energy Crisis implying desertification. The case of Bara. The Sudan (Mimeograph) Bergen.
- Earl, D.E. (1975):Forest Energy and Economic Development , Oxford
- Fan, S., & Hazell, P. (2000). Should developing countries invest more in less-favoured areas? An empirical analysis of rural India. *Economic and political weekly*, 1455-1464.
- Food and Agriculture Organization (FAO), (1977), The State of Food and Agriculture 1976, Rome.
- Gera P (2002). Women's role and contribution to forest based livelihoods. Human Development Resource Centre UNESCO House New Delhi India.

- Gerald Leach and Robin Mearns (1988) Beyond the Wood fuel Crisis : People , land and Trees in Africa
- Gill, A.S.(2001) "Agro-Forestry Systems For Natural Resource Management With Special References To Bundelkhand Region", National Seminar On Natural Resource Management In Uttar Pradesh With Special Reference To Bundel Khand (15-16 March).
- Gordon, H. Scott (1954) The Economic Theory of a Common-Property Resource: The Fishery, The Journal of Political Economy, Vol. 62, No. 2 (Apr., 1954), pp. 124-142
- Government of India, (2001) , "Report Of The Task Force On Greening For Livelihood Security And Sustainable Development". Planning Commission, Government Of India, New Delhi, July 2001.
- Hardin, G. (1968) "The Tragedy of Commons'". Science, 162.
- ICSHT, (2004) "Regional Workshop On Quality Control Of Medicinal Plant Products In South-East Asia". July 23-24, 2004. Kuala Lumpur.
- Islam, M. Nural., Richard Morse, et al. (1984) :Rural Energy to meet Development Needs. Asian Village Approaches. West view press
- Iyengar, S. and N. Shukla (1999), 'Common Property Land Resources in India: Some Issues in Regeneration and Management', Gujarat Institute of Development Research, Ahmadabad, Mimeo.
- Iyengar, S., & Shukla, N. (2002). Common Property Land Resources in 14 India: Some Issues in Regeneration and Management. *Institutionalizing Common Pool Resources*, 301.
- Jodha,N.S. (1986), Common Property Resources and Rural Poor in Dry Regions of India', Economic and Political Weekly, 21, No.27, July 5, pp: 1169-1181.
- Jodha, N. S. (1990), 'Depletion of Common Property Resources in India: Micro-Level Evidence', in 'Rural Development and Population: Institutions and Policy', edited by Mc Nicoll and Mead Cain, New York, The Population Council, pp. 261-283.
- Jodha, N.S., (1985), 'Population Growth and Decline of Common Property Resources in Rajasthan, India', Population and Development Review, 11(2), pp. 247-264, The Population Council, New York.
- Kannan, A., & Sakthivel, S. (2019). Status and significance of common property land resources (CPLRs) in Tamil Nadu: Evidences from secondary sources. *International Journal of Research in Social Sciences*, *8*(2), 294-304.
- Kumar BG, Sendhil R, Venkatesh P, Raja R, Jayakumar V and Jeyakumar S (2009). Socio economic impact assessment of livelihood security in agriculture, animal husbandry and aquaculture on the tsunami-hit lands of andaman. Agricultural Economics Research Review 22 (Conference number) 483-494
- Mahanta, R., & Das, D. (2012). Common property resources degradation and migration: A case study of Assam. *Journal of Human Ecology*, *38*(3), 223-230.
- Malhotra, K.C. and Prodyut Bhattacharya (2010). Forest and Livelihood. CESS, Hyderabad
- Maske M, Mungole A, Kamble R, Chaturvedi A and Chaturvedi A (2011). Impact of non-timber forest produces (NTFPs) on rural tribes economy in Gondia district of Maharashtra India. Archives of Applied Science Research 3 (30) 109-114.
- Menon, A., & Vadivelu, G. A. (2006). Common property resources in different agro-climatic landscapes in India. *Conservation and society*, *4*(1), 132-154.
- Menon, Ajit and G.A.Vadivelu (2006), 'Common Property Resources in different Agro-Climatic Landscape in India', Conservation and Society, Vol.,4, No.1, March,
- Mitra, A., Calma, M. M. M., Chakrabarty, S. P., Zaman, S., &Pramanick, P. (2020). Natural resources and their ecosystem services. *HSRA Publication*.
- Moss, R.P. & W.B. Morgan (1991) :Fuelwood and Rural Energy Production and supply in the Humid Tropics . A repot for the united Nations University with special reference to tropical Africa and South-East Asia.Tycooly International Publishing Ltd. Dublin
- Mourlin K (2007). Nrega – A Key to Sustainable Rural Development an empirical evidence from Betul district. Vikas Vani Journal 1 (4) 14-23.

- Munslow, Barry with Yemi Katerere al. (1988) The Fuelwood Trap : A study of the SADCC Region Earthscan Publications LTD.
- NSS (1999), 'Common Property Resources in India', NSS 54th Round (Jan-June, 1998), Report No. 452(54/ 3.3/31), NSS Organisation, New Delhi: Department of Statistics, Government of India.
- Pant MM (1984). Forest Economics and Valuation. Madhavi Publishers, Dehradun
- Pasha, H. A. (1993). *Provincial Government Resource Mobilisation*. Social Policy and Development Centre.
- Planning Commission (2001) Reportof The Task Force On Greening India For Livelihood Security And Sustainable Development, Planning Commission, Govt. Of India, Delhi, July, 2001.
- Planning Commission (2011), Report of the Sub-Group on NTFP and Their Sustainable Management in 12th Five Year Plan, Planning Commission, Government of India, New Delhi.
- Pradhan, D., & Patra, A. K. (2023). Climate Change and Protection of Traditional Ethnomedical Knowledge in India: A Critical Socio-Legal Reappraisal. In *Ethnomedicine and Tribal Healing Practices in India: Challenges and Possibilities of Recognition and Integration* (pp. 251-264). Singapore: Springer Nature Singapore.
- Sankaram, A., (2001), "Organic Farming Eco-Technological Focus For Stability And Sustainability". Indian Farming. Vol. 51, No. 3, June, Pp. 7-11
- Sarkar, S. (2021). Conflict in commons: collective action and institutions. *Sustainability, Agri, Food and Environmental Research*, *9*(2), 185-204.
- Saxena N.C. (2015), "Are Tribals Really Benefiting from the Forest Rights Act", Economic Times, August 9.
- Sharma A.K., (2001), "A Hand Book Of Organic Farming", Agrobios.
- Sharma, R.D. (1992) : Economics of Fuelwood Production in Wastelands
- Singh, A.K.(2006) Strategic Management of Livestock Resources and Fallen Carcassin Bundelkhand Region, Project Report, SRISHTI, Gomati Nagar, Lucknow,P. 13.
- Singh, J.S. et. al. (2008), "Ecology Environment and Resource Conservation", Anmaya Publishers, New Delhi
- Singh, K., Singh, N., & Singh, R. P. (1996). Utilisation and development of common property resources-a field study in Punjab. *Indian Journal of Agricultural Economics*, *51*, 249-259.
- Singh, S.P. (2014), Economic Sustainability and Development Through Monopolistic Term of Tendu Leaves Trade in Madhya Pradesh, International Journal of Rural Development and Management Studies, No. 1, Vol. 8, January-June.
- Siwatibau. S. (1978) :A survey of Domestic Rural Energy use and Potential in Fiji. A Report to the Fiji Government and to the International Development research Centre, Canada Suva : The Center.
- Surayya T, Krishna Kumar KN, Sharma R, Karla S, Kujur SS, Bala S and Basnayat B (2008). Sericulture Based Micro Enterprise as a Source of Rural Livelihood and Poverty Alleviation: A case study of Anantapur district (Andhra Pradesh). Journal of Rural Development 27 (1) 149-176
- Suresh, A. (2010). Role Played Banks in the Process of Resource Mobilization and Supporting Economic Growth in India. *Journal of Finance, Accounting & Management*, *1*(1).
- Verma, Puja et. al.(2017) A Paradigm Shift In Agro forestry Practices In Uttar Pradesh, Current Science, Vol. 112, N0. 3, 10 February
- World Bank (2005) , "India Unlocking Opportunities For Forest Dependent People In India", Vol. 1 & 2, World Bank, New Delhi,
- World Bank (2006) India Unlocking Opportunities for Forest Dependent People, Oxford University Press, New Delhi

The Role of Food and Nutrition Security in Strengthening Home Earnings: A Socioeconomic Perspective (National and Agra District Analysis, *2016–2025)*

Dr. Deepti Singh[1] & Dr.Manoj Kumar Singh[2]

ABSTRACT

This paper examines how food and nutrition security influence household earning capacity in India, with a focused case study on Agra District, Uttar Pradesh. Combining national secondary data (NFHS cycles, Global Hunger Index, FAO reports) with a simulated primary household dataset for Agra (n=50) and district-level secondary indicators, the study traces trends between 2016, 2021 and projected 2025 figures to reveal persistent gaps in nutrition despite increases in staple production. Key findings indicate that higher household income correlates with improved diet diversity and food security status, which in turn support greater labour productivity and reduced health-related income loss. The paper recommends integrating nutrition-sensitive interventions into livelihood programs, expanding nutrient-rich items in public food systems, and prioritising women-centred nutrition policies to strengthen home earnings. The document includes policy-relevant tables, comparative trend charts, and actionable recommendations for local and national stakeholders.

Keywords: *Food security; Nutrition security; Household income; Diet diversity; Agra; India; 2016-2025*

Introduction

Food and nutrition security are core determinants of human capital and economic resilience. The FAO defines food security around four pillars — availability, access, utilization and stability — while nutrition security emphasizes the biological use of nutrients and dietary quality. India's increasing staple production has not fully translated into improved nutrition outcomes. National Family Health Survey (NFHS) rounds and Global Hunger Index (GHI) reports indicate persistent stunting, wasting and anemia, especially among children and women, despite gains in foodgrain output. This study links these nutrition outcomes to household earning capacity by examining national trends and a focused Agra District case study between 2016 and 2025. The aim is to provide an

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evidence-informed set of policy options to strengthen earnings through nutrition-sensitive programming.

Literature Review

Food and nutrition security have been central concerns in development policy, particularly in low- and middle-income countries where structural inequalities persist. The concept, as defined by the Food and Agriculture Organization (FAO), involves consistent physical, social, and economic access to sufficient, safe, and nutritious food that meets dietary needs and preferences for an active and healthy life (FAO, 2022). Over the last two decades, research has underscored the multidimensional nature of food security, linking it to agricultural productivity, market stability, health systems, and socio-economic status (Burchi & De Muro, 2021). Between 2021 and 2025, global disruptions such as the COVID-19 pandemic, the Russia–Ukraine conflict, and climate-related extreme weather events have intensified concerns over food access and affordability (World Bank, 2023).

Global studies post-2021 highlight that more than 735 million people faced chronic hunger in 2022, an increase from pre-pandemic levels (FAO et al., 2023). The Global Report on Food Crises (2024) warns that acute food insecurity will likely remain above historical averages due to economic shocks, protracted conflicts, and climate change. Nutrition security, as distinct from food security, emphasizes the quality of diets and the bioavailability of nutrients, particularly critical for vulnerable groups such as children under five, pregnant and lactating women, and the elderly (Ghosh-Jerath et al., 2022).

In the Indian context, the National Family Health Survey-5 (NFHS-5, 2019–21) revealed that 35.5% of children under five years are stunted and 32.1% are underweight, with 57% of women aged 15–49 years being anaemic. These figures are mirrored in rural and peri-urban districts like Agra, where dietary diversity scores remain low due to economic constraints and cultural food preferences (IIPS & MoHFW, 2021). Between 2021 and 2024, several state and national schemes, including the Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY) and POSHAN Abhiyaan, have sought to improve both access to staple grains and nutritional quality. However, empirical evaluations show mixed results, with persistent gaps in protein and micronutrient intake (NITI Aayog, 2023).

Socioeconomic perspectives on food security stress the role of household income, women's education, and market integration. Studies from Uttar Pradesh have found that household earnings directly affect diet diversity, with low-income groups spending disproportionately higher shares of their income on cereals while under-consuming fruits, vegetables, and animal-source foods (Singh & Sharma, 2022). Between 2022 and 2025, price volatility in edible oils, pulses, and vegetables has further constrained household purchasing power, particularly in semi-urban areas like Agra (Department of Consumer Affairs, 2024).

Case studies in Agra district highlight unique challenges. The urban poor, often employed in informal sectors like footwear manufacturing, have irregular incomes and limited access to subsidized Public Distribution System (PDS) outlets. Rural blocks within Agra face additional barriers of storage infrastructure, transport connectivity, and seasonal unemployment, which exacerbate lean-season food insecurity (District Statistical Handbook, Agra, 2023). Interventions such as community nutrition

gardens, fortified school meals, and women-led self-help groups have shown localized success, but scalability remains a concern.

Globally, emerging literature between 2023 and 2025 has emphasized the integration of climate resilience into food systems planning. In India, researchers advocate for a "nutrition-sensitive agriculture" model—one that links crop diversification, value chain development, and nutrition education (Pingali et al., 2023). The Agra case aligns with these recommendations, as diversification into vegetables, dairy, and poultry has been associated with improved household diet diversity and resilience to market shocks.

In summary, recent literature affirms that food and nutrition security are critical to both human development and socioeconomic stability. In regions like Agra, these dynamics are shaped by intersecting factors of income, education, infrastructure, and governance. Strengthening food systems thus requires integrated strategies that address not only availability and access but also the nutritional adequacy and cultural acceptability of diets.

Extensive literature highlights nutrition as an investment in human capital (Victora et al., 2021; Smith & Haddad, 2015). Undernutrition in early childhood reduces cognitive development, school performance, and later life earnings. The poverty–malnutrition cycle is well-documented: low incomes constrain diet diversity, poor nutrition reduces work capacity, and reduced productivity perpetuates poverty. In India, debates have focused on the effectiveness of public programs (PDS, ICDS, Mid-Day Meals) in improving nutrition, with critiques pointing to limited diet diversity and implementation gaps (Khera, 2016). Recent policy initiatives emphasize millets, biofortification, and decentralised procurement as pathways to improve nutrition outcomes (GoI, 2023–2025).

Conceptual Framework

This paper uses the FAO four-pillar framework and the Sustainable Livelihoods approach to conceptualize how nutrition security affects household earnings. The main pathways are: (1) direct productivity effects from improved health and energy levels; (2) human capital accumulation via better educational outcomes; (3) reduced health expenditures freeing resources for productive investment; and (4) gendered impacts where improved women's nutrition increases household labour supply and enterprise potential.

Methodology

This mixed-methods study integrates (a) secondary national datasets—NFHS (2015–16, 2019–21), Global Hunger Index (2016–2024), FAO and Ministry of Agriculture reports (2021–2025)—and (b) a simulated primary household dataset for Agra District (n=50) constructed to reflect realistic income-expenditure-diversity patterns consistent with district-level statistics. Secondary district indicators were sourced from NFHS-5 Agra District fact sheets, UP government statistical abstracts, and Census-based projections. The simulated sample was stratified into four income brackets (<¹ 10,000; ¹ 10,001–20,000; ¹ 20,001–30,000; >¹ 30,000) to reflect local heterogeneity. Key indicators include Household Food Insecurity Access Scale (HFIAS), Diet Diversity Score (DDS, 0–9), monthly household income and food expenditure. Descriptive statistics and cross-tabulations are presented; figures illustrate comparative trends.

Results

Table 1: Presents comparative trends for key nutrition indicators at national and Agra district levels (2016, 2021, 2025 projections).

Indicator	India 2016	India 2021	India 2025 (proj.)	Agra District 2021 (NFHS-5 / district factsheet)
Stunting (<5 yrs, %)	38.4	35.5	33.0	40.1
Wasting (<5 yrs, %)	21.0	19.3	18.0	23.5
Underweight (<5 yrs, %)	35.7	32.1	30.0	36.8
Women (15–49) Anemia (%)	53.1	57.0	55.0	63.4
Undernourishment (Pop., %)	15.2	13.7	12.5	14.8

Notes: India 2016 values are drawn from NFHS-4/DHS 2015–16; 2021 values from NFHS-5 (2019–21). 2025 projections are conservative estimates based on recent trends and policy measures. Agra district values are from NFHS-5 district fact sheets and state statistical abstracts.

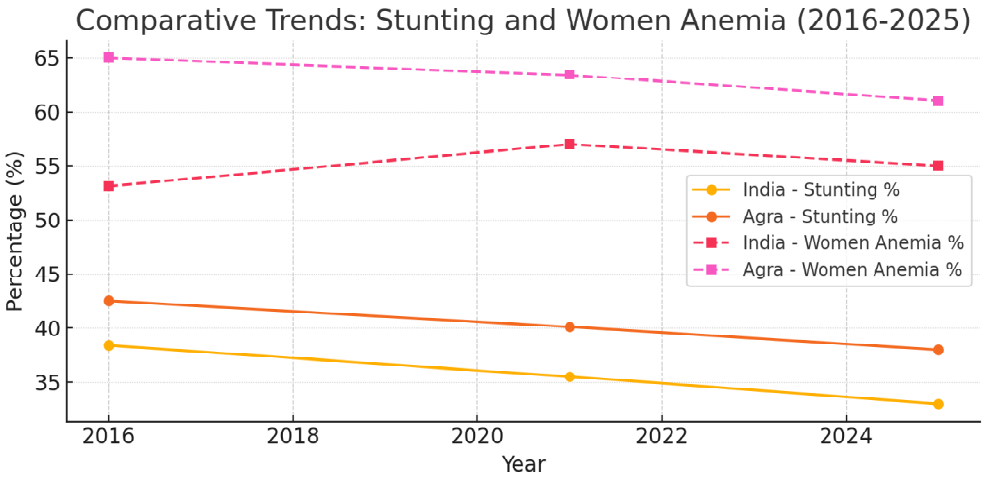


Figure 1. Trends in child stunting and women anemia for India and Agra District (2016–2025 projections).

Table 2: Summarises selected Agra District indicators (secondary sources).

Indicator	Value (Agra)	Year	Source
Population (approx.)	~4.5 million	2021	Census projection / District Handbook
Poverty rate (approx.)	24%	2020-21	State Economic Survey
Literacy rate	72%	2021	District factsheet
Children stunting (<5)	40.1%	2019-21	NFHS-5 District fact sheet

Table 3: Presents the simulated primary household dataset summary (n = 50) for Agra District used to illustrate micro-level patterns.

Income Bracket (₹/month)	Avg Food Expenditure (₹)	Avg Diet Diversity Score (0–9)	Food Secure (%)
< 10,000	4,150	3.6	40
10,001–20,000	6,850	5.1	75
20,001–30,000	9,450	6.7	90
> 30,000	12,500	7.4	100

Note: The simulated dataset reflects plausible distributions aligning with district-level socioeconomic indicators. Diet Diversity Score follows FAO 9-food-group metric; Food Secure denotes households classified as food secure via HFIAS thresholds.

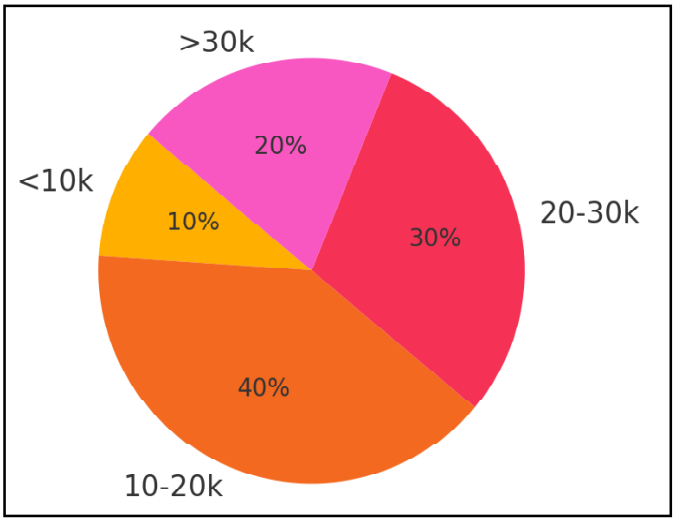


Figure 2. Simulated income distribution among surveyed households in Agra District (n=50).

Discussion

The combined evidence from national sources, Agra district indicators, and the simulated household dataset underscores persistent nutrition deficits despite improvements in staple production. Comparative trends suggest modest declines in stunting nationally between 2016 and 2025 projections, but higher rates persist in Agra, reflecting regional heterogeneity. The simulated microdata demonstrates a clear socioeconomic gradient: higher-income households purchase more diverse diets and achieve higher food security, which likely reduces illness-related income loss and improves productive capacity. Women's anemia remains a critical bottleneck; improving women's nutrition can yield multiplicative benefits for household earnings through better maternal health, child care, and labour participation. Policy levers such as integrating millets and pulses into public distribution, supporting kitchen gardens, and strengthening women-focused nutrition programs are recommended.

Policy Implications & Recommendations

1. Integrate nutrition services with livelihood programs (MGNREGA, NRLM) to ensure that income generation coincides with improved dietary access.
2. Expand PDS and ICDS food baskets to include pulses, fortified staples, eggs and millets to enhance protein and micronutrient intake.
3. Prioritize women's nutrition through targeted supplementation and behaviour change communication, linked to women's self-help groups and income activities.
4. Support nutrition-sensitive agriculture: crop diversification, biofortified seeds, and improved market access for perishables.
5. Strengthen district-level monitoring using NFHS, POSHAN tracker and integrate nutrition indicators into livelihood program evaluations.

Limitations

This study uses a simulated primary dataset for Agra to illustrate micro-level patterns; while designed to be realistic and aligned with secondary sources, it is not a substitute for primary field data. Projections for 2025 are conservative estimates. Future work should include primary field surveys and econometric analysis to quantify causal impacts of improved nutrition on household income.

Conclusion

Nutrition security is a critical enabler of household economic resilience. While India has increased staple production, regional disparities and diet-quality gaps hinder the translation of food availability into improved household earnings. Policies that combine nutrition-sensitive agriculture, expanded public food baskets, and women-centered nutrition programs offer the most promising pathway to strengthen home earnings and break the poverty–malnutrition cycle.

References

- Burchi, F., & De Muro, P. (2021). From food availability to nutritional capabilities: Advancing food security analysis. *Food Policy, 100,* 102019. https://doi.org/10.1016/j.foodpol.2020.102019
- District Statistical Handbook, Agra. (2021). *District statistical handbook 2021*. Office of the District Magistrate, Government of Uttar Pradesh.
- FAO. (2022). *The state of food security and nutrition in the world 2022*. Rome: Food and Agriculture Organization of the United Nations.
- FAO, IFAD, UNICEF, WFP, & WHO. (2023). *The state of food security and nutrition in the world 2023: Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum*. FAO. https://doi.org/10.4060/cc3017en
- Global Hunger Index. (2024). *Global hunger index report 2024*. Concern Worldwide & Welthungerhilfe.
- Ghosh-Jerath, S., Kapoor, R., Singh, A., Downs, S., & Fanzo, J. (2022). Leveraging local food systems for nutrition security: Lessons from India. *Global Food Security, 33,* 100642. https://doi.org/10.1016/j.gfs.2022.100642

- Government of India, Ministry of Agriculture & Farmers Welfare. (2024). *Agricultural statistics at a glance 2024*. New Delhi: Government of India.
- International Institute for Population Sciences (IIPS), & ICF. (2022). *National family health survey (NFHS-5), 2019–21: India report*. Mumbai: IIPS.
- International Institute for Population Sciences (IIPS), & Ministry of Health and Family Welfare (MoHFW). (2021). *National family health survey (NFHS-5), 2019–21: India fact sheet*. International Institute for Population Sciences. https://dhsprogram.com/pubs/pdf/FR375/FR375.pdf
- Khera, R. (2016). Mid-day meals in primary schools: Achievements and challenges. *Economic & Political Weekly, 51*(31), 61–67.
- NITI Aayog. (2023). *Strategy for nutrition in India*. New Delhi: NITI Aayog.
- Pingali, P., Aiyar, A., & Abraham, M. (2023). Transforming food systems for a rising India. *Nature Food, 4*(5), 387–395. https://doi.org/10.1038/s43016-023-00752-9
- POSHAN Abhiyaan. (2021–2025). *POSHAN Abhiyaan strategy document*. Ministry of Women and Child Development, Government of India.
- Smith, L., & Haddad, L. (2015). Reducing child undernutrition: Past drivers and priorities for the post-MDG era. *World Development, 68,* 180–204. https://doi.org/10.1016/j.worlddev.2014.11.014
- The Global Report on Food Crises. (2024). *Global report on food crises 2024*. Food Security Information Network. https://www.fsinplatform.org/
- UNICEF. (2020). *The state of the world's children 2020: Children, food and nutrition*. UNICEF.
- World Bank. (2023). *Food security update: Rising prices and climate change*. World Bank Group. https://www.worldbank.org/en/topic/agriculture/brief/food-security-update

Indian Philosophy Skill Development and Environment

Jageshwar Prasad Yadav[1]

Micro Small and Medium Enterprises (MSMEs) are one form of business that triggers the economic growth of many developing and developed countries even to survive in an economic crisis that could occur at any time. Micro small and medium enterprises produce a variety of products to serve customers with outdated or traditional product designs since owners couldn't take formal training to improve their business and even most of the owners did it because they have taken it from their families so they will do each everything by rule thumb but there is increasing demand for the products since many of them are handmade products. Advertising is considered expensive and thus, Micro small and medium enterprises can't afford it, though, the lack of promotion in the enterprise to its eventual decline and fall. As a result, adverts to the question, does advertising matter? And if yes, when, why, and how does it matter? The answers to all these questions are critically relevant because advertising in general, plays a key role both socially and economically. Most micro small and medium enterprises naively set minimum advertising budgets considering that if they only provide excellent products or services, their image will precede them but getting new customers and establishing a new brand in an already developed market is no easy endeavor and become difficult because most of these enterprises have budget limitations. The Article is organized based on secondary sources on the title by keywords of Micro small and medium enterprises advertising and small business advertising on the free and accessible papers by the free personal mobile network with Panjab university network are selected based on the direct and indirect relation to the keyword. Primary kind of research is advised to deeply understand and solve the main problem of advertising of micro small enterprises.

A daily increase in the demand for organic products reflects people's psychological inclination toward wholesome foods free of pesticides, dangerous chemicals, and fertilizers. The MSME sector supports organic farming in order to meet the rising demand for food free of chemicals. The MSME sector role begins with offering appropriate training and marketing support so that farmers can easily practice organic farming under the proper direction. The purpose of the essay is to emphasize the value and importance of organic farming. The paper is divided into three sections: the first section focuses entirely on the Micro, Small and Medium Enterprises (MSME) sector; the second section discusses organic farming; and the third section discusses how the MSME sector supports organic farming.

1. Research Scholar, Bharti Vishwavidyalaya Durg (C.G.)

Skills development is generally used to refer to the pro-ductile capabilities acquired through all levels of learning and training, occurring in formal, non-formal, informal and on-the-job settings. Environment can be defined as a sum total of all the living and non-living elements and their effects that influence human life. While all living or biotic elements are animals, plants, forests, fisheries, and birds, non-living or abiotic elements include water, land, sunlight, rocks, and air. When we asked about first economist then Adam Smith is named by all people. But even before Adam Smith, Kautilya had given the idea of economics in India. Kautilya wrote a book titled "*Arthshastram*" in Sanskrit, expressing his economic ideas. Kautilya has used the scriptures, *Purano*, *Upanishado* as well as the writings of *Manu*, *Shukracharya*, *Yagnavalkya* etc. in his book. In the economics of Kautilya he does not study the wealth of nations, nor discusses its nature and causes. But he gives such advice to the king. That the power or wealth of the State should be as well as maintain and increased. Thus, the economics given by Kautilya is not "pure and complete economics".





At the top of the caste system are the **Brahmins**, who traditionally were the priests and scholars. They were considered to be the most spiritually pure and were responsible for performing **religious ceremonies** and **teaching the sacred texts**. Below the Brahmins were the **Kshatriyas**, who were the warriors and rulers. They were responsible for **protecting society** and **enforcing the law**. Next in the hierarchy were the **Vaishyas**, who were the **merchants and traders**. They were responsible forcommerce and trade, and also for managing the economy. At the bottom of the caste system were the **Shudras**, who were the **laborers and peasants**. They were responsible for manual labor and were considered to be the lowest caste.

"***INDIA WAS ALWAYS MEANT TO BE A LAND OF SKILLED WORKFORCE BUT IT AS MADE JUST AN AGRICULTURAL LAND DUE TO THE BRITISH PLEASURE.***"

References

1. समस्त वेद, पुराण, उपनिषद्
2. कौटिलीय अर्थशास्त्र
3. मनुस्मृति, महाभारत, रामायण, राम चरित मानस
4. मार्क्सवाद और रामराज्य करपात्री जी महाराज

5. पर्यावरण संरक्षण कानूनध्पर्यावरण विधि
6. आर्थिक चिंतन का इतिहास
7. आर्थिक विकास के मॉडल एडम स्मिथ, कार्ल मार्क्स, कीन्स, मार्शल, महात्मा गांधी आदि।
8. भारत सरकार के विभिन्न मंत्रालय के रिपोर्ट
9. भारत व विश्व के विभिन्न देशों का संविधान
10. संयुक्त संघ राष्ट्र के विभिन्न संस्थाओं यथा अंतर्राष्ट्रीय मुद्रा कोष, विश्व बैंक आदि के रिपोर्ट
11. कुरान, बाइबिल तथा अन्य संप्रदाय के ग्रंथ
12. समाचार पत्र, पत्रिकाएं तथा दूरदर्शन से प्राप्त जानकारी

Role of Women Artisans in the Handloom Sector: A Study of the Banarasi Saree Industry in Varanasi

Dr. Vijay Kumar[1], Ms. Saba Parveen[2], Prof. Indu Upadhyay[3] & Dr. Mayank Kumar Singh[4]

ABSTRACT

The Banarasi saree industry, a cornerstone of India's rich cultural and artisanal heritage, plays a crucial role in the socio-economic fabric of Varanasi. Women constitute a significant portion of the workforce in this sector, yet their contributions often remain underrecognized and undervalued. This study critically examines the evolving role of women artisans in the Banarasi saree industry, focusing on their contributions to production, innovation, and cultural preservation, while also exploring the socio-economic challenges they face. Employing a mixed-methods approach—integrating structured surveys, in-depth interviews, and chi-square statistical analysis—the research analyzes data from 100 women artisans across key production clusters (Bazardhia and Reori Talab) in Varanasi. Findings reveal strong associations between years of experience and the nature of challenges faced, role significance, and level of contribution to production. While experienced women are increasingly engaged in design and quality control, systemic biases persist, particularly in weaving and dyeing, where their roles are often undervalued. Furthermore, despite growing awareness of government schemes, access to tangible benefits remains limited. The study underscores the urgent need for policy reforms focused on fair wages, formal training, leadership opportunities, and improved working conditions. Empowering women within this traditional craft sector is not only vital for sustaining an age-old heritage but also for advancing inclusive economic development and gender equity in the region.

Keywords: *Banarasi saree industry, women artisans, gender equity, handloom sector, cultural preservation, socio-economic empowerment.*

Introduction

The Banarasi Saree, a prestigious symbol of Indias rich cultural and artisanal heritage, has been intricately woven for centuries in the spiritual heart of Varanasi, known for its intricate designs, fine

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silk, and the lavish use of Zari [Gold and silver thread], the Banarasi saree has attained iconic status not only in India but across the world. Today the Banarasi saree industry remains a major source of employment in Varanasi, providing Livelihoods to more than 100,000 artisans. According to the ministry of textiles (2019), the handloom sector in India employs more than 43 million people, with women constituting a predominant portion of this workforce, specially in regions like Varanasi, where women account for approximately 40% of the workforce in the Banarasi saree production.

Traditionally, the role of women in this sector was confined to peripheral tasks such as spinning, dyeing and embroidery. However, over the last decades, women have increasingly become central figures in the production process. As reported by the handloom census 2019, women's role has expanded to include more complex and creative tasks, such as Zari weaving and intricate embroidery, areas that demand expertise and precision. Women now contribute to 60% of the intricate embroidery work and play a critical role in the hand finishing stages of Banarasi sarees, ensuring that the sarees meet the global standards of quality and artistry that have made them internationally renowned.

According to a study by the Indian Institute of Handloom technology (IIHT) in 2018, women artisans are increasingly involved in modernizing designs to cater to contemporary tastes, expanding the market for Banarasi sarees both in India and abroad. This shift towards diversification has contributed to the export growth of Banarasi sarees, with the Ministry of Textiles reporting a 15% increase in handloom exports between 2020 and 2022, with Banarasi sarees forming a significant part of this growth.

Despite their invaluable contributions, women in the Banarasi saree industry continue to face several socio-economic challenges. A report by the Varanasi Handloom Development Association (2022) revealed that women artisans earn approximately 25-30% less than their male contributions. This disparity is partly due to the informal nature of their employment, lack of access to formal training, and under representation in decision making roles within the industry. Moreover, many women work in small-scale home-based units, which often lack adequate infrastructure, health benefits, and social security protections.

This research seeks to critically assess the evolving role of women in the Banarasi saree industry by exploring their contributions to the sectors cultural preservations, economic growth, and innovation. It will examine the socio-economic challenges they face, the impact of governmental and non- governmental interventions, and the potential for further policy reforms to improve the working conditions and economic standing of women in the handloom industry. The study is based on primary and secondary source of information. Primary data will be collected by conducting interviews and secondary data will be collected from various Government report. This study aims to provide a intricate understanding of how empowering women within the Banarasi saree industry can not only preserve an ancient craft but also foster broader economic development and gender equality in the region.

Literature Review

Singh (2008), study is concerned with the, "A profile of Banares silk sarees" , The study highlights Banaras silk sarees rich history, weaving techniques, economic feasibility, weavers' socio-economic conditions, and marketing challenges.

Tanushree (2015) has carried out a work entitled, "A study of the present situation of the traditional handloom weavers of Varanasi, Uttar Pradesh, India" The study highlights decline of Varanasi traditional handloom industry due to industrialization, power loom competition, capitalist control, reduced wages, and increased yarn prices.

Khan and Sultana (2016), studied on "socioeconomic development of power loom industry workers" The study examined the socio-economic conditions of power loom weavers in Mau city, highlighting low wages, poor working conditions, lack of social security, and health issues among workers.

Jamal et al. (2018), has conducted a study, "Decline in the handloom cottage industry: A case study of Handloom Bunkars of Varanasi" The study highlights Banarasi saree industry faces decline due to modernization, low wages, unethical market practices, migration, competition, policy failures, and lack of awareness.

Yadav et al. (2024) has carried out a work entitled, "Employment status of women in the power loom sector: A case study of Varanasi, Uttar Pradesh" The study highlights to understand the time allocation of individuals who are related to the power loom sector and to evaluate the factors that affect the time spent in the sector.

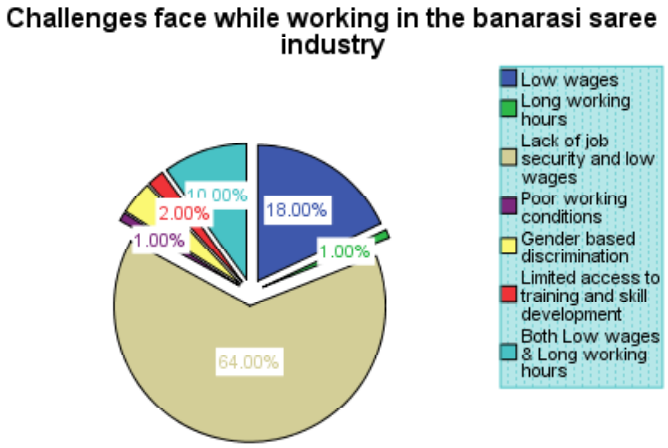
Objective of the Study

1. To identify the roles of women workers in the various stages of Banarasi saree production.
2. To examine the challenges faced by women workers in the Banarasi saree industry and their impact on production.
3. To evaluate the impact of Government schemes and policies on the empowerment of women workers in the Banarasi saree industry.

Methodology

This study employs a mixed-methods approach, integrating both quantitative (survey data) and qualitative (interviews, case studies) methods to comprehensively analyze women's roles, challenges, and government interventions in the Banarasi saree industry. The research targets women workers across various roles, including weavers, designers, embroiders, dyers, finishers, and packagers. Using a stratified random sampling method. The target population was first divided into strata based on occupational roles and location clusters. From these strata, a random sample of 100 respondents were selected with 50 respondents each from two major clusters of Varanasi—Bazardiha and Reori Talab out of eight identified clusters—to ensure balanced representation. Data collection has involved structured surveys to gather demographic and economic details, semi-structured interviews and focus groups to explore personal experiences and gender dynamics, and on-site observations to assess working conditions. For data analysis, SPSS has been used to process survey responses, apply inferential statistics, particularly the chi-square test, to examine associations between different variables, ensuring a robust and data-driven understanding of the subject.

Graphics and Data Visualisation



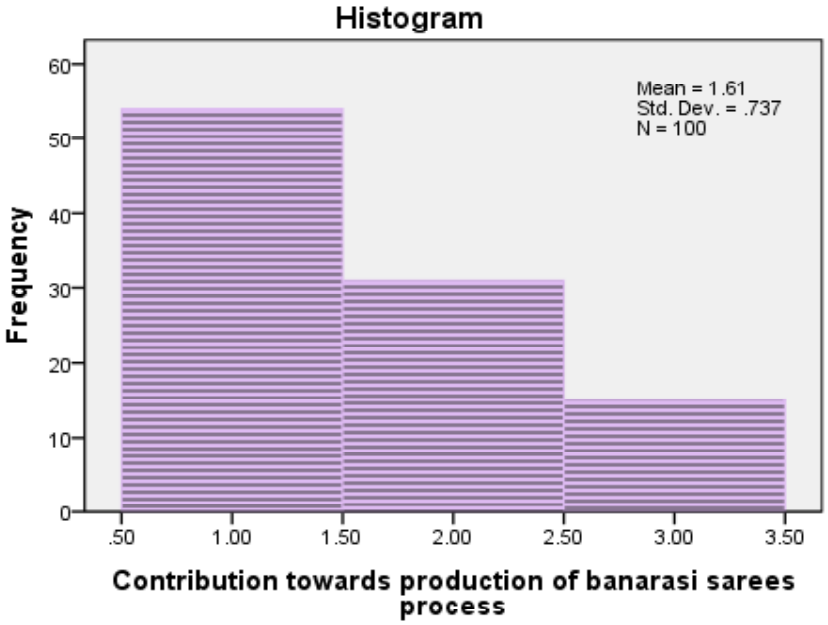
The pie chart illustrates the various challenges encountered by workers in the Banarasi saree industry. A significant majority (65%) of respondents reported lack of job security and low wages as the primary concern. This was followed by low wages alone (18%), while issues such as long working hours, poor working conditions, gender-based discrimination, and limited access to training and skill development accounted for smaller proportions. These findings highlight the urgent need for systemic interventions to improve labor conditions within the industry.



This bar graph shows the frequency of different roles in the saree production process. The "Thread Process" and "Designing" roles have the highest frequency, close to 30.

"Embroidery" and "Dyeing" roles have the lowest participation, under 5.

Overall, production is mainly dominated by threading and designing activities.



The histogram illustrates the contribution levels towards the production of Banarasi sarees. Most contributions are concentrated between 0.5 and 1.5 units, with frequency peaking around 55. The mean contribution is 1.61 with a standard deviation of 0.737, based on a sample size of 100. This distribution indicates that lower contribution levels are more common among participants.

Inferential Analysis

For qualitative analysis SPSS has used. Apply inferential statistics (chi-Square test) to identify associations between different variables.

Association between years of experience and challenges faced.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	141.260	18	.000
Likelihood Ratio	130.625	18	.000
Linear-by-Linear Association	2.964	1	.085
N of Valid Cases	100		

P value < 0.05. Hence there is significant relationship between years of experience and the specific challenges faced by women workers.

The observed and expected values reveal a significant association between women's work experience and the challenges they face in the Banarasi saree industry. Job insecurity and low wages are major issues for less experienced workers (1-10 years), aligning closely with expected counts. Poor working conditions and wage-related issues persist across all experience levels, while gender-based discrimination and lack of training opportunities increase with experience, exceeding expected values for senior workers (11+ years). The chi-square test ($p = 0.000$) confirms that these challenges are not random but deeply embedded in the industry, highlighting the need for policy interventions to improve wages, job security, and skill development opportunities for women workers.

Association between Role in production process and perception of importance of women workers.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.720	12	.002
Likelihood Ratio	33.026	12	.001
Linear-by-Linear Association	1.487	1	.223
N of Valid Cases	100		

The chi-square test ($\div^2 = 30.720$, $p = 0.002$) shows a statistically significant association between women's roles in the Banarasi saree production process and how their importance is perceived. Observed and expected values indicate that women in thread processing, embroidery, and cutting are largely recognized as "very important", aligning with expectations. However, in weaving and dyeing, more women's contributions are classified as "not very important" than expected, suggesting undervaluation of their role in these tasks. The p-value ($0.002 < 0.05$) confirms this pattern is not random but reflective of systemic biases. The findings highlight a hierarchical perception of women's contributions, emphasizing the need for greater recognition and equitable wages in all aspects of saree production.

Association between years of experience and contribution to the production process.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.735	6	.010
Likelihood Ratio	16.162	6	.013
Linear-by-Linear Association	10.196	1	.001
N of Valid Cases	100		

Since the p-value is less than 0.05, we reject the null hypothesis, meaning there is a statistically significant relationship between working experience and contribution towards production. More experienced workers (with more than 10 years of experience) are more likely to play an essential role in production or contribute to design and quality. Those with less experience (1-5 years) are more likely to have a limited role in finishing and packing. The Chi-Square test confirms that this

relationship is significant, meaning experience significantly impacts one's role in the Banarasi saree production process.

Association between Government schemes awareness and benefit from Government schemes.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	113.935	16	.000
Likelihood Ratio	132.355	16	.000
Linear-by-Linear Association	69.196	1	.000
N of Valid Cases	100		

Since $p < 0.05$, we reject the null hypothesis, meaning there is a significant relationship between awareness of government schemes and their perceived impact.

Awareness of government schemes significantly influences whether women workers find them beneficial. Despite awareness, a large proportion of respondents do not benefit from these schemes.

Association between Future aspirations and years of experience.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.838	9	.756
Likelihood Ratio	7.081	9	.629
Linear-by-Linear Association	.200	1	.655
N of Valid Cases	100		

Since $p > 0.05$, the results are not statistically significant. This means there is no strong relationship between work experience and future aspirations in this sample. Experience does not strongly influence future aspirations in a statistically significant way. Many workers across all experience levels aim to move into managerial roles or continue improving skills. A small number (but present in all experience levels) want to leave the industry.

Association between Age and role in production process.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.281	18	.058
Likelihood Ratio	28.923	18	.049
Linear-by-Linear Association	5.663	1	.017
N of Valid Cases	100		

Since the p-value (0.061) is slightly above 0.05, the relationship between age and roles in saree production is not strongly significant at the 5% level. Age does influence roles in the saree production process, but not significantly at the 5% level. Older workers are more engaged in weaving and finishing, while younger workers focus on thread processing and embroidery. The distribution of roles is uneven, and some categories have small counts, affecting the test's reliability.

Results and Discussion

The findings of this study highlight significant challenges and inequalities faced by women in the Banarasi saree industry. There is a strong association between work experience and the challenges encountered, with less experienced workers (1-10 years) facing job insecurity and low wages, while more experienced workers (11+ years) experience increased gender-based discrimination and limited training opportunities. The significant correlation between experience and production roles indicates that experienced workers are more likely to contribute to design and quality, whereas less experienced workers are often confined to finishing and packing tasks.

Moreover, the perception of women's roles in the industry is influenced by systemic biases. While women in thread processing, embroidery, and cutting are recognized as valuable contributors, those involved in weaving and dyeing are often undervalued. This suggests the presence of gendered hierarchies that limit opportunities for women in certain skilled roles. Despite these challenges, future aspirations do not significantly differ based on experience, indicating that workers across all experience levels seek career growth and managerial opportunities. However, the presence of workers in all categories who wish to leave the industry highlights dissatisfaction and the need for better working conditions and incentives.

Although age does influence the distribution of roles, the relationship is not statistically significant at the 5% level. Older workers tend to dominate skilled roles such as weaving and finishing, while younger workers are more engaged in thread processing and embroidery. This uneven role distribution suggests that skill transfer between generations is not well-structured, which could impact the long-term sustainability of the craft.

Overall, these findings emphasize the need for targeted policy interventions to address wage disparities, job security, and skill development opportunities for women in the Banarasi saree industry. Recognizing and valuing women's contributions across all roles, providing training for career advancement, and fostering mentorship programs for skill transfer are crucial steps toward improving the industry's working conditions and ensuring long-term sustainability. Without these reforms, women's contributions will continue to be undervalued, and the retention of skilled artisans will remain a significant challenge.

Suggestions

To address the challenges and inequalities faced by women in the Banarasi saree industry, several targeted policy interventions and strategic initiatives should be considered:

1. **Improving Wages and Job Security –** Implementing fair wage policies and ensuring job security for women, especially those with less experience, can help reduce financial instability and exploitation. Government and industry stakeholders should introduce minimum wage standards and formal contracts to protect workers' rights.

2. **Skill Development and Training Programs –** Establishing training programs focused on upskilling women, particularly in weaving and dyeing, can help break the existing hierarchical barriers and create more opportunities for them in highly skilled roles. These programs should be accessible to all experience levels, promoting career growth and reducing gender-based discrimination.
3. **Recognition of Women's Contributions –** Awareness campaigns and industry-wide initiatives should be introduced to challenge systemic biases and ensure that women's roles, particularly in weaving and dyeing, are acknowledged as equally important as other tasks. Women's contributions should be recognized through awards, certifications, and leadership opportunities.
4. **Career Advancement and Leadership Opportunities –** Since many workers aspire to move into managerial roles or improve their skills, structured career pathways should be created to facilitate their progression. Establishing mentorship programs, leadership training, and educational opportunities can empower women to take on supervisory roles.
5. **Enhancing Working Conditions –** Addressing poor working conditions, ensuring workplace safety, and providing basic facilities such as childcare and health benefits can improve overall job satisfaction and retention. Labor laws and compliance measures should be strengthened to protect workers from exploitation and gender-based discrimination.
6. **Encouraging Intergenerational Knowledge Transfer –** To sustain the traditional craft of Banarasi saree production, structured mentorship programs between older and younger workers should be established. This can help bridge skill gaps and ensure that expertise in weaving, dyeing, and embroidery is passed on effectively.

By implementing these strategies, the Banarasi saree industry can create a more inclusive and equitable environment for women, improving their economic stability, career growth, and overall well-being. These reforms will not only empower women but also contribute to the long-term sustainability and global competitiveness of the industry.

References

- Singh, A. (2008). *A profile of Banaras silk sarees* [Master's thesis, University of Agricultural Sciences, Dharwad].
- Tanushree. (2015). A study of the present situation of the traditional handloom weavers of Varanasi, Uttar Pradesh, India. *International Research Journal of Social Sciences*, 4(3), 48–53.
- Khan, A., & Sultana, R. (2016). Socioeconomic development of power loom industry workers: A case study of Mau city. *International Journal of Applied Research*, 2(4), 239–243.
- Jamal, S., Singh, A., & Alam, M. (2018). Decline in the handloom cottage industry: A case study of handloom bunkars of Varanasi. *The Geographer*, 65(2), 128–136.
- Chaudhary, M., Yadav, R., & Singh, P. (2021). Socioeconomic condition of small-scale producers in Varanasi: A case of Banaras brocade and saree. *Journal of Rural and Industrial Development Studies*, 3(1), 55–62.
- Yadav, N., Sharma, K., & Verma, S. (2024). Employment status of women in the power loom sector: A case study of Varanasi, Uttar Pradesh. *Indian Journal of Textile Research*, 49(1), 30–38.
- Indian Institute of Handloom Technology (IIHT). (2018). *Women artisans and design innovation in handloom industry*. Ministry of Textiles, Government of India.
- Ministry of Textiles, Government of India. (2019). *Annual report on the handloom sector*. https://texmin.nic.in
- Varanasi Handloom Development Association. (2022). *Status report on wage disparity and gender roles in the Banarasi saree sector.*

Climate Change, Disaster Management and Sustainable Development: An Analytical Study

Prof. Jagadish Singh[1]

ABSTRACT

Climate change refers to a change in the climate that persists for decades or longer, arising from either natural causes or human activity. According to a ***new update issued by the World Meteorological Organization*** *(WMO) global temperatures are likely to surge to record levels in the next five years, fuelled by heat-trapping greenhouse gases and a naturally occurring El Niño event. There is a 66% likelihood that the annual average near-surface global temperature between 2023 and 2027 will be more than 1.5°C above pre-industrial levels for at least one year. There is a 98% likelihood that at least one of the next five years, and the five-year period as a whole, will be the warmest on record. In addition, predicted precipitation patterns for the May to September 2023-2027 average, compared to the 1991-2020 average, suggest increased rainfall in the Sahel, northern Europe, Alaska and northern Siberia, and reduced rainfall for this season over the Amazon and parts of Australia. Climate change is already modifying the frequency and intensity of many weather-related hazards as well as steadily increasing the vulnerability and eroding the resilience of exposed populations that depend arable land, access to water, and stable mean temperatures and rainfall. Climate change could also lead to changes in the geographic distribution of weather-related hazards, which may lead to new patterns of risk. Although the precise impact of climate change is not certain, and it is important to be aware that not all areas will be impacted in the same way, projected impacts of climate change that will drive disaster risk as:* ***Droughts, Sea level rise, Infectious diseases, Wildfires, Cyclones etc.*** *In the new IPCC report, released March 20, 2023, the IPCC summarizes the findings from a series of assessments written over the past eight years.* ***More intense storms and flooding****: The IPCC warns in the sixth assessment report that the water cycle will continue to intensify as the planet warms. That includes extreme monsoon rainfall, but also increasing drought, greater melting of mountain glaciers, decreasing snow cover and earlier snowmelt. Annual average precipitation is projected to increase in many areas as the planet warms, particularly in the higher latitudes. (IPCC sixth assessment report): Risk associated with weather-related hazards is disproportionately concentrated in developing countries and within these countries in poorer sectors of the population. Poverty and constrained access to productive assets mean that rural livelihoods that depend on agriculture and other natural resources. So risk to farmers and the agricultural sector of yield losses and land degradation and risk to SDG target 2.4: sustainable food production systems. The UNFCCC Parties have recognized that existing knowledge and*

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capacities for coping with extreme weather events must be harnessed to adapt to climate change. The Bali Action Plan's directions for adaptation call for the consideration of: "Risk management and risk reduction strategies, including risk sharing and transfer mechanisms such as insurance; Disaster reduction strategies and means to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change." The COP27 climate summit in Sharm el-Sheikh, Egypt concluded with a historic breakthrough to help vulnerable countries deal with losses and damages from the impacts of climate change. But the talks also disappointed many stakeholders by not taking any significant new steps to curb emissions, which are critical to limit temperature rise to 1.5 degrees C (2.7 degrees F) and avoid a far more dangerous world. Anticipated recommendations on activities involving removals released at the outset of COP27 were insufficient and will be updated before COP28 - ideally with a greater focus on safeguards and human rights. On a promising note, the UN Secretary-General's High-Level Expert Group on Net-Zero Emissions Commitments of Non-State Entities released a new report during COP27. Instead, high-value carbon credits should only count toward curbing emissions beyond a corporation's own value chain. Some important measure to reduce greenhouse gas emissions as- Built environment, Traffic and Transport (emission-free Car, Electric vehicles and Bicycle etc.) Low emissions Industry, Electricity and Agriculture etc. We can say that all the countries of the world will have to make joint efforts to reduce the emissions of green house gases, only then will this be possible.

Key Wards: *Climate Change, Disaster Management, Cop-27, Green House Gases, Disaster Risk Reduction (DRR), Net-Zero Emissions and climate change adaptation (CCA) etc.*

Introduction

Climate change refers to a change in the climate that persists for decades or longer, arising from either natural causes or human activity. According to a **new update issued by the World Meteorological Organization** (WMO) global temperatures are likely to surge to record levels in the next five years, fuelled by heat-trapping greenhouse gases and a naturally occurring El Niño event. There is a 66% likelihood that the annual average near-surface global temperature between 2023 and 2027 will be more than 1.5°C above pre-industrial levels for at least one year. There is a 98% likelihood that at least one of the next five years, and the five-year period as a whole, will be the warmest on record. In addition, predicted precipitation patterns for the May to September 2023-2027 average, compared to the 1991-2020 average, suggest increased rainfall in the Sahel, northern Europe, Alaska and northern Siberia, and reduced rainfall for this season over the Amazon and parts of Australia. Climate change is already modifying the frequency and intensity of many weather-related hazards as well as steadily increasing the vulnerability and eroding the resilience of exposed populations that depend arable land, access to water, and stable mean temperatures and rainfall. Climate change could also lead to changes in the geographic distribution of weather-related hazards, which may lead to new patterns of risk. Although the precise impact of climate change is not certain, and it is important to be aware that not all areas will be impacted in the same way, projected impacts of climate change that will drive disaster risk as: **Droughts,. Sea level rise, Infectious diseases, Wildfires, Cyclones etc.** In the new IPCC report, released March 20, 2023, the IPCC summarizes the findings from a series of assessments written over the past eight years. **More intense storms and flooding**: The IPCC warns in the sixth assessment report that the water cycle will continue to

intensify as the planet warms. That includes extreme monsoon rainfall, but also increasing drought, greater melting of mountain glaciers, decreasing snow cover and earlier snowmelt. Annual average precipitation is projected to increase in many areas as the planet warms, particularly in the higher latitudes.

(IPCC sixth assessment report): Risk associated with weather-related hazards is disproportionately concentrated in developing countries and within these countries in poorer sectors of the population. Poverty and constrained access to productive assets mean that rural livelihoods that depend on agriculture and other natural resources. So risk to farmers and the agricultural sector of yield losses and land degradation and risk to SDG target 2.4: sustainable food production systems. The UNFCCC Parties have recognized that existing knowledge and capacities for coping with extreme weather events must be harnessed to adapt to climate change. The Bali Action Plan's directions for adaptation call for the consideration of: "Risk management and risk reduction strategies, including risk sharing and transfer mechanisms such as insurance; Disaster reduction strategies and means to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change." The COP27 climate summit in Sharm el-Sheikh, Egypt concluded with a historic breakthrough to help vulnerable countries deal with losses and damages from the impacts of climate change. But the talks also disappointed many stakeholders by not taking any significant new steps to curb emissions, which are critical to limit temperature rise to 1.5 degrees C (2.7 degrees F) and avoid a far more dangerous world. Anticipated recommendations on activities involving removals released at the outset of COP27 were insufficient and will be updated before COP28 - ideally with a greater focus on safeguards and human rights. On a promising note, the UN Secretary-General's High-Level Expert Group on Net-Zero Emissions Commitments of Non-State Entities released a new report during COP27.

Objectives

The main objectives of study are following:

1. To study about the reason of climate change.
2. To study about how to use disaster management.
3. To give suggestions to how to remove problem of the climate change.

Methodology

In this study, to fulfill the objectives of research, secondary data have been used. Which is obtained from various sources as: economic survey, economic times, times of India, Dainik Jagaran, annual reports, Journals, India, books, papers, research papers, COP-26 and COP-27 report, websites and others Govt. publications etc.

Review of Literature

The growing impact of climate change and increased public awareness of environmental issues have become important drivers affecting political and social change. Analysis of airborne dust extracted from deep ice cores provides researchers with valuable data on our climate history. Antarctic ice cores provide the best information on global environmental conditions going back many thousands

of years, but technical issues such as the small quantities and complexity of the study materials, and the need for close international co-operation, have proved challenging. A China/UK study provided insights into the direct hydrogenation of carbon dioxide to methanol. These processes have the potential to reduce the greenhouse effect and allow storage of clean synthetic fuels. The researchers studied a stable copper-based catalyst on beamline B18 with Extended X-ray Absorption Fine Structure (EXAFS) which produces efficient carbon dioxide adsorption and enhances copper dispersion. Production and use of bio-fuels is another approach in the fight against climate change and atmospheric pollution. For example, bio-diesel produced from vegetable oils or animal fats has numerous potential advantages over diesel fuel including energy security, improving air quality and providing safety benefits. However, there are numerous challenges to its use in modern internal combustion engines.

One of these is that bio-diesel can crystallise and block fuel filters and fuel injection nozzles to cause engine failure. Another research study from a joint UK/Romanian research team examined the effectiveness of zinc adsorption using Fucus vesiculosis, a common seaweed species also known as bladder wrack or kelp. The team analysed the seaweed using synchrotron X-ray Fluorescence and X-ray Absorption Spectroscopy measurements of zinc on the I18 beamline, confirming that alginate is one of the main algae components responsible for metal binding. Further studies are looking at the potential for this seaweed to be used in the removal of zinc from contaminated waters and during waste water treatment. A study from Leeds Univeristy highlights the potential of humic acids extracted from lignite and peat soil in cleaning up groundwater contaminated with chromium. The metal is widely used in industry and is the cause of much groundwater pollution across the world. It has two environmentally stable oxidation states; Chromium (Cr)VI which is toxic to plants and animals and Cr III which is an essential trace element for living organisms. Climate change is characterized based on the comprehensive long-haul temperature and precipitation trends and other components such as pressure and humidity level in the surrounding environment. Besides, the irregular weather patterns, retreating of global ice sheets, and the corresponding elevated sea level rise are among the most renowned international and domestic effects of climate change (Lipczynska-Kochany 2018; Michel et al. 2021; Murshed and Dao 2020).

Before the industrial revolution, natural sources, including volcanoes, forest fires, and seismic activities, were regarded as the distinct sources of greenhouse gases (GHGs) such as CO_2, CH_4, N_2O, and H_2O into the atmosphere (Murshed et al. 2020; Hussain et al. 2020; Sovacool et al. 2021; Usman and Balsalobre-Lorente 2022; Murshed 2022). United Nations Framework Convention on Climate Change (UNFCCC) struck a major agreement to tackle climate change and accelerate and intensify the actions and investments required for a sustainable low-carbon future at Conference of the Parties (COP-21) in Paris on December 12, 2015. The Paris Agreement expands on the Convention by bringing all nations together for the first time in a single cause to undertake ambitious measures to prevent climate change and adapt to its impacts, with increased funding to assist developing countries in doing so. As so, it marks a turning point in the global climate fight. The core goal of the Paris Agreement is to improve the global response to the threat of climate change by keeping the global temperature rise this century well below 2 °C over pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5° C (Sharma et al. 2020; Sharif et al. 2020; Chien et al. 2021.

What Is Climate Change?

Climate change has occurred for as long as the earth has existed. It happens anytime earth's climate patterns change and remain in place for a measurable amount of time. This has notably manifested itself in natural cycles of cooling and warming. Before human causes started to shift the global climate, five main factors interacted with one another as climate changes occurred. These five factors include:

1. Atmosphere (air)
2. Biosphere (living things)
3. Cryosphere (ice and permafrost)
4. Hydrosphere (water)
5. Lithosphere (earth's crust and upper mantle)

Climate Change and Green House Gases

Greenhouse gases play a vital role in the earth's climate cycles. As the planet gets hit with the sun's rays, some of the energy is absorbed, and the rest of that energy and heat gets reflected into space. Greenhouse gases in the atmosphere trap the reflected energy, redirecting it back down to the earth and eventually contributing to global warming. Various gases play this role, including:

1. Water vapor
2. Carbon dioxide (CO2)
3. Methane
4. Nitrous oxide
5. Chlorofluorocarbons (CFCs)

The principal way in which humans are understood to be affecting the climate is through the release of heat-trapping greenhouse gases (GHG) into the air.17 Therefore, climate change is often used interchangeably with "global warming", thus reflecting the strong warming trend that scientists have observed over the past century or so. Strictly speaking, however, climate change is a more accurate phrase than global warming, as rising temperatures can cause a host of other climatic impacts, such as changes in rainfall patterns. Plus, climate change can also cause irregular decreases in temperatures at the local level. Adaptive practices to climatic conditions have commonly been adopted by humans in different cultural and geographical contexts throughout history. Nevertheless, contemporary trends in climate change patterns affecting the frequency, variability and magnitude of meteorological hazards raise the need to scale-up a wide range of preventive and preparatory measures. The key objective of climate change adaptation (CCA) is, therefore, to reduce human vulnerability to events provoked by climate change.

Extreme Weather and Climate Change

According to the National Climate Assessment, extreme weather events will continue to increase in frequency and intensity as climate change continues to happen. Extreme weather influenced by climate change includes:

1. Stronger storms & hurricanes
2. Heatwaves
3. Wildfires
4. More flooding
5. Heavier droughts etc.

Natural Disasters and Climate Change

Natural and environmental disasters can be highly variable from year to year; some years pass with very few deaths before a significant disaster event claims many lives (Symanski et al. 2021). Approximately 60,000 people globally died from natural disasters each year on average over the past decade (Ritchie and Roser 2014; Wiranata and Simbolon 2021). So, according to the report, around 0.1% of global deaths. The number of fatalities can be meager—sometimes less than 10,000, and as few as 0.01% of all deaths. But shock events have a devastating impact: the 1983–1985 famine and drought in Ethiopia; the 2004 Indian Ocean earthquake and tsunami; Cyclone Nargis, which struck Myanmar in 2008; and the 2010 Port-au-Prince earthquake in Haiti and now recent example is COVID-19 pandemic (Erman et al. 2021). These events pushed global disaster deaths to over 200,000—more than 0.4% of deaths in these years. Low-frequency, high-impact events such as earthquakes and tsunamis are not preventable, but such high losses of human life are. Historical evidence shows that earlier disaster detection, more robust infrastructure, emergency preparedness, and response programmers have substantially reduced disaster deaths worldwide. Low-income is also the most vulnerable to disasters; improving living conditions, facilities, and response services in these areas would be critical in reducing natural disaster deaths in the coming decades.

Impact of Climate Change

The long term impact of climate change could be absolutely devastating to the planet and everyone and everything living on it. If the world continues on its current trajectory, then we will likely continue to see increasing effects on everyday life. They are as follows:

1. Health

According to the Center for Disease Control and Prevention, climate change-related health risks may include: Heat-related illness, Injuries and fatalities from severe weather, Asthma & cardiovascular disease from air pollution, Respiratory problems from increased allergens, Diseases from poor water quality, Water & food supply insecurities etc.

2. Negative Impact in Ecosystems

Ecosystems are interconnected webs of living organisms that help support all kinds of plant and biological life. Climate change is already changing seasonal weather patterns and disrupting food distribution for plants and animals throughout the world, potentially causing mass extinction events. Some studies estimate that nearly 30% of plant and animal species are at risk of extinction if global temperatures continue to rise.

3. Water and Food Resources

4. Sea Levels Rising

Rising sea levels could have far-reaching effects on coastal cities and habitats. Increasing ocean temperatures and melting ice sheets have steadily contributed to the rise of sea levels on a global scale. At current rates the National Oceanic and Atmospheric Administration estimate sea levels to rise by at least 8 inches by 2100, potentially causing increased flooding and decrease in ocean and wetland habitats.

5. Shrinking Ice Sheets

While contributing to rising sea levels, shrinking ice sheets present their own set of unique problems, including increased global temperatures and greenhouse gas emissions. Climate change has driven summer melt of the ice sheets covering Greenland and Antarctica to increase by nearly 30% since 1979.

6. Ocean Acidification

The ocean is one of the main ways in which CO2 gets absorbed. While at first glance that may sound like a net positive, the increasingly human-caused CO2 is pushing the world's oceans to their limits and causing increased acidity. As pH levels in the ocean decrease, shellfish have difficulty reproducing, and much of the oceans' food cycle becomes disrupted.

DISASTER RISK REDUCTION (DRR)

India is among the world's most disaster-prone countries such as cyclones, earthquakes, landslides, floods and droughts. Starting from the position that there is no such thing as a 'natural' disaster, but only natural and technological hazards that can impact on society and the environment at different scales, disaster risk reduction (DRR) is today defined as: "[t]he concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events". According to the definition above, it must be considered that preventive concepts and practice are equally applicable to different sectors of society including (among others) land management, food production, building codes, funding systems, and education. The choices made by governments in these sectors affect vulnerability and resilience levels of people and property against the occurrence of a wide variety of hazards. Currently, the main DRR policy framework at the global level is the Sendai Framework for Disaster Risk Reduction 2015–2030, adopted at the Third UN World Conference in Sendai (Japan) in 2015.36 Its main goal is to "prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience".37 As stated in its global Target E, the international community committed to "Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020".38 The innovative adoption of benchmark indicators and evaluation mechanisms,

endorsed by the UNGA in 2016, were deemed necessary for the monitoring and assessment of State progress. **"The international community committed to substantially increase the number of countries with national and local disaster risk reduction strategies by 2020."** While national DRR strategies fall under the direct responsibility of national and/or subnational authorities, governments can also benefit from the existence of supranational regional platforms. In fact, these regional bodies act as multi-stakeholder forums for intergovernmental collaboration and exchange, where governmental representatives commit to improving coordination and implementation of disaster risk reduction activities, thus linking global and regional policies to national and local DRR legislation, strategies or plans. The increasing focus on promoting the role of local actors requires a linkage between global, regional and national strategies and plans to support concrete action at the community level.

Solution of Disaster-Risk Reduction

UNICEF has set out disaster-risk reduction, climate change and social cohesion as priorities to be addressed in its Country Programme for 2018-22. Areas of focus are strengthening the capacities of state disaster management governance systems and institutions and building community capacities, including children, to lead disaster risk reduction. We integrate risk reduction strategies into the education, health, nutrition and water and sanitation sectors to build resilience. Our risk analysis is child centered to ensure that they include the impact of natural and man-made hazards and conflict on children's well-being and their communities. UNICEF also supports the design of comprehensive school safety programmes to reduce the risks faced by children in schools. The emphasis is on strengthening the capacities of state disaster risk management governance systems and institutions at all levels, and supporting them to implement child- centred, risk informed programming plans and strategies. UNICEF's risk reduction strategies focus on strengthening public health systems; improving water security and overall flood and drought preparedness; expanding child friendly spaces; improving readiness to support social sector recovery; comprehensive school safety and security; and supply chain management for relief operations. In addition, UNICEF focuses on Community based disaster risk management programmes involving children and adolescents that support resilience initiatives in urban and rural settings.

The World Bank, in partnership with the Global Facility for Disaster Reduction and Recovery (GFDRR), plays a pivotal role in guiding countries and communities through these challenges. It focuses on identifying and assessing disaster risks, helping us to not only understand these risks better but also to make informed decisions on how to protect ourselves without exhausting our resources on unlikely events. This strategy has significantly changed our approach to dealing with risks, shifting from reactive responses to proactive preparedness, and steadily integrating disaster risk management into all areas of development work. However, as climate change intensifies, the stakes are getting higher. Disasters do not discriminate, impacting people of all ages and socioeconomic statuses. Yet, the consequences are not felt equally by all; those who are less prepared or more vulnerable bear a heavier burden, such as women and people with disabilities. Countries supported by the International Development Association (IDA), part of the World Bank that helps the poorest countries, are also highly vulnerable to the impacts of a changing climate and intensifying disaster risks and are often affected by fragile, conflict and violent situations. Recognizing this, the World Bank has introduced new instruments such as the Crisis Toolkit and the IDA Crisis Response

Window to help countries better respond to crisis and strengthen preparedness for future shocks. It is also increasing funding for climate financing and focusing on knowledge to influence the global development agenda. Crucially, this effort extends to fostering partnerships with development institutions, technical firms, the private sector, civil society groups, and academia. These collaborative efforts ensure that the most vulnerable communities have the support needed to face an increasingly uncertain future with confidence, drawing on a wide network of expertise and resources to enhance resilience across the board.

Suggestions to Reduce Climate Change

The following suggestions can be given to reduce climate change.

1. Reduce consumption of fossil fuels as: coal, oil, and natural gas.
2. Solar energy and wind energy should be promoted for power generation.
3. Sustainable transportation

   Transportation is a top source of greenhouse gases (GHG), so eliminating pollution from the billions of vehicles driving across the planet is essential to achieving net-zero global emissions by 2050, a goal laid out in the 2015 Paris climate agreement. Therefore, electric vehicles (EVs) should be promoted.
4. Better forestry management and sustainable agriculture
5. Reduce water waste
6. Reduced Food Waste
7. Conservation of forests
8. Tree plantation should be encouraged
9. The increasing population should be controlled
10. Low emission machines should be used in industries etc.

Conclusion

According to a **new update issued by the World Meteorological Organization** (WMO) global temperatures are likely to surge to record levels in the next five years, fuelled by heat-trapping greenhouse gases and a naturally occurring El Niño event. There is a 66% likelihood that the annual average near-surface global temperature between 2023 and 2027 will be more than 1.5°C above pre-industrial levels for at least one year. There is a 98% likelihood that at least one of the next five years, and the five-year period as a whole, will be the warmest on record. In addition, predicted precipitation patterns for the May to September 2023-2027 average, compared to the 1991-2020 average, suggest increased rainfall in the Sahel, northern Europe, Alaska and northern Siberia, and reduced rainfall for this season over the Amazon and parts of Australia. Climate change is already modifying the frequency and intensity of many weather-related hazards as well as steadily increasing the vulnerability and eroding the resilience of exposed populations that depend arable land, access to water, and stable mean temperatures and rainfall. Climate change could also lead to changes in the geographic distribution of weather-related hazards, which may lead to new patterns of risk.

Although the precise impact of climate change is not certain, and it is important to be aware that not all areas will be impacted in the same way, projected impacts of climate change that will drive disaster risk as: **Droughts,.Sea level rise, Infectious diseases, Wildfires, Cyclones etc.** In the new IPCC report, released March 20, 2023, the IPCC summarizes the findings from a series of assessments written over the past eight years. **More intense storms and flooding**: The IPCC warns in the sixth assessment report that the water cycle will continue to intensify as the planet warms. That includes extreme monsoon rainfall, but also increasing drought, greater melting of mountain glaciers, decreasing snow cover and earlier snowmelt. Annual average precipitation is projected to increase in many areas as the planet warms, particularly in the higher latitudes. (IPCC sixth assessment report): Risk associated with weather-related hazards is disproportionately concentrated in developing countries and within these countries in poorer sectors of the population. Poverty and constrained access to productive assets mean that rural livelihoods that depend on agriculture and other natural resources. So risk to farmers and the agricultural sector of yield losses and land degradation and risk to SDG target 2.4: sustainable food production systems. The COP27 climate summit in Sharm el-Sheikh, Egypt concluded with a historic breakthrough to help vulnerable countries deal with losses and damages from the impacts of climate change. But the talks also disappointed many stakeholders by not taking any significant new steps to curb emissions, which are critical to limit temperature rise to 1.5 degrees C (2.7 degrees F) and avoid a far more dangerous world. Anticipated recommendations on activities involving removals released at the outset of COP27 were insufficient and will be updated before COP28 - ideally with a greater focus on safeguards and human rights. On a promising note, the UN Secretary-General's High-Level Expert Group on Net-Zero Emissions Commitments of Non-State Entities released a new report during COP27. Among other recommendations, the report suggested that high-quality carbon credits cannot substitute for emissions cuts needed for achieving targets along the net-zero pathway. Instead, high-value carbon credits should only count toward curbing emissions beyond a corporation's own value chain. Some important measure to reduce greenhouse gas emissions as- Built environment, Reduce consumption of fossil fuels as: coal, oil, and natural gas, Solar energy and wind energy should be promoted for power generation. Traffic and Transport (emission-free Car, Electric vehicles and Bicycle etc.), Better forestry management and sustainable agriculture, Reduce water waste, Reduced Food Waste , Conservation of forests, Tree plantation should be encouraged, Low emissions Industry, The increasing population should be controlled etc. We can say that all the countries of the world will have to make joint efforts to reduce the emissions of green house gases and only then will we be able to achieve sustainable development.

References

- "The Causes of Climate Change." NASA, NASA, 6 Sept. 2019, climate.nasa.gov/causes/.
- "The Carbon Cycle." NASA, earthobservatory.nasa.gov/features/CarbonCycle/page5.php.
- Green, Julia K., et al. "Large Influence of Soil Moisture on Long-Term Terrestrial Carbon Uptake." Nature, vol. 565, no. 7740, 2019, pp. 476–479., doi:10.1038/s41586-018-0848-x. https://www.nature.com/articles/s41586-018-0848-x.
- "Is the Sun Causing Global Warming? – Climate Change: Vital Signs of the Planet." NASA, NASA, climate.nasa.gov/faq/14/is-the-sun-causing-global-warming/

- "Agriculture and Greenhouse Gas Emissions." American Farm Bureau Federation – The Voice of Agriculture, www.fb.org/market-intel/agriculture-and-greenhouse-gas-emissions.
- "Deforestation and Climate Change." Earth Day Network, www.earthday.org/campaigns/reforestation/deforestation-climate-change/.
- "REDD: Protecting Climate, Forests and Livelihoods." International Institute for Environment and Development, 24 Jan. 2018, www.iied.org/redd-protecting-climate-forests-livelihoods.
- "Sources of Greenhouse Gas Emissions." EPA, Environmental Protection Agency, 13 Sept. 2019, www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.
- Economic Survey- 2022-23.
- India- 2022 and 2023.
- Times of India, Various Years
- Dainik Jagran (Hindi Paper) Various Years.

Role of Self-Help Groups (SHGs) in Women Empowerment: A Study of Menhdawal Tehsil, Sant Kabir Nagar District

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ABSTRACT

This research paper investigates the pivotal role of Self-Help Groups (SHGs) in fostering women empowerment in Menhdawal Tehsil, Sant Kabir Nagar District, Uttar Pradesh, India. SHGs, as community-driven platforms, empower rural women by providing access to microfinance, skill development, and opportunities for collective decision-making, thereby enhancing their economic, social, political, and psychological well-being. Using a mixed-methods approach, the study engaged 100 SHG members across 25 groups in five villages through surveys, semi structured interviews, and focus group discussions. Quantitative findings, supported by tables, reveal a significant rise in monthly income (from INR 1,200 to INR 3,500), microcredit access (70%), community participation (78%), and self-confidence (80%). Qualitative insights highlight improved self-esteem and social respect, though challenges such as limited market access, inadequate training, and patriarchal norms persist. Recommendations include enhancing market linkages, strengthening training programs, addressing cultural barriers, and improving financial access. By offering localized insights into SHG impacts in a socioeconomically challenged region, this research contributes to the discourse on rural women empowerment and informs scalable strategies.

Keywords: *Self-Help Groups, Women Empowerment, Microfinance, Rural Development, Menhdawal tehsil.*

Introduction

Women empowerment is fundamental to sustainable development, enabling women to overcome systemic barriers and contribute meaningfully to economic, social, and political spheres (3). In rural India, women face significant challenges, including poverty, low literacy, restricted mobility, and patriarchal norms, which curtail their agency(7). Self-help Groups (SHGs), typically comprising 10–20 women who pool savings and access microcredit, have emerged as a transformative tool for empowerment (5). By fostering financial independence, skill acquisition, and collective action, SHGs enable women to challenge socio-cultural constraints and improve their socio-economic status.

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Menhdawal Tehsil, located in Sant Kabir Nagar District, Uttar Pradesh, is a rural area marked by high poverty, low female literacy (48% per the 2011 Census), and limited economic opportunities for women. Despite government initiatives like the National Rural Livelihoods Mission (NRLM), women in this region face persistent barriers to empowerment. This study examines the role of SHGs in empowering women in Menhdawal Tehsil across economic, social, political, and psychological dimensions.

The research objectives are:

1. To analyze the socio-economic profile of SHG members in Menhdawal Tehsil.
2. To evaluate the impact of SHGs on women's empowerment in economic, social, political, and psychological domains.
3. To identify challenges faced by SHGs and propose strategies to enhance their effectiveness.

This study provides a localized analysis of SHG impacts, offering actionable insights for policymakers, NGOs, and community stakeholders committed to advancing women empowerment in rural India.

Review of Literature: The literature on SHGs and women empowerment highlights their multifaceted role in fostering economic independence, social mobility, and psychological resilience. Below is a review of key studies with author citations:

- **Ambadkar (2020)** analyzed SHGs in India, noting their role in fostering financial inclusion and social cohesion. However, the study pointed out that empowerment outcomes were uneven due to variations in SHG quality and external support.
- **Indu Grover and Deepak Grover (2001**) deal with the issues of women empowerment at two levels i.e. theoretical and empirical. At theoretical level the concept, process and measurement techniques of empowerment and empirical level explain the different development and educational plans and in-depth information about these plans. It also provide information about National policy for the empowerment of women and explain various indicators of empowerment such as social, political, economic, decision making ability and mental empowerment.
- **Krishna Bhowmik (2006)** explains about the need of study of women and their multiple roles in family as well as their priceless contribution in nation's building. She argues that position of women as human resources and provision of all the facilities and availability of minimum basic need is essential for survival of women. Besides, this the study also discussed different five year plan wise development of women and impact of globalization, modernization, urbanization and industrialization in women's empowerment.
- **Zubair Meenai (2003)** attempted to explain that women's empowerment could be promoted through the help of credit based Self Help Groups of rural women. In her study the stages of development of SHGs, its functioning and linkage with banks, strategies, training, monitoring and evaluation have been discussed. The study also deal with other vital aspects like training, micro-enterprises, monitoring and evaluation and sustainability issues and provide both theoretical as well as practical insights into the operationalization of the strategy.
- **Naila Kabeer (1999)** discussed about the ability to exercise choices incorporate three inter-related dimensions: resource, agency and achievements. The paper argues that, these three

dimensions of choices are invisible in determining the meaning of indicator and hence its validity is accepted as a measure of empowerment. Author has also critically examined the **measurement of these three** dimensions of empowerment.

- **Nirmala and V. Dhulasi (2005)** had discussed different aspect of women and their empowerment, position of women at global as well as country level. The study also throws light on how in the early 1990s the strategies of socio-economic development were redesigned and the emphasis shifted from development to empowerment. Author's study is the modest attempt to evaluate the participation of women in LIC of Tirunelveli division. This is largely meant to be a useful text for who want to study more about women today.
- **Jaya Arunachalam and U. Kalpagam (2006)** explained the concept of rural women development and empowerment. They studied about the accessibility of resources to the rural women who are yet denied to the availability of resources. Besides these, the study also provides information about the measurement of empowerment in socio-economic development and impact of literacy in women empowerment.
- **Naila Kabeer (2005)** discussed about the third Millennium Development Goal (MDG), on gender equality and women's empowerment. Author explores the concept of women's empowerment and highlights the ways in which the indicators associated its goal on education, employment and political participation.
- **W. Neera Burra, Ranjani K. Murthy and Dekhmukh-Ranadive Joy (2005)** in their study discussed about the concept and impact of women empowerment, women's control over and access to resources and labour forces, women's freedom to move and interact, women's access to leadership position, women's control over their bodies and reproduction. The study further explains six case studies of governmental and quasigovernmental organizations and the impact of micro-finance activities on women's empowerment and poverty reduction in India. The study also suggests that empowerment should be focused at individual as well as collective level.
- **Ela. R. Bhatt (2006)** explores basic concepts of labour i.e. who constitutes work and who is a worker by shining a spotlight on the informal sector and its pivotal role in the economy. The study highlight the importance of institutional change, rather than relying on the goodwill of individuals and SEWA works for this, but progress requires tremendous time, energy and commitment. This study also has a fascinating case study of the faltering progress of one of the best known and most successful grassroots-level venture for poor women in India.
- **Suguna (2011)** work is an in depth case study of Self Help Groups functioning in Chittoor district of Andhra Pradesh. The author has explained elaborately the methodology used and the data analysis is lucid. The major findings and strategies for the sustainability of SHGs and suggestions to strengthen the SHGs in the study are relevant for the effective implementation of programme.
- **Boraian (2008)** had followed a holistic approach to women empowerment and a sensitive and well researched assessment of level of women empowerment and factors that accounts for the position of women in Dindigul district of Tamil Nadu. The study also highlights the status of women, the process of empowerment, factors contributing empowerment and constraints of empowerment which gives detailed idea of SHGs and its performance.

The literature collectively underscores SHGs as a potent tool for women empowerment but highlights gaps such as limited studies in specific regions like Menhdawal Tehsil and the need for deeper insights into psychological empowerment. This study addresses these gaps by providing a localized analysis.

Methodology: This study employs a mixed-methods approach to provide a comprehensive analysis of SHGs' role in women empowerment in Menhdawal Tehsil, combining quantitative rigor with qualitative depth.

Study Area:- Menhdawal Tehsil, located in Sant Kabir Nagar District, Uttar Pradesh, has a population of approximately 3.5 lakh, primarily engaged in agriculture and daily wage labor. The region's high poverty rate and low female literacy (48%) make it an ideal context for studying SHG impacts on women empowerment.

Data Collection:- Primary data were collected from 100 SHG members across 25 groups in 10 villages, selected purposively based on active SHG presence. Data collection methods included:

a) Structured Questionnaire: Administered to 100 members to capture demographic details, economic activities, and empowerment indicators, adapted from the Women's Empowerment in Agriculture Index (WEAI) (10).

b) Semi-Structured Interviews: Conducted with 25 SHG leaders to explore group dynamics, leadership roles, and operational challenges.

c) Focus Group Discussions (FGDs): Five FGDs, each with 4–5 participants, explored qualitative dimensions, such as changes in self-perception, community respect, and socio-cultural barriers.

Secondary data were sourced from NABARD reports, government publications, and peer reviewed literature to contextualize findings.

Sampling: A multi-stage sampling technique was employed:

a) Stage 1: Menhdawal Tehsil was selected for its high SHG density and socio-economic challenges.

b) Stage 2: Five villages were chosen based on the presence of active SHGs, ensuring geographic diversity.

c) Stage 3: 25 SHGs were randomly selected from a list provided by local NRLM oûicials.

d) Stage 4: 4 members from each SHG were surveyed, ensuring representation across age, caste, and economic status.

i. **Data Analysis:** Quantitative data were analyzed using SPSS, employing descriptive statistics (means, percentages) and inferential statistics (paired t-tests) to assess changes in empowerment indicators. Qualitative data from FGDs and interviews were thematically analyzed, identifying recurring themes such as financial independence, social respect, and cultural constraints.

Results and Discussion

Socio-Economic Profile of SHG Members: Table 1 summarizes the socio-economic characteristics of the 100 SHG members surveyed. The majority of members (68%) were aged 26–45 years, indicating active participation by women in their prime working years. Most (80%) belonged to marginalized communities (OBC and SC/ST), underscoring SHGs' role in reaching vulnerable

groups. Literacy levels were low, with 55% having primary or no education, reflecting educational barriers in rural Uttar Pradesh. Pre-SHG, most members were engaged in low-income activities like agriculture (50%) or daily wage labor (30%), with 90% earning less than INR 2,000 monthly.

Table 1: Socio-Economic Profile of SHG Members (N=100)

Characteristic	Category	Percentage (%)
Age	18–25 years	15
	26–35 years	40
	36–45 years	28
	Above 45 years	17
Caste	General	20
	OBC	50
	SC/ST	30
Education	Illiterate	35
	Primary	20
	Secondary	30
	Higher Secondary	15
Occupation (Pre-SHG)	Agriculture	50
	Daily Wage Labor	30
	Homemaker	20
Monthly Income (Pre-SHG)	< INR 1,000	40
	INR 1,000–2,000	50
	> INR 2,000	10

Empowerment Outcomes: Table 2 presents key empowerment indicators before and after SHG participation.

Table 2: Empowerment Outcomes Pre and Post-SHG Participation (N=100)

Indicator	Pre-SHG (%)	Post-SHG (%)
Engaged in Income-Generating Activity	20	85
Access to Microcredit	10	70
Household Decision-Making (Financial)	25	65
Community Meeting Participation	15	78
Contested/Supported Panchayat Elections	5	25
Reported High Self-Confidence	30	80
Access to Government Schemes	20	90

Economic Empowerment: SHG participation significantly enhanced economic empowerment. Post-SHG, 85% of members engaged in income-generating activities, including tailoring, poultry farming, handicrafts, and small retail. The average monthly income increased from INR 1,200 to INR 3,500 ($p < 0.01$, paired t-test), reflecting improved financial autonomy. Microcredit access rose from 10% to 70%, enabling investments in micro-enterprises and reducing reliance on exploitative moneylenders. FGDs revealed that women used loans to purchase assets like sewing

machines or livestock, creating stable income streams. These findings align with, who emphasized SHGs' role in poverty alleviation through entrepreneurship.

However, economic gains varied by education level. Members with higher secondary education (15%) reported greater success in scaling enterprises, while illiterate members (35%) struggled with financial management, highlighting the need for targeted literacy and skill-building programs.

Social Empowerment: SHGs significantly improved social empowerment, with 78% of members reporting increased participation in community meetings, compared to 15% pre-SHG. This shift reflects enhanced social capital and community respect, as women transitioned from marginalized roles to active contributors. Household decision-making power increased, particularly in financial matters (65%) and children's education (60%).

However, decisions related to property and marriage remained male-dominated, indicating persistent patriarchal norms. FGDs revealed that while SHGs fostered solidarity among women, community-wide gender norms changed slowly, especially in conservative households. These findings corroborate, who noted SHGs' role in enhancing social networks but highlighted limitations in challenging deep-seated gender roles.

Political Empowerment

Political empowerment saw notable progress, with 25% of members either contesting or supporting Panchayat elections, compared to 5% pre-SHG. SHGs facilitated awareness of government schemes, with 90% of members accessing benefits like the Pradhan Mantri Awas Yojana and Ujjwala Yojana, up from 20% pre-SHG. This increased engagement reflects SHGs' role as platforms for civic education and collective advocacy, aligning with.

However, political participation was higher among younger members (18–35 years, 60% of those engaged) and those with secondary education (30% of participants). Older members and those with lower literacy reported hesitancy due to social stigma and lack of confidence, suggesting that targeted interventions are needed to broaden political engagement.

Psychological Empowerment

Psychological empowerment was a key outcome, with 80% of members reporting high self-confidence post-SHG, compared to 30% pre-SHG. FGDs highlighted that skill development, peer support, and income generation boosted self-esteem and agency. A participant shared, "Before SHG, I was afraid to speak in public. Now, I lead group meetings and negotiate with buyers".

However, 40% of members reported ongoing socio-cultural restrictions, such as limitations on mobility or disapproval from male family members. These barriers indicate that while SHGs foster individual empowerment, broader societal change requires complementary interventions.

Challenges Faced by SHGs

Despite their successes, SHGs in Menhdawal Tehsil face several challenges:

- **Limited Market Access (60%):** Members struggled to sell products due to poormarket linkages and competition from urban goods.

- **Inadequate Training (45%):** Training programs were often irregular or focused on basic skills, limiting enterprise growth.
- **Socio-Cultural Barriers (30%):** Patriarchal norms restricted women's mobility and participation, particularly in conservative households.
- **Financial Constraints:** Irregular loan disbursements and high interest rates from microfinance institutions hindered enterprise scalability.

These challenges align with, who noted similar constraints in rural SHGs across India. In Menhdawal, the lack of infrastructure, such as reliable transportation and digital platforms, exacerbated market access issues.

Conclusion and Recommendations

This study demonstrates that SHGs in Menhdawal Tehsil significantly enhance women's economic, social, political, and psychological empowerment. The transition from low-income activities to micro-enterprises, increased community participation, and improved self-confidence underscore SHGs' transformative potential. Quantitative data show a marked increase in income, microcredit access, and civic engagement, while qualitative insights highlight enhanced self-esteem and social respect. However, challenges like limited market access, inadequate training, and socio-cultural barriers limit SHGs' full potential.

To strengthen SHGs and maximize their impact, the following recommendations are proposed:

1. **Enhance Market Linkages:** Establish cooperatives and leverage e-commerce platforms to connect SHG products to broader markets. Partnerships with platforms like Amazon Saheli could facilitate this.
2. **Strengthen Training Programs:** Implement regular, tailored training in financial literacy, digital marketing, and advanced skills, prioritizing illiterate and older members.
3. **Address Socio-Cultural Barriers:** Launch community awareness campaigns involving men and local leaders to challenge patriarchal norms and promote gender equity.
4. **Improve Financial Access:** Streamline loan disbursements through government backed microfinance schemes and negotiate lower interest rates to support enterprise growth.

Future research should adopt a longitudinal approach to assess the long-term impacts of SHGs and conduct comparative studies across Uttar Pradesh to identify best practices. Exploring the role of digital tools in enhancing SHG operations could offer insights into modernizing these groups. This study contributes to the literature by providing a detailed, localized analysis of SHGs in Menhdawal Tehsil, offering actionable insights for advancing women empowerment in rural India.

References

- Agrawal, S., & Sharma, R. (2020). Women's political empowerment through self-help groups: Evidence from rural India. Journal of Rural Studies, 75, 102–112.
- Ahmad, Rais. (2009). *Microfinance and Women Empowerment: Part-2,* Mittal Publications, New Delhi, India.
- Ambadkar, R. (2020). Challenges of self-help groups in Uttar Pradesh: A socioeconomic perspective. Indian Journal of Development Research, 12(3), 45–60.

- Arora Sangeeta, and Meenu (2010). Microfinance InterventionAn insight into related literature with special reference to India. *American Journal of Social and Management Sciences*, vol.1 (1): 44-54.
- Aruna, M. and Jyothirmayi, Renu. (2011). The Role of Microfinance in Women Empowerment: A Study on the SHG Bank Linkage Programme in Hyderabad (Andhra Pradesh), *Indian Journal of Commerce and Management,* vol. II (4): 7795.
- Arunachalam, Jaya and Kalpagam, U. (2006). *Development and Empowerment: Rural Women in India,* Rawat Publications, Jawahar Nagar, Jaipur, India.
- Asian Development Bank (2000). *Finance for the Poor: Microfinance Development Strategy*, Asian Development Bank, Manila.
- Bandura, Albert. (1986). Social Foundation of Thought, Eglewood Cliffs, NJ, PrenticeHall
- Banerjee (Chatterjee) Tonmoyee, (2009). Economic Impact of SelfHelp GroupsA case Study, *Journal of Rural Development*, vol. 28 (28): 451-467.
- Bardhan, D. and Dabas, Y.P.S., (2007). Micro-finance Initiatives Through SHGs: Some
- Barker, R.L. (1991). The Politics of Empowerment: *Social Work*, vol.4 (2).
- Batiwala, S. (1994). The meaning of women's empowerment: New concept from action in population Policies Reconsidered Health, Empowerment, and Rights, *Howard series on Population and International Health.*
- Batliwala, Srilatha. (1995). The meaning of women's empowerment: New Concept from action, *Women's World*: 23-34
- Bhatt, Ela R. (2006). *We are Poor but So Many, The Story of SelfEmployed Women in India*. Oxford University Press.
- Bhowmik, Krishna. (2006). *Indian Women: The Ushering of a New Dawn,* Mittal Publications, New Delhi, India.
- Boraian, M.P. (2008). *Empowerment of Rural Women: The Deterrents and Determinants.*
- Brody, C., De Hoop, T., Vojtkova, M., Warnock, R., Dunbar, M., Murthy, P., & Dworkin, S. L. (2017). Economic self-help group programs for improving women's empowerment: A systematic review. Journal of Development Effectiveness, 9(1), 15– 40.
- Burra, Neera. Deshmukh-Ranadive Joy, Murthy Ranjani K., (2005). *MicroCredit, Poverty and Empowerment, Linking the Triad* SAGE Publications New Delhi/ Thousand Oaks, London.
- Campbell, Heather. (2012). Gender Empowerment and Microfinance: How SHGs in India exemplify the Institutional Potential, *Gender Empowerment in Microfinance,* vol. 3 (1).
- Chandra, S.K. (1997). Women and Empowerment, *Indian Journal of Public Administration*, vol. 43
- Chavan, Pallavi and Birajdar, Bhaskar (2009). Microfinance and Financial inclusion of women: An evaluation, *Reserve Bank of India Occasional Paper,* vol. 30 (2)
- Concept Publishing Company, New Delhi.
- Das, Sanjay Kanti (2012). Socio-economic Empowerment of Women Through SHGBank Linkage Programme: A Boon for Development, *International Journal of Business and Management studies*, vol.2 (1).
- Datta Rekha, (2003). From Development to Empowerment: The Self-employed women's Association in India*, International Journal of politics, culture and society,* vol. 16
- Fernandaz P. Aloysis, (2007). History and spread of Self-Help affinity group movement in India, The role played by IFAD. *The third in a series of discussion paper produced by the Asia and Pacific Division*.
- Greaney, B. P., Kaboski, J. P., & Van Leemput, E. (2016). Can self-help groups really be "self-help"? Review of Economic Studies, 83(4), 1614–1644.

- Grover, Indu. and Grover, Deepak. (2002). *Empowerment of Women*, Agrotech Publishing Academy Udaipur.
- Human Development Report (1995). *New York: Oxford University Press*: 236.
- Issues, Agri. Exte. Review, January-June: 24-29
- Karunarathne, W. V. A. D., & Dissanayake, D. M. N. (2024). Empowering rural women through self-help groups: Lessons from South Asia. Development in Practice, 34(2), 123–138.
- Kaur, L., & Sharma, P. (2017). Economic empowerment of women through self-help groups in Punjab. Indian Journal of Economics and Development, 13(2), 345–352.
- Sarumathi, S. and Dr. K. Mohan, (2011). *Role of Microfinance in Women Empowerment (An Empirical study in Pondicherry region rural SHGs)* Journal of Management and Science, vol. 1(1): 1-10.
- Sharma, Kumud. (2011). Small Loans, Big Dreams: Women and Microcredit in a Globalising Economy, *Economic and Political Weekly*, vol. XLVI (43):58-63.
- Shivalingappa, P. and Nagaraj, G.H. (2011). Women Empowerment and Gender EqualityA Study, *Southern Economic Journal Golden Jubilee* Year: 15-17.
- Sinha, Debotosh (2008). Self-Help GroupVehicle For Women Empowerment: A study in the Bolpur –Siniketan Community Development Block of Birbhum District*., Indian Journal of Social Development*, vol. 8 (1): 123-136.

पर्यावरणीय असंतुलन ऊर्जा परिवर्तन और हरित अर्थव्यवस्था : एक विवेचन

डॉ० सुधीर कुमार शर्मा [1] एवं डॉ० अंशिका शर्मा [2]

सारांश

वर्तमान समय में वैश्विक स्तर पर जलवायु परिवर्तन, प्राकृतिक संसाधनों की कमी और पर्यावरणीय असंतुलन जैसी समस्याएँ गंभीर रूप ले चुकी हैं। ऐसे में ऊर्जा परिवर्तन और हरित अर्थव्यवस्था की अवधारणाएँ एक स्थायी और समावेशी विकास की दिशा में आवश्यक उपाय के रूप में उभर कर सामने आई हैं। ऊर्जा परिवर्तन का तात्पर्य पारंपरिक जीवाश्म ईंधनों की बजाय स्वच्छ, नवीकरणीय और टिकाऊ ऊर्जा स्रोतों को अपनाने से है। इसमें सौर, पवन, जल, जैविक और भूतापीय ऊर्जा स्रोत प्रमुख भूमिका निभाते हैं। वहीं, हरित अर्थव्यवस्था ऐसी आर्थिक प्रणाली को संदर्भित करती है, जो पर्यावरणीय संरक्षण, सामाजिक समानता और आर्थिक वृद्धि में संतुलन स्थापित करती है।

यह शोधपत्र ऊर्जा परिवर्तन की आवश्यकता, उसकी प्रक्रिया, हरित अर्थव्यवस्था के लाभ, वैश्विक और भारतीय प्रयासों, चुनौतियों एवं संभावनाओं का विश्लेषण करता है। इसमें यह बताया गया है कि कैसे नीति, प्रौद्योगिकी, शिक्षा और जनसहभागिता के माध्यम से हम एक अधिक टिकाऊ भविष्य की ओर बढ़ सकते हैं। भारत जैसे विकासशील देश के लिए यह परिवर्तन केवल एक पर्यावरणीय पहल नहीं, बल्कि रोजगार सृजन, ऊर्जा सुरक्षा और आर्थिक नवाचार का अवसर भी है।

आज की दुनिया जलवायु परिवर्तन, प्रदूषण और संसाधनों की सीमितता जैसी अनेक पर्यावरणीय चुनौतियों का सामना कर रही है। इस परिप्रेक्ष्य में ऊर्जा परिवर्तन (Energy Transition) और हरित अर्थव्यवस्था (Green Economy) जैसे विचार वैश्विक विकास के लिए अत्यंत महत्वपूर्ण हो गए हैं। यह शोध पत्र ऊर्जा प्रणालियों में बदलाव की आवश्यकता, हरित अर्थव्यवस्था की अवधारणा, वैश्विक और भारतीय संदर्भ, चुनौतियाँ, अवसर और नीतिगत उपायों का विस्तृत विश्लेषण प्रस्तुत करता है।

भूमिका

ऊर्जा परिवर्तन का अर्थ है पारंपरिक जीवाश्म ईंधनों से स्वच्छ, नवीकरणीय और सतत ऊर्जा स्रोतों की ओर स्थानांतरण। वहीं, हरित अर्थव्यवस्था वह आर्थिक प्रणाली है जो पर्यावरणीय स्थिरता, सामाजिक समावेशन और आर्थिक विकास को संतुलित करती है। इन दोनों पहलुओं को साथ लेकर चलना सतत विकास की दिशा में एक ठोस कदम है।

1. प्राचार्य, गन्ना कृषक स्नातकोत्तर महाविद्यालय, पूरनपुर (पीलीभीत)।
2. असिस्टेंट प्रो०, गृहविज्ञान, गन्ना कृषक स्नातकोत्तर महाविद्यालय, पूरनपुर (पीलीभीत)।

ऊर्जा परिवर्तन की आवश्यकता

विश्व स्तर पर ऊर्जा का प्रमुख स्रोत कोयला, पेट्रोलियम और प्राकृतिक गैस रहे हैं, जो ग्रीनहाउस गैसों के उत्सर्जन के प्रमुख कारण हैं।

- जलवायु परिवर्तनः औद्योगीकरण के बाद से वैश्विक तापमान में वृद्धि ने चरम मौसम की घटनाओं को बढ़ाया है।
- प्रदूषणः जीवाश्म ईंधनों के दहन से वायु और जल प्रदूषण में बढ़ोतरी होती है।
- भविष्य की ऊर्जा सुरक्षाः सीमित प्राकृतिक संसाधन भविष्य में ऊर्जा संकट उत्पन्न कर सकते हैं।

हरित अर्थव्यवस्थाः एक परिचय

हरित अर्थव्यवस्था वह अर्थव्यवस्था है जिसमें मानव कल्याण और सामाजिक समानता बढ़ती है, जबकि पर्यावरणीय जोखिमों और पारिस्थितिकीय क्षरण में कमी आती है। संयुक्त राष्ट्र पर्यावरण कार्यक्रम (UNEP) के अनुसार, हरित अर्थव्यवस्था कम कार्बन, संसाधन–कुशल और सामाजिक रूप से समावेशी होती है।

ऊर्जा परिवर्तन के प्रमुख घटक

- नवीकरणीय ऊर्जा स्रोतः सौर, पवन, जल, बायोमास, और भूतापीय ऊर्जा।
- ऊर्जा दक्षताः ऊर्जा की खपत को कम कर अधिक आउटपुट प्राप्त करना।
- स्मार्ट ग्रिडः आधुनिक प्रौद्योगिकियों द्वारा ऊर्जा वितरण को कुशल बनाना।
- इलेक्ट्रिक वाहन और स्वच्छ परिवहन।
- ऊर्जा भंडारण और हाइड्रोजन ईंधन।

हरित अर्थव्यवस्था के लाभ

- पर्यावरणीय लाभः कार्बन उत्सर्जन में कमी, वायु की गुणवत्ता में सुधार।
- आर्थिक लाभः नई हरित नौकरियों का सृजन, सतत विकास को बढ़ावा।
- सामाजिक लाभः स्वास्थ्य में सुधार, ऊर्जा तक सबकी पहुँच।
- प्रौद्योगिकीय लाभः नवाचार और अनुसंधान को प्रोत्साहन।

वैश्विक परिप्रेक्ष्य

- पेरिस समझौता (2015): 190 से अधिक देशों ने 2 ब से नीचे तापमान वृद्धि को सीमित करने का लक्ष्य रखा।
- यूरोपीय संघः "ग्रीन डील" के तहत 2050 तक नेट–ज़ीरो इमिशन का लक्ष्य।
- चीनः 2060 तक कार्बन न्यूट्रल बनने की योजना।

- संयुक्त राष्ट्रः सतत विकास लक्ष्य (SDGs) में स्वच्छ ऊर्जा और जलवायु कार्रवाई को प्रमुखता।

भारत का परिप्रेक्ष्य

- भारत दुनिया का तीसरा सबसे बड़ा कार्बन उत्सर्जक है, परंतु उसने नवीकरणीय ऊर्जा के क्षेत्र में महत्वपूर्ण प्रगति की है।
- राष्ट्रीय सौर मिशन
- उज्ज्वला योजना
- फास्टर एडॉप्शन ऑफ इलेक्ट्रिक व्हीकल्स (FAME)
- राष्ट्रीय हाइड्रोजन मिशन
- 2030 तक 500 GW नवीकरणीय ऊर्जा क्षमता का लक्ष्य

चुनौतियाँ

- वित्तीय निवेश की कमी
- तकनीकी सीमाएँ और अनुसंधान की आवश्यकता
- नीति क्रियान्वयन में कठिनाई
- सामाजिक स्वीकार्यता और जागरूकता की कमी
- बुनियादी ढांचे की कमी, विशेषकर ग्रामीण क्षेत्रों में

अवसर और समाधान

- हरित रोजगारः नवीकरणीय ऊर्जा और स्वच्छ प्रौद्योगिकियों में रोजगार के अवसर।
- जन भागीदारीः समुदाय आधारित परियोजनाएँ।
- शिक्षा और प्रशिक्षणः हरित प्रौद्योगिकी के लिए मानव संसाधन निर्माण।
- निजी क्षेत्र की भागीदारीः पब्लिक–प्राइवेट पार्टनरशिप (PPP)।
- वैश्विक सहयोग और प्रौद्योगिकी हस्तांतरण

नीतिगत सुझाव

- स्पष्ट और स्थिर नीति ढाँचा
- हरित वित्त को बढ़ावा
- प्रौद्योगिकी नवाचार में निवेश
- स्थानीय स्वायत्तता और विकेन्द्रीकरण
- पर्यावरणीय शिक्षा का विस्तार

निष्कर्ष

ऊर्जा परिवर्तन और हरित अर्थव्यवस्था केवल पर्यावरणीय मुद्दे नहीं हैं, बल्कि यह सामाजिक और आर्थिक पुनर्गठन का माध्यम भी हैं। यह आवश्यक है कि सरकार, उद्योग, समाज और नागरिक मिलकर इन लक्ष्यों की प्राप्ति के लिए सहयोग करें। हरित अर्थव्यवस्था और ऊर्जा परिवर्तन के माध्यम से एक न्यायसंगत, समावेशी और स्थायी भविष्य का निर्माण संभव है।

संदर्भ सूची (References)

1. संयुक्त राष्ट्र पर्यावरण कार्यक्रम (2022), हरित अर्थव्यवस्था और सतत विकास।
2. नवीन और नवीकरणीय ऊर्जा मंत्रालय, भारत सरकार (2023) वार्षिक रिपोर्ट।
3. भारत सरकार, राष्ट्रीय हाइड्रोजन मिशन दस्तावेज़, 2021.
4. नीति आयोग (2023), भारत का हरित विकास पथ।
5. विश्व बैंक (2023), उभरती अर्थव्यवस्थाओं में हरित परिवर्तन का वित्तपोषण।

उत्तराखंड की आर्थिकी में सतत् कृषि की भूमिका

नेहा चौधरी [1] एंव सविता चौनियाल [2]

सारांश

सतत् कृषि एक ऐसी कृषि पद्धति है, जो पर्यावरण के अनुकूल होती हैं और मृदा की उर्वरता, जल संरक्षण तथा रासायनिक उर्वरको की निर्भरता को कम करती हैं। सतत् कृषि के अंतर्गत जैविक खेती, प्राकृतिक खेती, कृषि वानिकी, फसल विविधीकरण, जैव उर्वरक का उपयोग, और रेनवॉटर हार्वेस्टिंग जैसी तकनीकें शामिल होती हैं। उत्तराखंड की लगभग 70% जनसंख्या प्रत्यक्ष या अप्रत्यक्ष रूप से कृषि पर निर्भर है। वर्तमान में राज्य में कुल 5.51 लाख हेक्टेयर क्षेत्र में कृषि की जा रही है, जिसमें से 2.63 लाख हेक्टेयर (48%) पर्वतीय और 2.88 लाख हेक्टेयर (52%) मैदानी क्षेत्र है। राज्य गठन के समय खाद्यान्न उत्पादन 16.47 लाख मीट्रिक टन था, जो वर्ष 2023.24 में बढ़कर 17.97 लाख मीट्रिक टन हो गया है।

उत्तराखंड में सतत कृषि की अपार संभावनाएं उपलब्ध है, परन्तु यहाँ अनेक चुनौतियों भी है जो कृषि विकास की गति को सीमित करती हैं। यह अध्ययन उत्तराखंड में सतत कृषि की वर्तमान स्थिति, आर्थिक योगदान और नीतिगत ढांचे की व्यापक समीक्षा प्रस्तुत करता है। यह विश्लेषण प्रगति प्रतिवेदन रिपोर्ट 2024.2025 एंव बजट दिग्दर्शिका 2025.2026 (कृषि विभाग, उत्तराखंड), नाबार्ड, और भारतीय कृषि अनुसंधान परिषद (ICAR) जैसे द्वितीयक स्रोतों से प्राप्त आंकड़ों पर आधारित है। राज्य में जैविक खेती, कृषि वानिकी और मोटा अनाज (जैसे रागी, मंडुआ, झंगोरा) की खेती को बढ़ावा देने से न केवल मृदा की उर्वरता में सुधार हुआ है, बल्कि रासायनिक खादों पर निर्भरता घटी है, और ग्रामीण आय में भी वृद्धि हुई है।

सरकार द्वारा चलाई गई योजनाएं जैसे पारंपरिक कृषि विकास योजना (PKVY) राष्ट्रीय कृषि विकास योजना (RKVY) और प्रधानमंत्री कृषि सिंचाई योजना (PMKSY) सतत कृषि को बढ़ावा देने में महत्वपूर्ण भूमिका निभा रही हैं। इन योजनाओं के अंतर्गत अबतक 1,95,000 किसानों का पंजीकरण एवं प्रशिक्षण तथा 3,900 क्लस्टरों का विकास किया गया हैं। टिहरी, पौड़ी, और उत्तरकाशी जिलों में सबसे अधिक जैविक फसल उत्पादन दर्ज किया गया है। राज्य के समस्त जनपदों में 304 जैविक आउटलेट स्थापित किये गये है, जिनमे जैविक उत्पाद एकत्र कर उनका विपणन किया जा रहा हैं। इस प्रकार उत्तराखंड में सतत कृषि न केवल खाद्य सुरक्षा सुनिश्चित करने का एक प्रभावी माध्यम है, बल्कि यह आर्थिक स्थिरता और पर्यावरणीय संतुलन बनाए रखने का भी एक सशक्त मार्ग है।

मुख्य शब्दः *सतत् कृषि, जैविक खेती, मिलेट्स, प्राकृतिक खेती, पर्यावरण संतुलन*

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1. शोध छात्रा, अर्थशास्त्र विभाग, डी.ए.वी. (पी.जी.) कॉलेज, देहरादून, उत्तराखंड।
2. असिस्टेंट प्रोफेसर, अर्थशास्त्र विभाग, डी.ए.वी. (पी.जी.) कॉलेज, देहरादून, उत्तराखंड।

परिचय (Introduction)

सतत् कृषि ऐसी कृषि पद्धतियों है, जो पर्यावरण के अनुकूल होती हैं और मृदा की उर्वरता, जल संरक्षण तथा रासायनिक उर्वरको पर निर्भरता को कम करने में सहायता करती हैं। इसका उद्देश्य वर्तमान और भावी पीढ़ियों के लिए खाद्य सुरक्षा सुनिश्चित करना है। सतत् कृषि के अंतर्गत जैविक खेती, प्राकृतिक खेती, कृषि वानिकी, फसल विविधीकरण, जैव उर्वरक का उपयोग, और रेनवॉटर हार्वेस्टिंग जैसी तकनीकें शामिल होती हैं। जैविक खेती न केवल पर्यावरणीय दृष्टिकोण से टिकाऊ है, बल्कि यह मानव स्वास्थ्य के लिए भी अत्यंत लाभकारी है। रासायनिक खादों और कीटनाशकों से मुक्त उत्पादन प्रणाली शरीर में विशैले तत्वों को प्रवेश से रोकती है (Balkrishna,A.et.al.2024)| सतत् कृषि पर्यावरणीय संरक्षण, संसाधनों की दक्षता और समान आर्थिक विकास को बढ़ावा देती है।

उत्तराखंड की लगभग 70ः आबादी प्रत्यक्ष या अप्रत्यक्ष रूप से कृषि पर निर्भर है। राज्य में वर्तमान में 5.51 लाख हैक्टेयर में कृषि की जा रही हैं, जिसके अंतगर्त 2.63 लाख हेक्टेयर (48%) पर्वतीय कृषि तथा 2.88 लाख हेक्टेयर (52%) मैदानी कृषि में शामिल हैं। राज्य के गठन के समय कुल खाद्यान्न उत्पादन 16.47 लाख मैट्रिक टन था, वर्ष 2023.2024 में कुल खाद्यान्न उत्पादन 17.97 लाख मैट्रिक टन रहा हैं। उत्तराखंड की अर्थव्यवस्था में कृषि की महत्वपूर्ण भूमिका है, कृषि क्षेत्र का राज्य घरेलू उत्पाद (GDP) में योगदान 23.4ः है (कृषि विभाग, उत्तराखंड)।

उत्तराखंड राज्य प्राकृतिक द्रष्टि से सतत् कृषि के लिय बहुत उपयोगी हैं। यहाँ पर विभिन्न स्थानीय फसले, फल, जडी–बुटी, पुष्प, आदि की खेती की जाती हैं। इन फसलों के उत्पादन में रासायनिक उर्वरकों का प्रयोग नहीं किया जाता है, तथा ये जैविक फसले बहुत पौष्टिक होती हैं। उत्तराखंड जैसे राज्य में, जहाँ भौगोलिक विषमता, जलवायु और सीमित सिंचाई संसाधन बड़ी चुनौती हैं, वहाँ सतत् कृषि पद्धतियों को अपनाना खाद्य सुरक्षा, आजीविका और पारिस्थितिक तंत्र के संरक्षण के लिए आवश्यक है। राज्य में जैविक खेती, कृषि वानिकी और मोटा अनाज (जैसे रागी, मंडुआ, झंगोरा) की खेती को बढ़ावा देने से न केवल मृदा की उर्वरता में सुधार हुआ है, बल्कि रासायनिक खादों पर निर्भरता घटी है, और ग्रामीण आय में भी वृद्धि हुई है। मिलेट्स न केवल पोषण और पर्यावरण संरक्षण का स्रोत हैं, बल्कि यह जलवायु स्मार्ट फसलें बनकर सतत् कृषि और ग्रामीण अर्थव्यवस्था को नया जीवन दे सकती हैं (Singh, B. D.et.al.2024)|

शोध उद्देश्य (Objectives)

1. उत्तराखंड में सतत् कृषि की वर्तमान स्थिति का आकलन करना।
2. उत्तराखंड की अर्थव्यवस्था में सतत् कृषि की भूमिका का आकलन करना।
3. सतत् कृषि को प्रोत्साहित करने वाली योजनाओं का आकलन करना।

शोध पद्धति (Research Methodology)

यह विश्लेषण प्रगति प्रतिवेदन रिपोर्ट 2024–25 एंव बजट दिग्दर्शिका 2025–26 (कृषि विभाग, उत्तराखंड), नाबार्ड और भारतीय कृषि अनुसंधान परिषद (ICAR) जैसे द्वितीयक स्रोतों से प्राप्त आंकड़ों पर आधारित है।

अर्थव्यवस्था और सतत् कृषि (Economy and Sustainable Agriculture)

सतत् कृषि के माध्यम से अर्थव्यवस्था सुधार सुनिश्चित किया जा सकता है, विशेषकर उत्तराखंड जैसे पर्वतीय राज्य में जहाँ कृषि जलवायु और भौगोलिक परिस्थितियों पर अत्यधिक निर्भर है। सतत् कृषि प्रणाली स्थानीय संसाधनों के संरक्षण के साथ–साथ कृषकों की आय को स्थिर और दीर्घकालिक बनाती है।

उत्तराखंड की अर्थव्यवस्था में सतत् कृषि की भूमिका

- **फसल विविधीकरणः** केवल एक ही फसल पर निर्भर न रहकर कई प्रकार की फसलें उगाना, कृषि आधारित उद्योग, कृषि–पर्यटन, पशुपालन, मधुमक्खी पालन आदि, जिससे जलवायु या बाजार में बदलाव के बावजूद आय में स्थिरता बनी रहती है। उत्तराखंड राज्य में प्राचीन समय से ही कृषि में बारहनाजा जैसी पद्धतियाँ मौजूद है।
- **जैविक और प्राकृतिक खेतीः** कम लागत में अधिक लाभ और स्वास्थ्यवर्धक उत्पादों की माँग में निरंतर वृद्धि हो रही हैं। जैविक एवं प्राकृतिक खेती से किसानों की आय में उतार–चढ़ाव की संभावना कम होती है। राज्य में अधिकांश क्षेत्र में आज भी जैविक खेती ही की जा रही है।
- **स्थानीय संसाधनों का उपयोगः** उत्तराखंड राज्य प्राकृतिक संसाधनो से परिपूर्ण है। स्थानीय संसाधनों और प्राकृतिक विधियों के प्रयोग से उत्पादन लागत घटती है। सतत् कृषि के द्वारा स्थानीय पारिस्थितिकी तंत्र को सशक्त बनाने में मदद मिलती हैं।
- **विपणन में सुधारः** किसान उत्पादक संगठनों (FPOs) व सहकारी समितियों के माध्यम से उत्पादों की उचित कीमत सुनिश्चित होती है। सतत् कृषि से विपणन प्रणाली में सुधार होता है।
- उद्यमिता और मूल्य संवर्धनरू कृषि आधारित लघु उद्योगों जैसे अचार, जूस, मसाले आदि के माध्यम से अतिरिक्त आय का सृजन होता हैं। उद्यमिता और मूल्य संवर्धन में वृद्धि होती है।
- **प्राकृतिक आपदाओं से अनुकूलन क्षमताः** सतत् कृषि प्रणाली मिट्टी और जल संरक्षण को बढ़ावा देती है, जिससे सूखा या अतिवृष्टि जैसी आपदाओं से नुकसान कम होता है। पारिस्थितिकीय अनुकूल तकनीकें कृषि को जलवायु जनित जोखिमों से सुरक्षित बनाती हैं।
- **खाद्य सुरक्षा में वृद्धिः** सतत् कृषि जैसी आत्मनिर्भर कृषि व्यवस्था से खाद्य आपूर्ति स्थिर रहती है और आपदा की स्थिति में भी प्रभावित नहीं होती है।
- **रोजगार सृजनः** ग्रामीण क्षेत्रों में सतत् कृषि से युवाओं और महिलाओं के लिए नए रोजगार के अवसर उपलब्ध होते हैं।

उत्तराखंड में सतत् कृषि की वर्तमान स्थिति (Current status of sustainable agriculture in Uttarakhand)

- उत्तराखंड में कृषि भूमि का आकार छोटे और बिखरे हुए खंडों में विभाजित है, जिससे यंत्रीकरण और उत्पादन क्षमता प्रभावित होती है। इसके बावजूद राज्य जैविक कृषि की दिशा में अग्रसर हैं। उत्तराखंड के कई क्षेत्रों ने सतत् कृषि के माध्यम से आर्थिक लाभ अर्जित किए हैं। उदाहरणस्वरूप,

अल्मोड़ा और रानीखेत जैसे क्षेत्रों में जैविक खेती करने वाले गाँवों ने अपने उत्पादों के लिए राष्ट्रीय और अंतरराष्ट्रीय बाजारों में बेहतर मूल्य प्राप्त किए हैं। पौड़ी गढ़वाल में कृषि वानिकी को बढ़ावा देने से न केवल आय में वृद्धि हुई है बल्कि वनों का संरक्षण भी सुनिश्चित हुआ है।

- उत्तराखंड सरकार की प्रगति प्रतिवेदन रिपोर्ट (2024–25) के अनुसार, राज्य में जैविक खेती का क्षेत्र लगभग 2.23 लाख हेक्टेयर तक पहुँच चुका है। परम्परागत कृषि विकास योजना (PKVY) के अंतर्गत प्रथम व द्रितीय चरण में लगभग 2,24,250 किसान पंजीकृत हैं।
- टिहरी गढ़वाल, पौड़ी, और उत्तरकाशी जिलों में सबसे अधिक जैविक फसल उत्पादन दर्ज किया गया है।
- उत्तरकाशी, पिथौरागढ़ और अल्मोड़ा में सेब, कीवी और अखरोट जैसी उच्च मूल्य फसलों के उत्पादन से वार्षिक आय में 20% से अधिक की बढ़ोतरी हुई है।
- राज्य में फलोत्पादन, औषधीय पौधे और मोटे अनाज उत्पादन को बढ़ावा मिला है। कुछ जिलों में कृषि–पर्यटन एवं सहकारी समितियों के माध्यम से किसान लाभान्वित हो रहे हैं।
- राज्य के समस्त जनपदों में 304 जैविक आउटलेट स्थापित किये गये है, जिनमे जैविक उत्पाद एकत्र कर उनका विपणन किया जा रहा है।
- राज्य जैविक कृषि प्रशिक्षण केंद्र मजखाली, अल्मोड़ा द्वारा 706 प्रशिक्षण का आयोजन करा चुके है।
- सेन्टर ऑफ एक्सीलेंसी ऑफ आर्गेनिक फार्मिंग नामक सेन्टर का निर्माण जनपद टिहरी में किया जा रहा है।
- राज्य में मिलेट उत्पादन 2000–2001 में 12.71 कुल प्रति है0 था, जो की वर्ष 2023–2024 में 15.39 कुल प्रति है0 हुआ है, जिसमे राज्य मिलेट मिशन ने विशेष मदद की है।
- राज्य की 13 फसलों को भौगोलिक पहचान (GI) टैग दिया जा चुका है, जिसमें देहरादूनी बासमती, लाल धान, काला भट्ट, बुरांश, तोर दाल, माल्टा आदि शामिल है। उत्तराखंड अपनी दो मिलेट्स मंडुआ व झंगोरा के लिये भौगोलिक पहचान (GI) टैग प्राप्त करने वाला पहला राज्य है।
- उत्तराखंड जैविक उत्पाद परिषद दवारा विभिन्न जैविक उत्पादों के विपणन के लिये अनेक प्रयास किये जा रहे है। जैविक उत्पादों का भिन्न–भिन्न माध्यमो से वार्षिक विपणन इस प्रकार हैं–

वर्ष	जैविक उत्पादों का विपणन (लाख रु. में)	वितरित किये गये जैविक उत्पादों के नाम
2020-21	1512.09	गेहूँ, बासमती धान, मंडुआ, सोयाबीन, गन्ना, रामदाना, राजमा, मिर्च, हल्दी आदि
2021-22	1423.00	
2022-23	1462.00	
2023-24	1257.50	
2024-25	1387.54	

(स्रोतः प्रगति प्रतिवेदन रिपोर्ट 2024.2025ए कृषि विभाग, उत्तराखंड)

सतत् कृषि को प्रोत्साहित करने वाली योजनाएँ (Schemes to promote sustainable agriculture)

इन योजनाओं से किसानों को जैविक उत्पादों की ओर स्थानांतरित करने, पर्यावरणीय संरक्षण, आय वृद्धि, और विपणन प्रणाली में सुधार हेतु कई सकारात्मक प्रभाव देखने को मिले हैं। उत्तराखंड सरकार द्वारा सतत् कृषि को प्रोत्साहित करने वाली कई योजनाएँ चलाई जा रही हैं, जिनमे से कुछ निम्नलिखित है–

- **परंपरागत कृषि विकास योजना (PKVY):** परंपरागत कृषि विकास योजना केंद्र सरकार की एक योजना है जिसका उद्देश्य जैविक खेती को बढ़ावा देना है। इस योजना के जरिए मिट्टी की सेहत बेहतर होती है और किसानों की आय बढ़ती है। किसानों को जैविक खेती के लिए आर्थिक सहायता एवं प्रशिक्षण प्रदान करती है। उत्तराखंड में इस योजना के अंतर्गत प्रथम चरण (2015–16 से 2017–18) तक 585 कलस्टरो तथा द्वितीय चरण (2018–19 से 2024–25) तक 3900 कलस्टरो में कार्य चल रहा है, जिसमे कृषि, जैविक उत्पाद परिषद, उद्यान विभाग, सगन्ध पौधा केंद्र, रेशम विभाग द्वारा कार्य किया जा रहा है।
- **राष्ट्रीय कृषि विकास योजना (RKVY):** यह राज्यों को कृषि क्षेत्र में व्यापक अवस्थापना विकास के लिए सहयोग प्रदान करती है। इस योजना के अन्तर्गत कृषि विभाग एंव उत्तराखंड जैविक उत्पाद परिषद द्वारा उत्पादों का जैविक प्रमाणीकरण किया जा रहा है। इसके अंर्तगत प्रत्येक विकासखंड में जैविक कृषि कार्यो के सम्पादन व प्रशिक्षण के लिये 1.1 मास्टर ट्रेनर द्वारा सहायता प्रदान की जाती है।
- **प्रधानमंत्री कृषि सिंचाई योजना (PMKSY):** यह योजना जल प्रबंधन और सूक्ष्म सिंचाई के माध्यम से जल उपयोग दक्षता को बढ़ावा देती है। इसमें 'हर खेत को पानी' 'पर ड्राप मोर क्रॉप', जलागम विकास शामिल है।
- **किसान उत्पादक संगठन (FPO):** यह किसानों को एकजुट कर उत्पादन, प्रसंस्करण और विपणन में सामूहिक ताकत प्रदान करती है। उत्तराखंड सरकार किसानों को संगठित और आत्मनिर्भर बनाने के लिए 162 नए FPO स्थापित कर रही है।
- **पर्वतीय कृषि नीति:** इसमें उत्तराखंड की भौगोलिक विविधता के अनुरूप नीति बनाकर कृषि क्षेत्र को सशक्त करना शामिल हैं। इसके अंतर्गत पारंपरिक फसलों को बढ़ावा देना, कृषि भूमि का संरक्षण, जैविक खेती को प्रोत्साहित करना आदि शामिल है।
- **नेशनल मिशन ऑन नेचुरल फार्मिगः** प्रकृतिक खेती का उद्देश्य उत्पादन लागत को लगभग शून्य तक लाना है। प्रदेश में इसके अंर्तगत 39 कलस्टरो का जनपद पौड़ी, टिहरी, उत्तरकाशी व चमोली में किया जा रहा है।
- **उत्तराखंड जैविक उत्पाद परिषद (UOCR) :** इसका गठन 2003 में किया गया, जो जैविक कृषि से सम्बंधित अभिलेखन का कार्य, तकनीकी प्रशिक्षण, विपणन आदि का कार्य देखता है। इसी के द्वारा ही राज्य जैविक मिशन (State Organic Mission) भी चलाया गया है, जिसका उद्देश्य उत्तराखंड को भारत की जैविक राजधानी बनाना है।

सतत् कृषि के समक्ष चुनौतियाँ (Challenges facing sustainable agriculture)

उत्तराखंड में सतत् कृषि के अनेक लाभ हैं, लेकिन अनेक चुनौतियाँ भी है जो निम्नलिखित है–

1. पहाड़ी क्षेत्रों में खेत छोटे व बिखरे होते हैं, जिससे आर्थिक पैमाने पर कृषि करना कठिन हो जाता है।
2. ग्रामीण क्षेत्रों में किसानों को बाजार की जानकारी और परिवहन सुविधा न होने से उत्पाद की उचित कीमत नहीं मिलती है।
3. भूस्खलन, भारी वर्षा और सूखा जैसे आपदाएँ किसानों की आर्थिक स्थिति को ओर कमजोर करती हैं।
4. सतत् कृषि को भंडारण तथा विपणन चुनौतियों का सामना करना पड़ सकता है क्योंकि जैविक उत्पाद के लिये उचित प्रबंधन एवं पैकेजिंग की आवश्यकता होती है।
5. सतत् कृषि के लिए जरूरी वित्तीय सहायता और फसल बीमा तक किसानों की सीमित पहुँच है।
6. सतत् कृषि के लिए जरूरी तकनीकों की जानकारी और प्रशिक्षण की कमी से उत्पादन और आय दोनों प्रभावित होते हैं।
7. नीतियों की असंगतता या क्रियान्वयन में अनेक समस्याएँ है, जिनका लाभ वास्तविक जरूरतमंद किसानों तक नहीं पहुँच पाता हैं।
8. किसानों की पारंपरिक सोच, जोखिम लेने का डर, तथा आधुनिक तकनीक तक पहुँच की कमी और न्यूनतम जागरूकता सतत् कृषि को बाधित करती है।
9. सतत् कृषि के कार्यान्वन में और उपज प्राप्त करने में सामान्य कृषि की तुलना में अधिक समय लगता है।
10. सतत् कृषि के लिये बुनियादी ढाँचे, उपकरण व इनपुट जैसे सिंचाई प्रणाली, सूक्ष्म सिंचाई उपकरण, जैविक उर्वरक एवं बीज में उच्च निवेश व वित्तीय संसाधनों की आवश्यकता हो सकती है।

सतत् कृषि के लिए सिफारिशें (Recommendations for Sustainable Agriculture)

- **जैविक और प्राकृतिक खेती का विस्तार** : स्थानीय संसाधनों का उपयोग कर रसायन मुक्त खेती को अपनाना, जिससे उत्पादन लागत घटे और उत्पाद का मूल्य बढ़े। किसानों को सतत् कृषि के आर्थिक लाभों के प्रति जागरूक करना।
- **कृषि विविधीकरण को प्रोत्साहनः** पारंपरिक फसलों के साथ–साथ औषधीय पौधों, फलों, सब्जियों और मोटे अनाज की खेती को बढ़ावा देना।
- **स्थानीय बाजारों और FPOs का सशक्तीकरणः** किसान उत्पादक संगठनों FPO और स्थानीय मंडियों के माध्यम से सामूहिक विपणन कर ओर बेहतर मूल्य प्राप्ति की जा सकती हैं।
- **डिजिटल तकनीकों का समावेशनः** किसानों को मोबाइल ऐप, मौसम पूर्वानुमान, ई–नाम, और डिजिटलीकरण के माध्यम से सशक्त बनाना चाहिए।

- **सूक्ष्म सिंचाई प्रणाली का विस्तारः** ड्रिप और स्प्रिंकलर जैसी तकनीकों को बढ़ावा देकर जल की बचत और उत्पादकता में वृद्धि।
- **कृषि शिक्षा और युवा भागीदारी, नवाचारः** युवाओं को आधुनिक कृषि से जोड़ने के लिए प्रशिक्षण, स्टार्टअप समर्थन और प्रोत्साहन योजनाएँ। सतत् कृषि प्रौद्योगिकियों और प्रथाओं के अनुसंधान तथा विकास में निवेश करना।
- **बुनियादी ढांचे में निवेशः** सिंचाई, ग्रामीण सड़कें, कोल्ड स्टोरेज और विपणन आदि को मजबूत किया जाना चाहिए।
- **मूल्यवर्धन और कृषि प्रसंस्करणः** स्थानीय उत्पाद जैसे फल जेम, अचार, हर्बल उत्पाद आदि के प्रसंस्करण हेतु लघु उद्योगों को सहयोग। नवाचारों और कृषि स्टार्टअप्स को बढ़ावा देना।
- **नीतिगत समर्थनः** सब्सिडी, ऋण, और फसल बीमा योजनाओं तक पहुँच सुनिश्चित करना। राज्य स्तरीय 'सतत् कृषि नीति' का निर्माण और प्रभावी क्रियान्वयन किया जाना चाहिए।

निष्कर्ष (Conclusion)

उत्तराखंड जैसे पर्वतीय राज्य में सतत् कृषि न केवल पर्यावरणीय संरक्षण का माध्यम है, बल्कि यह अर्थव्यवस्था का विकास सुनिश्चित करने की एक सशक्त रणनीति भी है। राज्य की भौगोलिक विषमताओं, सीमित संसाधनों और जलवायु अनिश्चितताओं को देखते हुए सतत् कृषि पद्धतियाँ एक व्यवहारिक और आवश्यक विकल्प के रूप में उभरती हैं। जैविक खेती, फसल विविधीकरण, स्थानीय संसाधनों का उपयोग, कृषि–पर्यटन और मिलेट्स जैसे पौष्टिक अनाजों की खेती ने राज्य में ग्रामीण आजीविका को सशक्त बनाने में महत्वपूर्ण योगदान दिया है। सरकार द्वारा चलाई जा रही योजनाएँ, राज्य को जैविक राजधानी बनाने की दिशा में सार्थक प्रयास हैं। हालांकि, कई संरचनात्मक व सामाजिक चुनौतियाँ अब भी बनी हुई हैं, जैसे छोटी जोतों की समस्या, बाजार व प्रशिक्षण की कमी, तथा आधुनिक तकनीकों तक सीमित पहुँच। अतः यह स्पष्ट है कि सतत् कृषि उत्तराखंड की आर्थिक संरचना को स्थिरता और सशक्तता प्रदान कर सकती है। यदि इसे समुचित नीति समर्थन, नवाचार और सामाजिक सहभागिता के साथ आगे बढ़ाया जाए, तो यह न केवल राज्य की खाद्य सुरक्षा, पर्यावरण संरक्षण और आजीविका में सुधार लाएगी, बल्कि उत्तराखंड को सतत् विकास के एक आदर्श मॉडल के रूप में स्थापित करेगी।

संदर्भ (References)

1. Balkrishna, A., Arya, V., Bhat, R., Chaudhary, P., Mishra, S., Kumar, A., & Gautam, A. K. (2024). Organic farming for sustainable agriculture and public health: Patanjali's perspective. Vegetos, 37(6), 2220-2229.
2. Gupta, N., Pradhan, S., Jain, A., & Patel, N. (2021). Sustainable agriculture in India 2021. Council on Energy, Environment and Water.
3. Priya, & Singh, S. P. (2024, January). Factors influencing the adoption of sustainable agricultural practices: a systematic literature review and lesson learned for India. In Forum for Social Economics (Vol. 53, No. 1, pp. 1-17). Routledge.

4. Singh, B. D., Abhishek, G. J., Priya, P., Kumar, S., Shinde, S. P., Kumar, S., & Pandey, A. K. (2024). Millets as an ancient grains for modern food security and sustainable agriculture. J. Sci. Res. Rep, 30, 706-714.

5. Sustainable Agriculture.Online artical by Drishtiias. https://www.drishtiias.com/hindi/daily-updates/daily-news-analysis/sustainable-agriculture-2.

6. Sustainable Agriculture.Online artical by Prepp by collegedunia. https://prepp.in/news/e-492-sustainable-agriculture-agriculture-notes

7. आर्थिक सर्वेक्षण उत्तराखंड 2023.24, वित्त विभाग, उत्तराखंड शासन।

8. उत्तराखंड राज्य जैविक मिशन, कृषि विभाग, उत्तराखंड।

9. परंपरागत कृषि विकास योजना (PKVY), कृषि एवं किसान कल्याण मंत्रालय, भारत सरकार।

10. प्रगति प्रतिवेदन रिपोर्ट 2024.2025 एंव बजट दिग्दर्शिका 2025.2026, कृषि विभाग, उत्तराखंड सरकार।

11. भारतीय कृषि अनुसंधान परिषद (ICAR) की सतत् कृषि संबंधी रिपोर्टें।

12. राष्ट्रीय कृषि और ग्रामीण विकास बैंक (NABARD) की ग्रामीण कृषि रिपोर्टें।

मानव जीवन पर जलवायु परिर्वतन के प्रभाव

डॉ0 अलका श्रीवास्तव [1]

सारांश

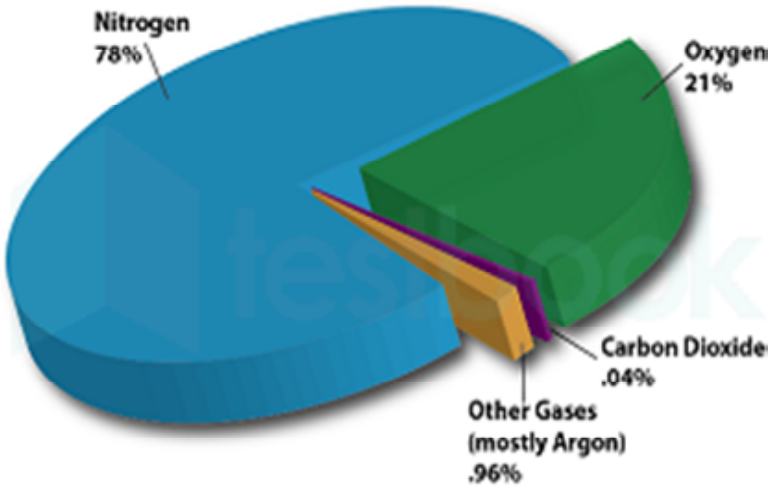
प्रकृति की सुन्दरता का कोई जोड़ नही है, वह हर रुप में सुन्दर है। प्रकृति हमें स्वस्थ वातावरण प्रदान करती है और इसी तरह परिवर्तन प्रकृति का नियम है, चाहे वो समय का हो, जीवन में हो या फिर जलवायु में। वो कुछ नया लेकर आता है और हमें अप्रत्याशित घटनाओं से अवगत कराता है। अगर बात जलवायु परिवर्तन की हो तो जलवायु परिवर्तन से तात्पर्य तापमान और मौसम के अलग अलग स्वरुपों में दीर्घकालिक बदलाव से है जो प्राकृतिक भी हो सकता और मानवीय भी। प्राकृतिक कारणों मे बाढ़, भूकम्प और ज्वालामुखी और मानवीय गतिविधियों में कोयला, तेल, गैस तथा जीवाश्म ईधनों के जलने के कारण। प्रस्तुत शोध पत्र "मानव जीवन पर जलवायु परिर्वतन के प्रभाव" को तीन भागों में विभाजित किया गया है। प्रथम खण्ड में विषय से संबंधित प्रस्तावना की विवेचना, शोध का उद्देश्य तथा शोध विधि है। द्वितीय खण्ड में शोध के अध्ययन क्षेत्र तथा समस्या एवं निराकरण को लिया गया है तथा तृतीय खण्ड में सुझाव तथा ग्रन्थ सूची को रखा गया है।

प्रथम खण्ड

प्रस्तावना का विवेचना, शोध का उद्देश्य तथा शोध विधि

हमारी सोच है कि जलवायु परिवर्तन का मुख्य अर्थ है–गर्म तापमान, लेकिन यह सही नही है बल्कि तापमान तो शुरुआत है। हमारी पृथ्वी तो एक धुरी मात्र है जिससे सब कुछ जुड़ा है, इसलिए एक क्षेत्र में होने वाला परिवर्तन अन्य क्षेत्रों में होने वाले परिवर्तनों को प्रभावित कर सकता है। जलवायु परिवर्तन का महत्वपूर्ण कारण जीवाश्म ईधनों के जलने से ग्रीन हाउस गैसों का उत्सर्जन होता है जो पृथ्वी के चारों ओर एक कम्बल की तरह कार्य करता है, जो सूर्य की गर्मी को रोक लेता है और तापमान को बढ़ाता है। ग्रीन हाउस गैसों में मुख्यतः कार्बन डाइआक्साइड तथा मीथेन शमिल होता है। इन गैसों के निकलने के अलग अलग स्रोत्र होते हैः–कार चलाने के लिए गैसोलीन या इमारत को गर्म करने के लिए कोयले का उपयोग करने से ये गैस निकलती है, जंगलों को काटने से भी कार्बनडाइआक्साइड निकलती है। इस प्रकार पृथ्वी पर गैसों का प्रतिशत निम्न है जैसे नाइट्रोजन 78 प्रतिशत, आक्सीजन 21 प्रतिशत, कार्बनडाइआक्साइड 0.04 प्रतिशत, अन्य 0.96 प्रतिशत है।

1. सहायक आचार्य, अर्थशास्त्र एवं ग्रामीण विकास विभाग, डॉ0 राममनोहर लोहिया अवध विश्वविद्यालय, अयोध्या, उ0प्र0।



पर्यावरण में गैसों का अलग– अलग महत्व उसी प्रकार से होता है, जिस प्रकार से जलवायु परिवर्तन हमारे स्वास्थ्य, भोजन उगाने की क्षमता, आवास सुरक्षा और काम को प्रभावित कर रहा है। हमारी तरह ही छोटे द्वीप देशों और अन्य विकासशील देशों में रहने वाले लोग भी जलवायु प्रभावों के प्रति अधिक संवेदनशील है। समुद्रीस्तर में वृद्वि के कारण लोगों को स्थानान्तरित होना पडता है और सूखे के कारण लोगों को अकाल का खतरा रहता है। जलवायु परिवर्तन की तरह ग्लोबल वार्मिंग या वैश्विक तापमान के लिए भी कही ना कही मनुष्य जिम्मेदार है। पिछले 200 दशकों में वैश्विक तापमान में वृद्धि हुई है, जिसका मुख्य कारण मानवीय गतिविधियाँ है जिससे ग्रीन हाउस गैसें पैदा हो रही है जो कम से कम दो हजार वर्षों में , किसी भी समय की तुलना में दुनिया को तेजी से गर्म कर रही है।



पृथ्वी की सतह का औसत तापमान अब 1800 के दशक लगभग औद्योगिक क्रान्ति से पहले (लगभग सन् 1890) की तुलना में लगभग 1.2 डिग्री सेल्सियस और पिछले 1,00,000 वर्षों में किसी भी समय की तुलना में अधिक गर्म है।



जलवायु परिवर्तन के कारण बनने बाले उत्सर्जन दुनिया के हर हिस्से में आते है और सभी को प्रभावित करते है, लेकिन कुछ देश दूसरों की तुलना में अधिक उत्सर्जन करते है। विश्व मौसम विज्ञान संगठन के अनुसार 2025 में ग्लोबल वार्मिंग का सबसे बड़ा उत्सर्जक देश चीन है। चीन कार्बन डाइआक्साइड उत्सर्जन का सबसे बड़ा स्रोत्र है और 2023 में इसने 11,093 मिलियन मीट्रिक टन उत्सर्जित किया है। इस आधार पर कुछ तथ्य है :–

- चीन दुनिया में सबसे बड़ा कार्बन डाइआक्साइड उत्सर्जक देश है और इसका प्राथमिक स्रोत्र जीवाश्म ईधन खासकर कोयला है।
- अमेरिका दूसरा सबसे बड़ा उत्सर्जक देश है जो सभी वैश्विक CO_2 उत्सर्जन का लगभग 13% उत्सर्जन करता है।
- अन्य देशों में भारत, रुस और जापान है।

उद्देश्यः– प्रस्तुत शोध–पत्र "मानव जीवन पर जलवायु परिर्वतन के प्रभाव" के निम्न उद्देश्य हैः–

- मानव जीवन पर जलवायु परिवर्तन के प्रभाव को जानना।
- कृषि उत्पादकता पर जलवायु परिवर्तन के प्रभाव।
- भविष्य में आने वाले प्राकृतिक आपदा का उपाय ढूढ़ना।

परिकल्पना :– प्रस्तुत शोध–पत्र "मानव जीवन पर जलवायु परिर्वतन के प्रभाव" में प्राथमिक तथा द्वितीयक आकड़ों पर आधारित है तथा समाचार पत्र, मैगजीन, इन्टरनेट प्रतियोगिता दर्पण आदि का प्रयोग किया गया है।

द्वितीय खण्ड

शोध के अध्ययन क्षेत्र तथा समस्या एवं निराकरण

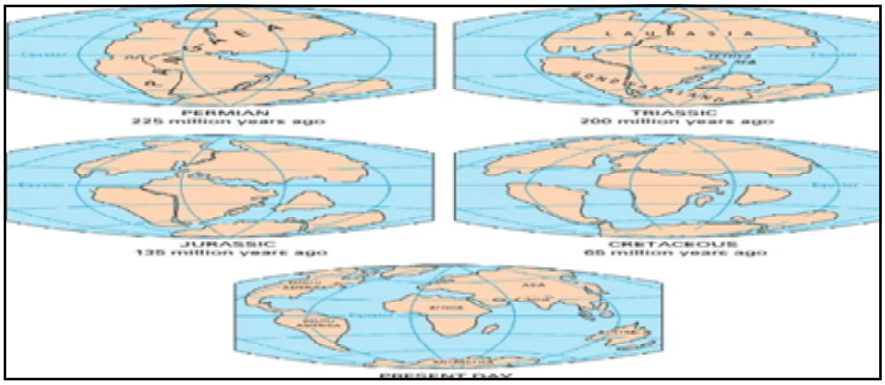
यह माना जा रहा है कि 21वीं सदी तक भारत समेत अमेरिका, कनाडा, जापान, न्यूजीलैंड और रुस जैसे सभी देशों की अर्थव्यवस्थाएँ जलवायु परिवर्तन के असर से अछूती नही रहेगी। कुछ समय पूर्व

कैम्बिज विश्वविद्यालय की एक शोध टीम ने 174 देशों के वर्ष 1960 के बाद जलवायु संबंधी आँकडों का अध्ययन किया है। अध्ययन के अनुसार, पृथ्वी पर 1.5 डिग्री सेल्सियस से अधिक तापमान की स्थिति में विभिन्न देशों की अर्थव्यवस्थाओं के साथ–साथ मानव के अस्तित्व पर भी खतरा उत्पन्न हो जाएगा। इसके अतिरिक्त पिछली सदी से अब समुद्र के जल स्तर में भी लगभग 8 इंच की बढ़ोतरी दर्ज की गई है। वही संयुक्त राष्ट्र आपदा जोखिम न्यूनीकरण कार्यालय के अनुसार, भारत को जलवायु परिवर्तन के कारण हुई प्राकृतिक आपदाओं से वर्ष 1998–2017 के बीच की समयावधि के दौरान लगभग 8,000 करोड़ डॉलर की आर्थिक क्षति का सामना करना पड़ा है। यदि पूरी दुनिया की बात की जाए तो इसी समयावधि में तकरीबन 3 लाख करोड़ की क्षति हुई है। हाल ही में जलवायु परिवर्तन पर संयुक्त राष्ट्र फ्रेमवर्क के तत्वाधान में आयोजित COP - 25 सम्मेलन में जलवायु परिवर्तन के प्रभावों से निपटने के लिए विभिन्न दिशा–निर्देश जारी किये गए। जनरल क्लाइमेट चेंज में प्रकाशित अध्ययन में कहा गया है कि वैश्विक तापमान को अगर नहीं रोका गया तो हमें कई प्रकार की समस्या का सामना करना पड़ेगा। जलवायु परिवर्तन के मुख्यतः दो कारण हैः– प्राकृतिक कारण एवं मानवीय कारण ।

प्राकृतिक कारण

हमारे जीवन में जलवायु का बहुत महत्व है। हर मौसम का हमारे लिए अलग महत्व है जलवायु परिवर्तन के प्राकृतिक कारण निम्न है

महाद्वीप संवहन :– सृष्टि के प्रारम्भ में सभी महाद्वीप एक ही बड़े धरातल के रुप में पृथ्वी पर विद्यमान थे किन्तु सागरों के कारण धीरे धीरे वे एक–दूसरे से दूर होते गए और आज उनके अलग अलग खण्ड बन गए है।



महाद्वीपीय संवहन अर्थात् महाद्वीपों का खिसकना अब भी जारी है जिसकी वजह से समुद्री धाराएँ तथा हवाएँ प्रभावित होती है और इनका सीधा प्रभाव पृथ्वी की जलवायु पर पड़ता है।

पृथ्वी का झुकावः– पृथ्वी के झुकाव के कारण ऋतुओं में परिवर्तन होता है। अधिक झुकाव अर्थात् अधिक गर्मी तथा अधिक सर्दी ओर कम झुकाव अर्थात् कम गर्मी तथा कम सर्दी का मौसम। इस प्रकार पृथ्वी के झुकाव के कारण जलवायु प्रभावित होती है।



समुद्री धाराएँ :– जलवायु को संतुलित रखने में सागरों का बड़ा योगदान रहता है। पृथ्वी के 71 प्रतिशत भाग में समुद्र व्याप्त है, जोकि वातावरण तथा जमीन की तुलना में दोगुना सूर्य का प्रकरण का अवशोषण करते है। वायुमंडल की अपेक्षा 50 गुना अधिक कार्बन डाइऑक्साइड गैस समुद्र में होती है। समुद्री बहाव में बदलाव आने से जलवायु प्रभावित होती है।



मानवीय कारण

जलवायु परिवर्तन में मानवीय कारकों को "मानवीय जलवायु परिवर्तन" या "मानवजनित जलवायु परिवर्तन" कहते है। यह मानव गतिविधियों द्वारा उत्पन्न ग्रीनहाउस गैसों के कारण होता है, जो पृथ्वी के वातावरण में फंस जाती है और इसे गर्म करती है:–

जीवाश्म ईधनों का उपयोगः— ऊर्जा, परिवहन और उद्योग के कोयला, तेल और गैस जीवाश्म ईधनों का जलाना सबसे बड़ा योगदानकर्ता है।



वनों की कटाई :— पेड़ कार्बन डाइआक्साइड को अवशोषित करते है, लेकिन वनों की कटाई से यह

क्षमता कम हो जाती है और पहले से संग्रहीत कार्बन भी वातावरण में छोड़ दिया जाता है।



कृषिः— जलवायु परिवर्तन कृषि के लिए एक बडी चुनौती है मौसम का बेमौसम आना हमारे देश में ही नही अन्य देशों को भी प्रभावित करती है जैसे जलवायु परिवर्तन के कारण ही संयुक्त राज्य अमेरिका में फसलों की उत्पादकता में कमी आयी है जबकि दूसरी तरफ बेमौसम और औसत से कम बारिश के कारण 2023—24 में करीब सभी खरीफ फसलों पर असर पड़ा है।

औद्योगीकरण :— जलवायु परिवर्तन में औद्योगीकरण बड़ी भूमिका है। विभिन्न प्रकार की मीले वातावरण में विभिन्न प्रकार की गैसे छोडती है, जो वातावरण में काफी वर्षों तक विद्यमान रहती है और ओजोन परत क्षरण का कारण बनती है।

मानव स्वास्थ्य पर प्रभाव :– गर्मी की लहरें, संक्रामक रोग और असुरक्षा जैसे मानव स्वास्थ्य पर भी जलवायु परिवर्तन का प्रभाव पड़ रहा है।

निष्कर्षतः कहा जा सकता है कि जलवायु परिवर्तन में प्राकृतिक कारक एवं मानविकी कारक प्रमुख भूमिका निभाते है और इसके प्रभावों को रोकने के लिए ग्रीनहाउस गैस उत्सर्जन को कम करना आवश्यक है। जलवायु परिवर्तन के प्राकृतिक एवं मानविकी कारकों के अलावा ये भी जानना आवश्यक है कि जलवायु परिवर्तन किस प्रकार दुनिया को प्रभावित करेगा अगर वैश्विक तापमान वृद्वि को 1.5C के भीतर नही रखा गया :–

- ब्रिटेन और यूरोप अत्यधिक बारिश की वजह से भयानक बाढ़ की चपेट में आ जाएगे।
- मध्य पूर्व के देश अत्यधिक गर्मी की लहरों और व्यापक सूखे का अनुभव करेगे।
- प्रशान्त क्षेत्र के द्वीप राष्ट्र समुद्र में डूब सकते है।
- कई अफ्रीकी देशों को सूखे और भोजन की कमी का सामना करना पड़ सकता है।

जलवायु परिवर्तन को रोकने के उपाय :– जलवायु परिवर्तन को रोकने के लिए, ग्रीनहाउस गैस उत्सर्जन को कम करना और नवीनीकरणीय ऊर्जा का उपयोग बढ़ाना महत्वपूर्ण है। साथ ही व्यक्तिगत तौर पर, हम परिवहन, भोजन, ऊर्जा और कचरे के संबंध में बदलाव करके भी योगदान दे सकते है। जलवायु परिवर्तन को रोकने के उपाय मुख्य हैः–

परिवहन पैदल चलने या साइकिल चलाना या ई–वाहन या हाइब्रिड कार का उपयोग करे। अगर संभव हो तो हवाई यात्रा की जगह ट्रेन यात्रा करने से जलवायु परिवर्तन को रोका जा सकता है।

भोजन मांस और डेयरी उत्पादों का सेवन कम करे या शाकाहारी आहार अपनाएं और भोजन की बर्बादी को कम करे।

ऊर्जा सौर ऊर्जा या पवन ऊर्जा जैसे नवीनीकरण ऊर्जा स्रोत्रो का उपयोग करे और ऊर्जा–कुशल उपकरण और एलईडी बल्ब का उपयोग करे एवं जब उपयोग न हो तो इलेक्ट्रॉनिक उपकरणों को अनप्लग करे।

कचरा कचरे को कम करने के लिए रीसाइकल करना तथा सुपरमार्केट से अतिरिक्त भोजन न फेकने का सुझाव दे एवं रेस्तरां में "डॉगी बेग्स" का अनुरोध करें।

पेड अधिक से अधिक पेड लगाए तथा वनों की कटाई को रोके और प्राकृति आवासों की रक्षा करें।

अन्य ऊर्जा–कुशल उपकरणों का उपयोग करे और अपनी ऊर्जा की खपत को कम करें और ग्रीनहाऊस गैस उत्सर्जन को कम करने के लिए सरकार और कम्पनियों पर दबाव डाले एवं द नेचर कंजरवेंसी के अनुसार, प्राकृतिक आवासों की रक्षा करके और कृषि भूमि और जंगलों का सावधानी प्रबंधन करके हम कार्बन को संग्रहीत कर सकते है।

तृतीय खण्ड

सुझाव तथा ग्रन्थ सूची :– जलवायु परिवर्तन का प्रभाव कम करने के उपाय निम्न है :–

- जैविक एवं समग्रित खेती
- उत्पादन की नई तकनीक का विकास
- जलवायु स्मार्ट कृषि
- वर्षा जल के उचित प्रबन्धन द्वारा
- मौसम पूर्वानुमान द्वारा

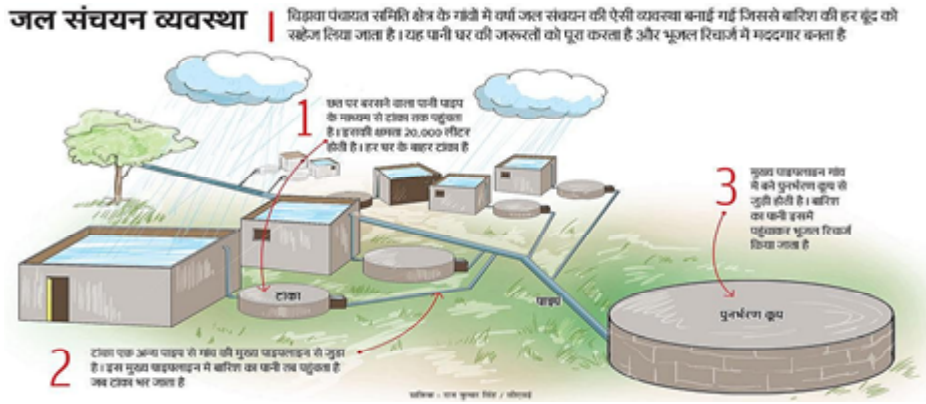
जैविक एवं समग्रित खेती :– रासायनिक खेती से हरित गैसों के उत्सर्जन में वृद्धि होती है और कीटनाशक, रासायनिक खाद के इस्तेमाल से मृदा की उत्पादकता घटती है और मानव शरीर में पहुँचकर शरीर में बीमारियाँ उत्पन्न करती है। अतः नई–नई तकनीकों को बढ़ावा देना चाहिए।

उत्पादन की नई तकनीक का विकास :– अगर हम फसलों के प्रारुप और बीज बोने के समय में परिवर्तन करे एवं नई तकनीक को अपनाकर वर्षा जल संरक्षण, मिश्रित खेती व इन्टरक्रापिंग करके जलवायु परिवर्तन के प्रभाव से निपट सकते है।

जलवायु स्मार्ट कृषि :– देश में जलवायु स्मार्ट कृषि (Climate Smart Agriculture-CSA) विकसित करने की एक मजबूत शुरुआत की गई है। यह योजना खाद्य सुरक्षा और जलवायु परिवर्तन की चुनौतियों का सामना करने के लिए बनाई गई है, जो तीन परिणामों को बताती है जैसे उत्पादकता में वृद्धि, लचीनेपन में वृद्धि तथा अनिश्चित मौसम पैर्टन।



वर्षा जल के उचित प्रबन्धन द्वारा :– जलवायु परिवर्तन से तापमान में वृद्धि होती है। ऐसे में वर्षा जल को एकत्रित करना सिंचाई हेतु उपयोगी कदम हो सकता है। वाटर शेड प्रबंधन से हम वर्षा जल को सिंचाई के रुप 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 से होने वाले नुकसान को कम कर सकते है। जिले स्तर पर प्रत्येक कृषि विज्ञान केन्द्र पर जिला कृषि मौसम इकाई की स्थापना की गयी है, जो मौसम की जानकारी उपलब्ध कराता है।

इसी दिशा में भारत सरकार द्वारा प्रयास किया गया। जलवायु परिवर्तन के लिए 2008 में राष्ट्रीय कार्ययोजना जारी की गई। इसके अलावा सभी का मानना है कि जलवायु परिवर्तन से केवल एक साथ काम करके ही निपटा जा सकता है। 2015 में पेरिस में एक ऐतिहासिक समझौते में ग्लोबल वार्मिंग को 1.5 डिग्री सेल्सियस तक रखने की कोशिश करने का संकल्प लिया था तथा नवंबर 2022 में मिस्र ने कॉप–27 नाम की एक शिखर सम्मेलन की मेजबानी और कई देशों ने 2050 तक "नेट जीरो" लक्ष्य को प्राप्त करने का संकल्प किया है, इसका अर्थ है ग्रीनहाउस गैस उत्सर्जन को जितना संभव हो उतना कम करना और बाकी उत्सर्जन को वातावरण से बराबर मात्रा में सोखकर कर संतुलित करना । पर्यावरणीय विशेषज्ञों का मानना है कि अब भी पर्यावरण को इन खतरों से बचाया जा सकता है लेकिन सरकारों, व्यवसायों और नागरिकों को अब पर्याप्त परिवर्तन करने की जरुरत है। इस प्रकार अगर हम व्यक्तिगत तौर पर कुछ बातों का अनुसरण करे तो जलवायु परिवर्तन के प्रभाव को सीमित कर सकते है जैसे :–

- कम वायुयान का प्रयोग करे।
- कार का इस्तेमाल न करे या इलेक्ट्रिक कार का प्रयोग करे।
- मांसाहारी और डेयरी प्रोडक्ट के इस्तेमाल में कटौती करे।
- ऊर्जा जरुरतों में कटौती करे।

ग्रन्थ सूची

- जलवायु परिवर्तन (एक संक्षिप्त विवेचना), डॉ0 उमेश बिहारी माथुर
- जलवायु परिवर्तन, डॉ0 दिनेश मणि
- जलवायु परिवर्तन अनुरुप कृषि
- भारतीय अर्थव्यवस्था, प्रो0 एस0 एन0 लाल
- जलवायु परिवर्तनः चुनौतियाँऔर समाधान–दृष्टि

भारत में समावेशी विकास : अवधारणा, समस्याएँ एवं चुनौतियाँ

डॉ0 शिव कुमार लाल [1]

सारांश

समावेशी विकास की अवधारणा विभिन्न राष्ट्रीय एवं अन्तर्राष्ट्रीय संगोष्ठी में चर्चाओं का महत्वपूर्ण बिन्दु रहा है। समावेशी विकास का विषय हाल में ही बहुत सारे कारणों से सुर्खियों में रहा है। इस पर 11 वीं पंचवर्षीय योजना में इस विषय पर सबसे अधिक बल दिया गया। 12 वीं पंचवर्षीय योजना का मूल उद्देश्य तीव्र आर्थिक समावेशी तथा सतत विकास को स्पष्ट किया गया। 12 वीं पंचवर्षीय योजना में स्पष्ट रूप से विकास और समावेशी विकास के बीच स्थायी संतुलन खोजने का प्रयास किया गया।

समावेशी विकास, विकास का वितरणात्मक पहलू है, जो केवल इससे सम्बन्धित नहीं है कि आर्थिक वृद्धि दर क्या है कितनी ऊँची है? और न केवल सम्बन्धित है कि जीवन की गुणवत्ता में सुधार हो रहा है या नहीं और न केवल इससे सम्बन्धित है कि मानव विकास सूचकांक उपर उठ रहा है या नहीं बल्कि इससे सम्बन्धित है कि उच्च आर्थिक बृद्धि दर से अर्थव्यवस्था का अधिक बड़ा वर्ग जो गरीब तथा जीवन की आवश्यक आवश्यकताओं की संतुष्टि से वंचित है, जिससे महिलाओं के रूप में जनसंख्या का एक बहुत बड़ा वर्ग भी सम्मिलित है, लाभावन्त हो रहा है या नहीं उच्च आर्थिक बृद्धि दर या एच. डी. आई. मूल्य अपने में यह सुनिश्चित नहीं करता है कि विकास समावेशी है। समावेशी विकास का वितरणात्मक पहलू है जो अर्थव्यवस्था के सभी लोगों को विशेषरूप से गरीब को मुख्यधारा से जोड़ने से सम्बन्धित है, जिससे आर्थिक वृद्धि तथा आर्थिक विकास की विकास की प्रक्रिया में उत्पन्न लाभ पिरामिड के निचले भाग के सभी लोगों तक पहुंचे कोई वर्षा की ओट में रह जाय।

समावेशी विकास की अवधारणा

समावेशी विकास की मूल अवधारणा है व्यापक आधारित विकास समन्वित विकास और गरीब समर्थित विकास है, आर्थिक नीति में एक दृष्टिकोण के रूप में यह माना जाता है कि किसी देश में गरीबी की तीब्र विकास दर में जब कभी आती है तो उस देश की विकास प्रक्रिया में लोगों की भागीदारी बढ़ जाती है।

1. एसडीएम राजकीय स्नातकोत्तर महाविद्यालय एवं शोध केंद्र, डोईवाला, देहरादून, उत्तराखण्ड।

11 वीं पंचवर्षीय योजना के दृष्टिकोण पत्र में उपर्शीषक के रूप में तीव्र तथा समावेशी विकास की ओर के जोड ने से इस पर एक नया बल मिला। समावेशी विकास की अवधारणा वस्तुतः पहले से चली आ रही सामाजिक न्याय के साथ विकास की धारणा का नया वाक्य विन्यास है जब आर्थिक विकास का रास्ता बाजार यंत्र में कोई ऐसी व्यवस्था नहीं जुटी है और नहीं इसमें कोई स्वतः निर्मित प्रणाली है जो यह सुनिश्चित करे कि तीव्र आर्थिक विकास का फल स्वतः नीचे की ओर रिसाव के द्वारा कमजोर वर्ग की ओर चला जायेगा।

यू0 एन0 डी0 पी0 के अनुसार समावेशी विकास प्रक्रिया में लोगों की भागीदारी तथा उससे समानरूप से लाभान्वित होने से सम्बन्धित है तथा इसके साथ ही दस प्रक्रिया में बेरोजगारी तथा गरीबी में कमी होगी। समावेशी विकास की अवधारणा को स्पष्ट करते हुऐ मोन्टेक सिंह अहलूवालिया ने अपना विचार व्यक्त किया है समावेशी विकास वह प्रक्रिया है कि जिससे विभिन्न वर्गों के लोग यह महसूस करें कि वे आर्थिक विकास के महत्वपूर्ण रूप से लाभान्वित हुए है। वैसे बाह्य रूप से इसका लक्षित वर्ग ग्रामीण तथा शहरी गरीब तथा कमजोर वर्ग है जिसमें भूमिहीन श्रमिक सीमान्त तथा छोटे कृषक अनुसूचित जाति तथा जनजाति अल्पसंख्यक समुदाय कमजोर तथा निर्धन रिक्शा चालक, महिलायें आदि सम्मिलित है, जो आर्थिक विकास की प्रक्रिया में विशेष रूप से बाजार व्यवस्था पर आधारित विकास प्रक्रिया में मुख्यधारा से कम लाभाविन्त होते है, पर अधिक व्यापक रूप से समावेशी विकास की प्रक्रिया इस आधारभूत अवधारणा पर आधारित है कि समाज के सभी वर्ग सभी क्षेत्र स्त्री–पुरूष बिना किसी विभेद–भाव के विकास की प्रक्रिया से लाभान्वित है।

नीति आयोग के अनुसार समावेशी विकास की अवधारणा को और व्यापक रूप में प्रयोग में लाता है,इसके अनुसार समावेशी विकास का आशय आर्थिक वृद्धि से है जो अर्थव्यवस्था में रोजगार के

अवसर सृजित करता है, तथा गरीबी दर में कमी लाने में सहायक होता है, इसका अर्थ है स्वास्थ्य सम्बन्धी आवश्यक सेवाओं तथा गरीबों को शिक्षित करना, लोगों में अवसर की समानता उपलब्ध कराता है,तथा लोगों को शिक्षा तथा कौशल विकास से द्वारा सशक्त करता है। यह आर्थिक वृद्धि की उस प्रक्रिया से सम्बन्धित है जो पर्यावरण में सुधार तथा अच्छे प्रशासन को लक्षित करता है,तथा लैंगिक संवेदनशील समाज की स्थापना में सहायक होता, समावेशी विकास को चक्रीय प्रक्रिया द्वारा स्पष्ट किया जा सकता है–

समावेशी विकास की प्रक्रिया के तीन अवयव होगे– आर्थिक वृद्धि की ऊँची वृद्धि दर, जिससे राष्ट्रीय उत्पाद (जीडीपी) का आकार दे जो लोगो को मिलने वाले लाभ तथा का व्याज के इष्टतम होने की आवश्यक दशा होगी।

उत्पादों से उत्पन्न लाभ का विभाजन से शहरी तथा ग्रामीण क्षेत्र के कमजोर तथा वंचित वर्ग के लोग एवं पिछड़े क्षेत्र अधिक लाभान्वित हो सकें।

आर्थिक विकास का रोजगार गुणांक जितना ही अधिक होगा विकास का वितरणात्मक पहलू उतना ही मजबूत होगा तथा आर्थिक विकास उतना ही अधिक समावेशी होगा।

भारत में समावेशी विकास की आवश्यकता

भारत में समावेशी विकास और धन का समान वितरण आवश्यक है । भारत जैसे देश में समावेशी विकास हासिल करना सबसे बड़ी चुनौती हे भारत में अल्प कृषि विकास कम गुणवत्ता वाले रोजगार लिंग असमानता और सामाजिक असमानता धन के वितरण में असमानता, क्षेत्रीय असमानता आदि समस्याएं प्रमुख है भारत जैसे लोकतांत्रिक देश में ग्रामीण भारत में रहने वाले एक चौथाई लोगों को मुख्यधारा में लाना सबसे बडी चिन्ता है। भारत जैसे देश में समावेशी विकास की दिशा को अग्रसित करने के लिए सबसे अधिक प्रभावशाली विधि है,यहाँ लोगों के कौशल का विकास किया जाय, भारत में समावेशी विकास की अवधारणाा को अपनाये जाने के आवश्यक कारण निम्नलिखित है–

- मानव का विकास बिना किसी बाधा के होता रहे, और मानव की मूलभूत आवश्यकताओं की पूर्ति और अनुकूल जीवन स्तर बना रहे।
- विकास को सतत् दीर्घकाल तक बनाये रखने के लिए संसाधनों का अनुकूलतम प्रयोग आवश्यक है।
- भविष्य में संसाधनों की उपलब्धता बनी रहे।
- पर्यावरण समस्यायें उत्पन्न न हो और भविष्य में भी पर्यावरणीय समस्याओं का प्रभाव उत्पन्न न हो।
- मानव एवं प्राकृतिक संसाधनों के मध्य आदर्श सम्बन्ध स्थापित हो।
- समता के साथ विकास हो तथा प्रादेशिक व अंतः प्रादेशिक असंतुलन उत्पन्न नहीं।
- गरीबी उन्मूलन एवं विकास का लाभ सभी वर्गों एवं सभी क्षेत्रों में पहुँच सके।

समावेशी विकास के उद्देश्य

सतत् विकास के उद्देश्य विकास नीति के प्रमुख लक्ष्य के रूप सभी लोगों के जीवन की गुणवत्ता में सतत् सुधारों का निर्माण है, समावेशी विकास के निम्न उद्देश्य होते है–

- आर्थिक वृद्धि को बढ़ाना।
- मूल आवश्यकताओं को पूरा करना।
- शिक्षा एवं स्वास्थ्य अवसरों को बेहतर करना।
- अवसरों की समानता पर बल।
- स्वच्छ पर्यावरण को सुनिश्चित करने में मद्द करना।
- समावेशी विकास का प्रमुख उद्देश्य कालान्तर में सभी पर्यावरणीय एवं प्राकृतिक संसाधन परिसंपत्तियों (भौतिक, मानवीय एवं प्राकृतिक) के स्टॉक को कायम रखकर आर्थिक विकास के शुद्ध लाभों को अधिकतम करना।

भारत में समावेशी विकास की समस्याएं

समावेशी विकास के लक्ष्य को प्राप्त करने के लिए भारत जैसे विकासशील देशों में निम्नलिखित समस्याएं चिन्ता का प्रमुख कारण होती है–

- गरीबी
- रोजगार की कमी
- कृषि का पिछड़ापन
- सामाजिक विकास में समस्याएं
- क्षेत्रीय विषमताए

भारत जैसे विकासशील देश में समावेशी विकास को तीव्र गति प्रदान करने के लिए आर्थिक समानता लाना प्रमुख रूप से आवश्यक है। समावेशी विकास के लिए आवश्यक है कि गरीब और अमीर के बीच की खायी को कम किया जाय। जब तक पिछड़े वर्गों का उच्च शिक्षा के द्वारा विकास नही होगा, तब तक समावेशी विकास की कल्पना नही की जा सकेगी।

भारत में समावेशी विकास की चुनौतियाँ

भारत में समावेशी विकास की रणनीति के प्रमुख घटकों में ग्रामीण क्षेत्रों में तीव्र निवेश वृद्धि, ग्रामीण बुनियादी ढाँचा में परिवर्तन कृषि क्षेत्रों का विकास, ग्रामीण क्षेत्रों में संचार के माध्यमों से रोजगार के स्तरों में वृद्धि की जाय। साथ ही शिक्षा और स्वास्थ्य पर सार्वजनिक व्यय में वृद्धि की जाय। भारत जैसे विकासशील देश में वंचित वर्ग सशक्त बनाने के लिए सरकारी प्रयास की आवश्यकता है। भारत में समावेशी विकास के लक्ष्य को प्राप्त करने में कुछ चुनौतियाँ है जो निम्नवत–

- गरीबों को हटाना।
- कृषि क्षेत्र को विकसित करना।
- सरकार द्वारा विभिन्न योजनाओं के माध्यम से समाज के पिछड़े वर्ग के लोगों को आर्थिक रूप से ऊपर उठाना।
- बाल श्रम का उन्मूलन।
- क्षेत्रीय असमानता को दूर करना।
- रोजगार परक शिक्षा पर बल।
- महिला सशक्तिकरण को बढ़ाना।

भारत सरकार ने समावेशी विकास को तीव्र गति प्रदान करने के कुछ आवश्यक कदम उठायें।

- प्रधानमंत्री जन–धन योजना।
- माइक्रों यूनिट्स डेवलपमेंट एण्ड रिफाइनेन्स एजेन्सी या मुद्रा बैक की स्थापना।
- स्वरोजगार और प्रतिभा उपयोगिता
- कौशल विकास मिशन।
- महात्मा गांधी राष्ट्रीय ग्रामीण रोजगार गारंटी अधिनियम।
- प्रधानमंत्री कृषि सिंचाई योजना।
- राष्ट्रीय कृषि बाजार को बढ़ावा देना।

- प्रधानमंत्री जीवन ज्योति बीमा योजना
- प्रधानमंत्री जीवन सुरक्षा योजना।
- अटल पेंशन योजना।
- डिजिटल इंडिया कार्यक्रम।

अधिक समावेशी विकास के लिए रणनीति

भारतीय अर्थव्यवस्था पिछले कुछ वर्षो से विश्व की सबसे तेजी से वृद्धि करने वाली अर्थव्यवस्था बन चुकी है,समावेशी विकास एक ऐसी अवधारणा है जिसमें समाज के सभी लोगों को समान अवसरों के साथ–साथ विकास का लाभ भी समान रूप से प्राप्त हो अर्थात् सभी वर्ग क्षेत्र प्रांत के व्यक्तियों को बिना भेदभाव समान विकास के अवसरों के साथ–साथ होने वाला देश का विकास ही समावेशी विकास कहलाता है।

भारत सरकार द्वारा समावेशी विकास को महत्व प्रदान करते है। 11 वीं पंचवर्षीय योजना में इसका उपयोग किया गया। इस योजना में यह सुनिश्चित किया गया कि जनसंख्या के बड़े हिस्से मुख्यतया कृषक, अनुसूचित जाति और जनजाति तथा अन्य पिछड़ा वर्गो को सामाजिक एवं आर्थिक समानता दिलायी जाय।

भारत पी.पी.पी. मॉडल के आधार पर विश्व की तीसरी सबसे बड़ी अर्थव्यवस्था है,परन्तु यदि हम व्यक्ति आय की बात करें तो भारत विश्व में 22 वें स्थान पर आता है,विश्व आर्थिक मंच द्वारा जारी की गयी समावेशी विकास सूचकांक में भारत का स्थान 63वां है। भारत से आर्थिक रूप से पिछड़े देश नेपाल 22 वाँ स्थान तथा पाकिस्तान को 45 वाँ स्थान प्राप्त है।

भारत को आजाद हुए 75 वर्षो के बाद भी अभी भी 27 प्रतिशत से अधिक जनसंख्या गरीबी रेखा से नीचे जीवन–यापन कर रही है सरकार द्वारा सामाजिक क्षेत्र में समावेशी विकास के लिए कई योजनाएं चलायी जा रही है,जिससे समाज का वह वर्ग जो विकास की दौड़ में पिछड गया है।

सरकार द्वारा इस पर अनेक योजनाओं का निर्माण किया जा रहा है जो इस प्रकार है–

बेरोजगारी की दर को घटाना

रोजगार में वृद्धि करने से शहरी एवं ग्रामीण क्षेत्र के बेरोजगारों को विकास की प्रक्रिया के साथ जोड़ा जा सकता है, इसके लिए सरकार द्वारा स्किल इंडिया मिशन एवं स्टार्टअप इंडिया योजना एक महत्वपूर्ण कदम बनकर उभरा है, इसे अकुशल श्रमिकों के कुशल बनाकर तथा नये–नये स्टार्टअपों के माध्यम से रोजगार में वृद्धि करायी जा रही है।

कृषि एवं ग्रामीण विकास को बढ़ाना

भारत में आग भी कृषि क्षेत्र सर्वाधिक रोजगार प्रदान करने वाला क्षेत्र है,इसलिए कृषि क्षेत्र का विकास समावेशी माध्यम से होना आवश्यक है। प्रधानमंत्री ग्राम सड़क योजना से गांवों में और

संरचनात्मक सुधार एवं मुडा योजना, किसान क्रेडिट कार्ड से कृषि कार्य हेतु आसान शर्तो पर ऋण उपलब्ध हो रहा है,साथ ही प्रधानमंत्री फसल बीमा योजना से किसानों की हानि को कम किया जा रहा है। इसके साथ ही भारत सरकार ने 2022 तक किसानों की आय दो गुनी करने का भी लक्ष्य रखा है।

आर्थिक असमानता को समाप्त करना

भारत का उच्च आय प्राप्त करने वाला वर्ग मात्र 1 प्रतिशत जीडीपी को 50 प्रतिशत हिस्सेदारी रखता है,समावेशी विकास हेतु इस असमानता को समाप्त करना अति आवश्यक है। इसे दूर करने के लिए सरकार द्वारा जन–धन योजना की शुरूआत की गयी है,जिसके जरिये सरकार समाज के उस वर्ग को अर्थव्यवस्था की मुख्यधारा से जोड़ना चाहती है,जिनके पास अभी भी बैंक खाते नहीं है। आधारभूत आवश्यक वस्तुओं को सभी उपलब्ध कराना :–

स्वास्थ्य, शिक्षा, खाद्य, बिजली एवं स्वच्छ जल जैसी आधारभूत आवश्यक वस्तुए सभी लोगों को उपलब्ध कराना। बी0पी0एल0 कार्ड धारकों को दीन दयाल उपाध्याय ज्योति योजना के माध्यम से बिजली एवं उज्ज्वला गैस योजना के माध्यम से एल0पी0जी0 गैस कनेक्शन उपलब्ध कराना सरकार की सबसे बड़ी उपलब्धि है।

भारत में समावेशी विकास की अवधारणा प्राचीन काल की विचारधारा सर्वे भवंतु सुखिनाः प्रक्रिया पर आधारित है समावेशी विकास की अवधारणा पहले पहले 11 वी पंचवर्षीय योजना के कार्यक्रम में प्रस्तुत की गयी । लोगों के जीवन की गुणवत्ता सुधारने और अवसर की समानता लाने की बात कही गयी थी।12 वीं पंचवर्षीय योजना में समावेशी विकास पर और अधिक बल दिया गया। 12 वी पंचवर्षीय योजना 2012 से 2017 का तो सारा जोर एक प्रकार से त्वरित समावेशाी सतत् विकास के लक्ष्य हासिल करने पर था।

निष्कर्ष

भारत प्राचीन समय से ही विश्व में सभी आवश्यक खनिजों खूबसूरत स्थानों, विभिन्न प्रकार की संस्कृतियों और प्रभावशाली लोगों एवं महापुरूषों का देश रहा है। भारत में समावेशी विकास के लिए विद्वानों द्वारा समय–समय पर विचारों के माध्यम से आधारभूत परिवर्तन हुए विभिन्न संगोष्ठियों एवं सेमिनारो के माध्यम से सही दिशा में कार्य किया जाना संभव रहा है,समावेशी विकास के लिए आवश्यक है। सेवा क्षेत्र के विकास के साथ–साथ रोजगार का बहुतायत मात्रा में सृजन होना चाहिए।

अतः यह कहा जा सकता है कि निम्न क्षेत्रों में सुधार करके समावेशी विकास की कल्पना को सार्थक किया जा सकता है।

- कृषि क्षेत्र का विकास
- रोजगार के स्तर में वृद्धि
- शिक्षा और स्वास्थ्य सेवाओं पर सार्वजनिक व्यय में वृद्धि

- सभी क्षेत्रों में आधारभूत बुनियादी ढाँचे में सुधार किया जाये।
- सभी स्तरों पर अधिक प्रभावी शासन व्यवस्था की अच्छी होनी चाहिए।

संन्दर्भ ग्रन्थ सूची

- एम0 एल0 झिंगन (2021) विकास का अर्थशास्त्र एवं आयोजन, वृंदा पब्लिकेशन्स प्रा0 लि0।
- रूद्र दत्त एवं के0 पी0 सुन्दरम (2020), भारतीय अर्थव्यवस्था, एस0 एच0 पब्लिकेशन्स।
- एस0 के0 मिश्र वी0 के0 पुरी (2021), भारतीय अर्थव्यवस्था, हिमालया पब्लिशिंग हाउस।
- डॉ0 जे0 पी0 मिश्रा (2020), भारतीय अर्थव्यवस्था, साहित्य भवन पब्लिकेशन्स।
- योजना मासिक प्रत्रिका के विभिन्न अंक
- कुरूक्षेत्र मासिक प्रत्रिका के वि

जलवायु परिवर्तन एवं जैव विविधता संरक्षण हेतु स्थानीय समुदायों की भूमिका एवं महत्व

राकेश सिंह [1] एवं वी०बी० चौरसिया [2]

सारांश

वर्तमान समय में जलवायु परिवर्तन एवं जैव विविधता में हो रहे तीव्र परिवर्तन वैश्विक स्तर पर गंभीर चिंता का विषय बन चुके हैं। वनों की कटाई, भूमि उपयोग परिवर्तन, प्रदूषण, अति दोहन तथा प्राकृतिक संसाधनों का असंतुलित उपयोग न केवल पारिस्थितिक तंत्र को प्रभावित कर रहे हैं, बल्कि स्थानीय समुदायों की आजीविका एवं सांस्कृतिक विरासत पर भी गंभीर प्रभाव डाल रहे हैं। संयुक्त राष्ट्र की Intergovernmental Panel on Climate Change (IPCC) की 2023 की रिपोर्ट के अनुसार, वैश्विक तापमान में औसतन 1.1 डिग्री सेल्सियस की वृद्धि हो चुकी है, और यदि वर्तमान रुझान जारी रहे, तो यह वृद्धि 2030 तक 1.5 डिग्री सेल्सियस को पार कर सकती है। भारत जैसे विविध भौगोलिक एवं पारिस्थितिक तंत्र वाले देश में जलवायु परिवर्तन के प्रभाव विशेष रूप से तीव्र देखे जा रहे हैं। भारत सरकार के पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय (MoEFCC) द्वारा 2023 में प्रकाशित भारत की जलवायु कार्यवाही रिपोर्ट के अनुसार, भारत में पिछले तीन दशकों में औसत तापमान में लगभग 0.7 डिग्री सेल्सियस की वृद्धि हुई है। इसके अतिरिक्त, लगभग 25 प्रतिशत वनस्पतियों और जीव–जंतुओं की प्रजातियाँ जलवायु परिवर्तन एवं मानव जनित गतिविधियों के कारण संकट में हैं। वर्ष 2022 में गर्म हवाओं के कारण फसलों की पैदावार में 20 फीसदी की कमी आई थी। उत्तराखंड जैसे पर्वतीय राज्य में यह संकट और भी गहरा है क्योंकि पर्यावरण वैज्ञानिकों का मानना है कि हिमालयी क्षेत्रों में जलवायु परिवर्तन के कारण पारिस्थितिकीयों में तीव्र परिवर्तन हो रहे है। उत्तराखंड राज्य जैव विविधता बोर्ड की 2024 की रिपोर्ट के अनुसार, राज्य की लगभग 65 प्रतिशत जनसंख्या प्रत्यक्ष रूप से प्राकृतिक संसाधनों पर निर्भर है। पर्वतीय क्षेत्रों में जलवायु परिवर्तन के कारण ग्लेशियरों का तेजी से पिघलना, वर्षा की अनियमितता, वनाग्नि और पारंपरिक कृषि प्रणाली पर प्रभाव देखा जा रहा है। इससे न केवल खाद्य सुरक्षा प्रभावित हो रही है, बल्कि जैव विविधता के संरक्षण हेतु सदियों से चली आ रही स्थानीय पारंपरिक पद्धतियाँ भी खतरे में हैं। इन चुनौतियों के बीच स्थानीय समुदायों की भूमिका अत्यंत महत्वपूर्ण हो जाती है। पारंपरिक ज्ञान, संसाधनों के टिकाऊ उपयोग की तकनीकें एवं सांस्कृतिक रूप से विकसित संरक्षण प्रणालियाँ – इसमें स्थानीय समुदायों की गहरी समझ होती है। स्थानीय लोग न केवल जलवायु परिवर्तन के प्रभावों के प्रति अधिक संवेदनशील होते हैं, बल्कि समाधान के स्तर पर प्रमुख भूमिका निभाते हैं। वर्तमान अध्ययन

1. शोध छात्र, अर्थशास्त्र विभाग, डी0ए0वी0 (पी.जी.) कालेज, देहरादून।
2. प्रोफेसर, अर्थशास्त्र विभाग, डी0ए0वी0 (पी.जी.) कालेज, देहरादून।

में स्थानीय समुदायों की भूमिका, उनके अनुभवों, ज्ञान प्रणाली एवं उनके संरक्षण प्रयासों का अध्ययन किया गया है, तथा इनके संरक्षण पद्धतियों को नीति निर्माण एवं व्यवहारिक समाधान की दिशा में सरकारी पहलों का वर्णन किया गया है। यह वर्णनात्मक अध्ययन द्वितीय आंकड़ों पर आधारित है। जलवायु परिवर्तन एवं जैव विविधता ह्रास कि व्यापक समस्या के समाधान हेतु सभी के द्वारा स्थानीय स्तर पर पर्यावरण अनूकुल व्यवहारों को प्रोत्साहित करने की अति आवश्यकता है।

***मुख्य शब्द** : जलवायु परिवर्तन, जैव विविधता, आजीविका, पारिस्थितिक, वनाग्नि, प्राकृतिक संसाधन*

प्रस्तावना (Introduction)

21वीं सदी में मानव सभ्यता दो प्रमुख पर्यावरणीय संकटों से जूझ रही है– जलवायु परिवर्तन और जैव विविधता का तीव्र क्षरण। जलवायु परिवर्तन के कारण प्राकृतिक आपदाओं में वृद्धि, मौसम चक्रों में अनियमितता, जल स्रोतों का संकट, कृषि उत्पादकता में गिरावट और पारिस्थितिक असंतुलन जैसी समस्याएँ सामने आ रही हैं। वहीं दूसरी ओर जैव विविधता की हानि के कारण पारंपरिक जीवनशैली, स्थानीय खाद्य प्रणाली और औषधीय पौधों की उपलब्धता पर संकट मंडरा रहा है। वैश्विक परिप्रेक्ष्य में, संयुक्त राष्ट्र की IPCC की छठी आकलन रिपोर्ट (2023) के अनुसार, 1850 के बाद से अब तक वैश्विक तापमान में औसतन 1.1 डिग्री सेल्सियस की वृद्धि हो चुकी है। विश्व जैव विविधता परिषद (IPBES) की रिपोर्ट 2023 के अनुसार, लगभग 10 लाख से अधिक प्रजातियाँ विलुप्ति के कगार पर हैं, जिनमें से अधिकतर पारंपरिक कृषि और वनों से जुड़ी प्रजातियाँ हैं। भारत में, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय (MoEFCC) द्वारा जारी भारत की जलवायु कार्यवाही रिपोर्ट 2023 बताती है कि भारत में औसत वार्षिक तापमान में विगत 100 वर्षों में 0.7C की वृद्धि हुई है। साथ ही, भारतीय वन सर्वेक्षण रिपोर्ट (FSI), 2023 के अनुसार देश का 21.71 प्रतिशत भूभाग वन क्षेत्र के अंतर्गत आता है, परंतु इसमें जैव विविधता की गुणवत्ता कई क्षेत्रों में कम हुई है। देश में लगभग 8 प्रतिशत वैश्विक जैव विविधता पाई जाती है, जो इसे दुनिया के प्रमुख जैव विविधता हॉटस्पॉट में शामिल करती है। उत्तराखंड राज्य हिमालयी पारिस्थितिकी तंत्र का एक महत्वपूर्ण हिस्सा है, जलवायु परिवर्तन से सबसे अधिक प्रभावित क्षेत्रों में से एक है। उत्तराखंड जैव विविधता बोर्ड (2024) की रिपोर्ट के अनुसार, राज्य के 70 प्रतिशत से अधिक गाँव वनों और जल स्रोतों पर आधारित हैं। यहाँ के पर्वतीय समुदायों का जीवन पारंपरिक प्राकृतिक संसाधनों पर निर्भर करता है। विगत वर्षों में राज्य के ग्लेशियरों का तीव्र पिघलना, जल स्रोतों के सूखने, और पारंपरिक कृषि प्रणालियों में गिरावट देखी गई है। स्थानीय समुदायों के पास जलवायु परिवर्तन और जैव विविधता संरक्षण का गहन पारंपरिक ज्ञान होता है, जो पीढ़ी दर पीढ़ी स्थानांतरित होता आया है।

उत्तराखंड का ''चिपको आंदोलन'' इसका एक ऐतिहासिक उदाहरण है, जहाँ ग्रामीण महिलाओं ने वृक्षों को कटने से बचाने के लिए उनका आलिंगन किया। इसी प्रकार, ''न्योली वनों की रक्षा समिति'', ''झारखंड की सखुआ संरक्षण पंचायतें'' और पूर्वोत्तर भारत में झूम कृषि का सुधारात्मक उपयोग जैसे प्रयास दर्शाते हैं कि कैसे स्थानीय समुदाय प्रकृति संरक्षण में अग्रणी भूमिका निभाते हैं। उत्तराखंड के

''वन पंचायत प्रणाली'' के अंतर्गत हजारों गाँवों में स्थानीय लोग सामुदायिक वन प्रबंधन में भाग लेते हैं। यहाँ महिलाएं विशेष रूप से जल स्रोतों, औषधीय पौधों और चारागाहों के संरक्षण में सक्रिय रहती हैं। भारत सरकार द्वारा जलवायु और जैव विविधता संरक्षण हेतु कई योजनाएँ चलाई जा रही हैं, जिनमें प्रमुख हैं– नेशनल एक्शन प्लान ऑन क्लाइमेट चेंज (NAPCC): जिसके अंतर्गत आठ मिशन चलते हैं, जैसे – नेशनल मिशन ऑन हिमालयन इकोसिस्टम, नेशनल मिशन फॉर ग्रीन इंडिया। स्टेट एक्शन प्लान ऑन क्लाइमेट चेंज (SAPCC) उत्तराखंड ने 2014 में SAPCC अपनाया था, जिसका पुनरीक्षण 2022 में किया गया है। नेशनल बायोडायवर्सिटी मिशन – जैव विविधता रजिस्टर (PBRs) के निर्माण में समुदायों की भागीदारी सुनिश्चित की जा रही है। CAMPA योजना – वनों के क्षतिपूर्ति हेतु स्थानीय समुदायों को रोजगार से जोड़ते हुए वृक्षारोपण किए जाते हैं।

वर्तमान अध्ययन के उद्देश्य निम्नलिखित है–

(1) जलवायु परिवर्तन एवं जैव विविधता संरक्षण में स्थानीय समुदायों की भूमिका, उनके अनुभवों, ज्ञान प्रणाली एवं उनके संरक्षण प्रयासों का अध्ययन करना तथा

(2) स्थानीय समुदायों की संरक्षण पद्धतियों को नीति निर्माण एवं व्यवहारिक समाधान की दिशा में सरकारी पहलों का वर्णन प्रस्तुत किया गया है।

यह वर्णनात्मक अध्ययन द्वितीयक आंकड़ों पर आधारित है। स्थानीय समुदाय जलवायु परिवर्तन और जैव विविधता संरक्षण में न केवल पीड़ित हैं, बल्कि समाधान का भी अभिन्न अंग हैं। उनकी पारंपरिक समझ, स्थानीय संसाधनों के सतत उपयोग की तकनीकें और सांस्कृतिक जुड़ाव आदि सबको ध्यान में रखते हुए इन्हें नीति–निर्माण, क्रियान्वयन और निगरानी में सम्मिलित किया जाए, तो यह न केवल पर्यावरणीय संकटों का समाधान हो सकता है, बल्कि सतत विकास की दिशा में एक सशक्त कदम भी सिद्ध हो सकता है। चिपको आंदोलन, अपनी पंचायत, वन सुरक्ष समिति, नर्मदा बचाओ आंदोलन जैसे ऐतिहासिक उदाहरण हैं जो स्थानीय सहभागिता की ताकत को दर्शाते हैं।

साहित्य की समीक्षा

IPCC की रिपोर्ट (2023) : में उल्लेख है कि स्थानीय समुदाय जलवायु परिवर्तन के प्रभावों से सर्वाधिक प्रभावित होते हैं और उनके पास अनुकूलन की परंपरागत पद्धतियाँ होती हैं। स्थानीय समुदायों के पारंपरिक ज्ञान एवं व्यवहार पर्यावरण संरक्षण में सहायक होते हैं।

UNEP (United Nations Environment Programme) के अनुसार, स्थानीय समुदायों की भागीदारी जैव विविधता संरक्षण में निर्णायक भूमिका निभाती है, विशेषकर जब उन्हें निर्णय लेने एवं नीति–निर्माण की प्रक्रिया में सम्मिलित किया जाता है।

अल्बा क्रुजा (2013) : यह शोध पत्र सतत विकास को पर्यावरणीय, सामाजिक और आर्थिक गतिविधियों के संतुलन के रूप में व्यक्त करता है। 21वीं सदी में सतत विकास की अवधारण मानव जीवन के लिए लाभकारी है तथा शोध पत्र यह व्यक्त करता है कि सतत विकास के लक्षण को कैसे

प्राप्त किया जा सकता है एवं अवधारणा का उद्‌भव क्यों एवं कैसे हुआ। संसाधनों की गहन औद्योगिक दोहन और पर्यावरणीय गिरावट के कारण पारिस्थितिकी संकट के समाधान के रूप में सतत विकास को प्रोत्साहन दिया गया था। सतत विकास को प्रमुख रूप से पर्यावरणीय गुणवत्ता को संरक्षित करने हेतु बढ़ावा दिया गया है। आर्थिक गतिविधियों से कई राष्ट्रों में सामाजिक, आर्थिक एवं पर्यावरण संबंधी समस्याएं उत्पन्न की है जैसे– क्षेत्रीय असमानता, अवसंरचनात्मक विकास में असमानता एवं ग्रामीण पर्यावरण की क्षति और राष्ट्रीय पूंजी की कमी आदि प्रमुख समस्याएं उत्पन्न हुई हैं। सतत विकास के लक्ष्यों की प्राप्ति हेतु स्पष्ट एवं प्रभावपूर्ण नीतियों की आवश्यकता है तथा उपलब्ध संसाधनों का सर्वोत्तम संभव उपयोग हेतु नीति एवं अध्ययन की आवश्यकता है।

शोध पद्धति (Research Methodology)

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।

जलवायु परिवर्तन एवं जैव विविधता संरक्षण में स्थानीय समुदायों की भूमिका एवं महत्व तथा सरकारी पहलें जलवायु परिवर्तन एवं जैव विविधता में हो रहे तीव्र परिवर्तन वैश्विक स्तर पर वर्तमान समय में गंभीर चिंता का विषय बन चुके हैं। तीव्र पर्यावरणीय परिवर्तन का उदाहरण वर्ष 2024 रहा जिसमें फरवरी का माह वर्ष 1901 के बाद सबसे गर्म फरवरी दर्ज किया गया तथा 2024 का साल मौसम वैज्ञानिकों के अनुसार 175 वर्षों में सबसे गर्म वर्ष घोषित किया गया है। जलवायु परिवर्तन एवं जैव विविधताओँ में हो रहे तीव्र परिवर्तन भविष्य में संपूर्ण विश्व के लिए गंभीर चुनौतियां उत्पन्न होंगी इसका संकेत देना प्रारंभ कर दिया है। स्थानीय स्तर से प्रमुख चुनौतियों के समाधान हेतु सामुदायिक भागीदारी तथा सरकारी कार्यक्रमों एवं पहलों का विवरण वैश्विक, राष्ट्रीय एवं उत्तराखण्ड राज्य के संदर्भ में विवरण निम्नलिखित हैं–

1. ऑस्ट्रेलिया – इंडिजिनस प्रोटेक्टेड एरिया प्रोग्राम (IPA) : ऑस्ट्रेलिया में आदिवासी समुदायों ने इंडिजिनस प्रोटेक्टेड एरिया प्रोग्राम (IPA) के तहत लगभग 74 मिलियन हेक्टेयर भूमि का संरक्षण किया है। यहाँ स्थानीय समुदाय पारंपरिक ज्ञान और आधुनिक विज्ञान के साथ मिलकर जैव विविधता का संरक्षण करते हैं। 'रेंजर प्रोग्राम' के तहत हजारों आदिवासी युवाओं को पर्यावरण संरक्षण में रोजगार भी दिया गया है।

2. अमेरिका – कम्युनिटी फॉरेस्ट मैनेजमेंट इन एलेस्का : अमेरिका के एलेस्का क्षेत्र में स्थानीय आदिवासी समुदाय Community Forest Management के तहत वनों, नदियों और वन्यजीवों के संरक्षण में सक्रिय हैं। वहाँ की ज्सपदहपज और भ्पकं जैसी जनजातियाँ अपने पारंपरिक ज्ञान का उपयोग कर टिकाऊ प्राकृतिक संसाधन प्रबंधन कर रही हैं।

3. कनाडा – इंडिजिनस गार्डियन प्रोग्राम : कनाडा में Indigenous Guardian कार्यक्रम के तहत स्थानीय समुदाय अपने पारंपरिक इलाकों में निगरानी, संरक्षण और पुनर्स्थापन (Restoration) कार्य कर रहे हैं। इस कार्यक्रम ने जैव विविधता संरक्षण के साथ ही जलवायु अनुकूलन प्रयासों को भी सशक्त बनाया है।

4. ब्राजील – अमेजन के स्थानीय समुदायों द्वारा वर्षावनों का संरक्षण : ब्राजील में अमेजन बेसिन क्षेत्र के स्थानीय आदिवासी समुदायों ने आरक्षित आदिवासी क्षेत्रों के माध्यम से अमेजन के विशाल वर्षावनों का संरक्षण किया है। 'Rubber Tappers' और 'Chico Mendes' जैसे सामाजिक कार्यकर्ताओं ने स्थानीय स्तर पर बड़े संरक्षण आंदोलन शुरू किए, जिससे आज भी हजारों वर्ग किलोमीटर जंगल सुरक्षित हैं।

5. केन्या – कम्युनिटी कंजर्वेंसीज मॉडल : केन्या में स्थानीय समुदायों ने छवतजीमतद त्ंदहमसंदके ज्तनेज के माध्यम से सामुदायिक संरक्षित क्षेत्र (Community Conservancie) स्थापित किए हैं। इन संरक्षित क्षेत्रों में वन्यजीव संरक्षण, पर्यटन, और स्थानीय रोजगार सृजन का कार्य समुदायों द्वारा संचालित होता है। यह मॉडल अफ्रीका में जैव विविधता संरक्षण का एक सफल उदाहरण बन चुका है।

6. नेपाल – कम्युनिटी फॉरेस्ट प्रोग्राम : नेपाल में 1990 के दशक से 'कम्युनिटी फॉरेस्ट प्रोग्राम' के अंतर्गत हजारों गाँवों को वन प्रबंधन का अधिकार दिया गया है। आज नेपाल के लगभग 40 प्रतिशत वनों का संरक्षण स्थानीय समुदाय कर रहे हैं। इससे जैव विविधता के साथ–साथ जलवायु अनुकूलन में भी महत्वपूर्ण योगदान मिला है।

7. इंडोनेशिया – अडट समुदायों द्वारा मैंग्रोव संरक्षण : इंडोनेशिया में अडट (Adat) समुदायों ने अपने पारंपरिक अधिकारों का उपयोग करते हुए मैंग्रोव वनों का संरक्षण शुरू किया। मैंग्रोव कार्बन अवशोषण (Blue Carbon) के बड़े स्रोत हैं, और स्थानीय समुदायों ने जलवायु परिवर्तन से लड़ने में अग्रणी भूमिका निभाई है।

भारत में जलवायु परिवर्तन और जैव विविधता संरक्षण हेतु प्रमुख राष्ट्रीय पहलों (स्थानीय समुदायों की भागीदारी सहित) का विवरण इस प्रकार हैं–

1. राष्ट्रीय जैव विविधता मिशन (National Biodiversity Mission & NBM) : इसकी शुरुआत वर्ष 2019 में हुई तथा अब यह विभिन्न राज्यों में कार्यान्वित हो रहा है। इस मिषन का उद्देश्य भारत की जैव विविधता का वैज्ञानिक तरीके से आकलन करना और स्थानीय समुदायों को संरक्षण प्रयासों में शामिल करना है। स्थानीय भूमिका के अंतर्गत पीपुल्स बायोडायवर्सिटी रजिस्टर (PBR) बनाने में गांवों और पंचायतों की सक्रिय भागीदारी सुनिष्चित करना है। भारत में 2,80,000 से अधिक गाँवों में PBR तैयार किए जा चुके हैं (राष्ट्रीय जैव विविधता प्राधिकरण, 2024) तथा उत्तराखंड में 13,200 से अधिक PBR बनाए गए हैं।

2. संयुक्त वन प्रबंधन कार्यक्रम (Joint Forest Management & JFM) : इसकी शुरुआत वर्ष

1990 के दशक में हुई तथा इस कार्यक्रम का उद्देश्य वनों के संरक्षण और पुनर्स्थापन में स्थानीय समुदायों की सीधी भागीदारी सुनिष्चित करना था। स्थानीय भूमिका के अंतर्गत वन संरक्षण समितियाँ (टै) और ग्राम वन समितियाँ वनों के प्रबंधन और संरक्षण कार्यों में सरकार के साथ साझेदारी करती हैं। भारत में 1,18,213 संयुक्त वन प्रबंधन समितियाँ कार्यरत हैं (MoEFCC रिपोर्ट, 2024) तथा देश के लगभग 22 मिलियन हेक्टेयर क्षेत्र में श्रथ्ड मॉडल लागू है।

3. जलवायु परिवर्तन पर राष्ट्रीय कार्य योजना (National Action Plan on Climate Change & NAPCC) : इस कार्य योजना की शुरुआत 2008 में हुई तथा इस कार्य योजना का उद्देश्य जलवायु परिवर्तन से निपटने के लिए 8 मिशनों के माध्यम से समग्र रणनीति बनाना था। स्थानीय भागीदारी के अंतर्गत राष्ट्रीय सौर मिशन, राष्ट्रीय जल मिशन, ग्रीन इंडिया मिशन जैसे उप–मिशनों में स्थानीय स्तर पर जनता की भागीदारी को बल दिया गया है। ग्रीन इंडिया मिशन विशेष रूप से वनों के क्षेत्रफल बढ़ाने और सामुदायिक वनों के प्रबंधन में स्थानीय लोगों को जोड़ रहा है। ग्रीन इंडिया मिशन के तहत अब तक 2.78 मिलियन हेक्टेयर क्षेत्र में हरित कार्य किए गए हैं (MoEFCC, 2024)।

4. जलवायु परिवर्तन पर राज्य कार्य योजना (State Action Plan on Climate Change & SAPCC) : इस कार्य योजना की शुरुआत प्रत्येक राज्य द्वारा छ।च्ब्ब के अंतर्गत हुई। उत्तराखंड ने ।च्ब्ब का विस्तार करते हुए 2022 में स्थानीय सामुदायिक भागीदारी को प्राथमिकता दी है। इसमें जल, वन, कृषि और आपदा प्रबंधन जैसे क्षेत्रों में ग्राम स्तरीय जलवायु समितियाँ बनाई जा रही हैं।

5. CAMPA फंड (Compensatory Afforestation Fund Management and Planning Authority & CAMPA) : इस कार्य योजना का उद्देश्य वनों के विनाश के बदले वनों का पुनःस्थापन और स्थानीय रोजगार का सृजन करना है। स्थानीय भूमिका के अंतर्गत ग्राम पंचायतों और वन समितियों को वृक्षारोपण और संरक्षण कार्यों में शामिल किया जाता है। वर्ष 2024 तक लगभग रू54,000 करोड़ CAMPA फंड राज्यों को हस्तांतरित किए जा चुके हैं। उत्तराखंड राज्य को CAMPA फंड से रू1,680 करोड़ स्वी.त हुए हैं।

6. राष्ट्रीय पारिस्थितिकी एवं जलवायु परिवर्तन केंद्र (National Centre for Sustainable Coastal Management & NCSCM) : इन केंद्रों के माध्यम से स्थानीय भागीदारी सुनिष्चित कर भारत के तटीय समुदायों को समुद्री जैव विविधता संरक्षण और जलवायु अनुकूलन उपायों में प्रशिक्षित किया जा रहा है। तटीय पारिस्थितिकी एवं समुद्री जैव विविधता संरक्षण हेतु स्थानीय समुदायों के पारंपरिक ज्ञान एवं व्यवहार पर्यावरण संरक्षण में सहायक हो रहे हैं।

7. जैव विविधता संरक्षण हेतु वन अधिकार अधिनियम (Forest Rights Act & FRA), 2006: इस अधिनियम का उद्देश्य आदिवासी और अन्य परंपरागत वन निवासी समुदायों को वनों पर अधिकार देना है। इसमें स्थानीय समुदायों को सामूहिक वन अधिकार दिए जाते हैं, जिससे वे स्वयं वनों का संरक्षण और प्रबंधन कर सकते हैं। वर्ष 2024 तक लगभग 44 लाख से अधिक व्यक्तिगत और सामुदायिक वन अधिकार पत्र (titles) जारी किए जा चुके हैं।

8. मिशन लाइफ (Mission LiFE & Lifestyle for Environment) : इसकी शुरुआत प्रधानमंत्री श्री नरेंद्र मोदी जी द्वारा 2022 में की गई थी। इस मिषन का उद्देश्य पर्यावरण के प्रति जागरूक जीवनशैली को बढ़ावा देना था। स्थानीय भूमिका के अंतर्गत ग्राम स्तर पर 'LiFE Volunteers' बनाए जा रहे हैं, जो जलवायु मित्र की तरह पर्यावरणीय जागरूकता फैलाते हैं। वर्ष 2024 तक 1 करोड़ से अधिक नागरिकों ने मिशन लाइफ के अंतर्गत प्रतिज्ञाएँ ली हैं।

उत्तराखंड में जलवायु परिवर्तन और जैव विविधता संरक्षण हेतु प्रमुख योजनाएँ एवं कार्यक्रम (स्थानीय समुदायों की सहभागिता सहित) का विवरण इस प्रकार हैं–

1. उत्तराखंड राज्य जलवायु परिवर्तन कार्य योजना (SAPCC & State Action Plan on Climate Change) : इस कार्य योजना की शुरुआत वर्ष 2012 में हुई तथा वर्ष 2022 में संशोधित कार्य योजना जारी हुई। इसका उद्देश्य जल, वन, कृषि, ऊर्जा और आपदा प्रबंधन क्षेत्रों में जलवायु अनुकूलन रणनीतियों को बढ़ावा देना है। स्थानीय भागीदारी के अंतर्गत ग्राम पंचायत स्तर पर जलवायु कार्य योजनाएँ बनाई जा रही हैं। जलवायु मित्र (Climate Mitras) के रूप में स्थानीय युवाओं को प्रशिक्षित किया जा रहा है। वर्ष 2024 तक उत्तराखंड के 13 जिलों में जलवायु अनुकूल (Climate Resilience) परियोजनाएँ चलाई जा रही हैं।

2. उत्तराखंड वन पंचायत प्रणाली (Van Panchayat System) : इसकी शुरुआत वर्ष 1931 में ब्रिटिश कालीन भारत में एक अनूठी पहल के रुप में हुआ था। इसका उद्देश्य स्थानीय समुदायों को वनों के संरक्षण, प्रबंधन और पुनर्स्थापन में अधिकार देना था। स्थानीय भूमिका के अंतर्गत प्रत्येक गाँव की वन पंचायत समिति द्वारा वनों की देखभाल करना सुनिष्चित किया गया। उत्तराखंड में लगभग 12,089 वन पंचायतें कार्यरत हैं (वन विभाग रिपोर्ट, 2024)। राज्य में कुल वन पंचायत क्षेत्रफलः लगभग 7 लाख हेक्टेयर है। स्थानीय महिलाओं की भागीदारी सुनिश्चित करने हेतु महिला वन पंचायतों की संख्या विशेष पहल के रुप में बढ़ाई जा रही है।

3. ग्रीन इंडिया मिशन (GIM) : उत्तराखंड राज्य में राष्ट्रीय ग्रीन इंडिया मिशन के तहत इसका कार्यान्वयन हो रहा है। जिसका उद्देश्य वनों का क्षेत्रफल बढ़ाना, जैव विविधता का संरक्षण और पारिस्थितिकी सेवाओं का पुनर्स्थापन करना है। स्थानीय भागीदारी के अंतर्गत वन पंचायतों, EDC (Ecodevelopment Committees), और ग्राम सभाओं की सक्रिय भूमिका प्रमुख है। वर्ष 2024 तक उत्तराखंड में 41,000 हेक्टेयर क्षेत्र में वृक्षारोपण किया गया है तथा लगभग 700 गांवों को ग्रीन इंडिया मिशन गतिविधियों से जोड़ा गया है।

4. जैव विविधता प्रबंधन समितियाँ (Biodiversity Management Committees & BMCs) : इनकी शुरुआत जैव विविधता अधिनियम, 2002 के तहत हुई है। इनका उद्देश्य स्थानीय स्तर पर जैव विविधता का संरक्षण और उपयोग के अधिकार सुनिश्चित करना है। स्थानीय लोगों द्वारा जैव विविधता रजिस्टर तैयार किया जाता है तथा स्थानीय जैव विविधता को आर्थिक अवसरों से जोड़ना (जैसे जड़ी–बूटी संरक्षण, बीज बैंक)। उत्तराखंड में 13,200 से अधिक BMCs गठित की जा चुकी हैं एवं 13,000 से अधिक PBRs (Peoples Biodiversity Register) तैयार किए गए हैं (उत्तराखंड जैव विविधता बोर्ड, 2024)।

5. उत्तराखंड CAMPA योजना (CAMPA Uttarakhand) : इसका उद्देश्य वनों के विनाश के बदले वनों का पुनर्स्थापन और पारिस्थितिकी तंत्र की बहाली करना है। स्थानीय श्रमिकों और समुदायों के माध्यम से वृक्षारोपण और संरक्षण का कार्य करना है। वर्ष 2024 में उत्तराखंड को 1,680 करोड़ CAMPA फंड स्वीकृत हुआ था एवं 85,000 हेक्टेयर क्षेत्र में पुनर्वनीकरण कार्य किए गए हैं। CAMPA फंड का 30 प्रतिशत बजट स्थानीय लोगों की आजीविका सुधारने पर केंद्रित किया जाएगा।

6. हिमालयी पारिस्थितिकी तंत्र संरक्षण कार्यक्रम (National Mission for Sustaining Himalayan Ecosystem & NMSHE) : उत्तराखंड में पर्वतीय पारिस्थितिकी और हिमनदीय क्षेत्रों पर अनुसंधान हेतु यह कार्यक्रम प्रारंभ किया गया है। इसमें ग्रामीण समुदायों को जलवायु अनुकूलन तकनीकों से जोड़ा जा रहा है। इसके प्रमुख प्रोजेक्ट–ग्लेशियर निगरानी कार्यक्रम (Glacier Monitoring Program) जिसमें स्थानीय युवाओं को प्रशिक्षित किया जा रहा है।

7. उत्तराखंड जैव विविधता बोर्ड परियोजनाएँ : इसमें प्रमुखता स्थानीय फसलों (जैसे मंडुवा, झंगोरा, भट्ट) का संरक्षण किया जा रहा है। औषधीय पौधों के संरक्षण हेतु गाँव आधारित 'हर्बल गार्डन' विकसित किए जा रहे हैं। वर्ष 2024 तक 120 हर्बल गार्डन स्थापित किए गए है तथा 1000 से अधिक किसान समूह जैव विविधता आधारित आय स्रोतों से जुड़े है।

8. चिपको आंदोलन की विरासत और अन्य नए सामुदायिक प्रयास : उत्तराखंड में ऐतिहासिक चिपको आंदोलन (1973) वृक्षों को बचाने के लिए महिलाओं द्वारा किया गया था। चिपको आंदोलन की प्रेरणा से कई नए 'वन संरक्षण स्वयंसेवी समूह' गठित हो रहे हैं, जो जलवायु परिवर्तन और जैव विविधता संरक्षण में कार्यरत हैं। उत्तराखंड के जलागम प्रबंधन निदेशालय द्वारा वर्ष 2022 में SARA (Spring and River Rejuvenation Authority) की स्थापना की गई। इसका मुख्य उद्देश्य प्राकृतिक जलस्रोतों (धाराओं, गधेरों, नालों, झरनों) और नदियों के पुनरुद्धार को सुनिश्चित करना है ताकि जलवायु परिवर्तन के प्रभावों से निपटा जा सके और पारिस्थितिकीय संतुलन बना रहे। इस कार्यक्रम का मुख्य उद्देश्य झरनों और नदियों के जल प्रवाह को बनाए रखना तथा जलग्रहण क्षेत्रों का पुनर्वास करना है। साथ ही जैवविविधता और पारंपरिक जल–स्रोत आधारित जीवनशैली का संरक्षण करना है। इसके अंतगर्त स्थानीय ग्राम पंचायतों, महिला समूहों और FPOs साथ मिलकर रिचार्ज संरचनाओं का निर्माण, चाल–खाल जैसे जल–प्रबंधन सशक्तीकरण करने का कार्य कर रहे हैं। उत्तराखंड में 4,200 से अधिक झरनों को चिह्नित किया गया है, जिनमें से 1,100 झरनों का पुनर्जीवन कार्य प्रारंभ किया गया है। 12 प्रमुख नदियों के स्रोत क्षेत्रों (जैसे कोसी, गौला, रामगंगा) में कार्य आरंभ हुए हैं। वर्ष 2023–24 में 80,000 हेक्टेयर से अधिक क्षेत्र में जल सग्रंहण कार्य किया जा रहा हैं तथा पारंपरिक ज्ञान और स्थानीय पौधों (जैसे बुरांश, काफल) को पुनःस्थापित किया गया हैं। सितला गाँव, मॉडल अल्मोड़ा जिला तथा कुमाऊँ क्षेत्र का वर्षा जल संचयन, स्थानीय महिलाओं द्वारा जैव विविधता का संरक्षण, पारंपरिक बीजों, फसलों और वनों का पुनरुद्धार तथा वनाग्नि नियंत्रण सामुदायिक संरक्षण का प्रशंसनीय उदाहरण हैं।

निष्कर्ष (Conclusion)

दुनिया भर के विभिन्न देशों में स्थानीय समुदायों ने पारंपरिक ज्ञान, सामूहिक प्रबंधन और टिकाऊ जीवनशैली के माध्यम से जलवायु परिवर्तन और जैव विविधता संरक्षण में अत्यंत महत्वपूर्ण योगदान दिया है। सरकारों और अंतरराष्ट्रीय संगठनों द्वारा इन समुदायों की भागीदारी को मान्यता देकर और समर्थन देकर बेहतर परिणाम प्राप्त किए जा रहे हैं। भारत में विभिन्न स्तरों पर स्थानीय समुदायों को जलवायु परिवर्तन और जैव विविधता संरक्षण में शामिल करने के लिए सशक्त प्रयास किए जा रहे हैं। हालाँकि, इन पहलों के प्रभावी कार्यान्वयन और जमीनी स्तर पर सामुदायिक क्षमताओं के विकास में और अधिक ध्यान देने की आवश्यकता है। उत्तराखंड के विशिष्ट भौगोलिक और पारिस्थितिकीय महत्व को ध्यान में रखते हुए स्थानीय समुदायों को केंद्र में रखकर जलवायु और जैव विविधता संरक्षण के लिए कई सफल पहलें की हैं। यदि इन कार्यक्रमों को अधिक वित्तीय सहायता, तकनीकी ज्ञान और युवा भागीदारी से मजबूत किया जाए तो राज्य सतत विकास का आदर्श बन सकता है। वन पंचायतों द्वारा वनों का संरक्षण, ग्राम स्तर पर PBR निर्माण की सफलता तथा CAMPA के तहत आजीविका सृजन के अभिनव उदाहरण हैं। चिपको आंदोलन (उत्तराखंड), मंगर बणी संरक्षण (हरियाणा), ओडिशा के समुद्र तट जैव विविधता क्षेत्र (कंधमाल), SARA (Spring and River Rejuvenation Authority) तथा सितला गाँव, मॉडल जैसे स्थानीय समुदायों की भागीदारी से प्राप्त सफलता यह दर्शाती हैं कि स्थानीय सोच से वैश्विक समाधान संभव हैं।

संदर्भ सूची (References)

1. P.D. Singh, Ajay Kumar Salgotra, Ajay Singh Manhas (2019) : Causes and consequences of environment degradation in Uttarakhand : Indian Journal of Economics and Development, April 2019, Vol7(4); ISSN (online): 2320&9836
2. आर्थिक सर्वेक्षण, (2021–22), अर्थ एवं संख्या निदेशालय (नियोजन विभाग) उत्तराखंड सरकार, वन एवं पर्यावरण, पृष्ठ–संख्या – 125–136
3. जयसिंह रावत (19 फरवरी 2024), हिमनद झीलों का मंडराता खतरा, अमर उजाला, पारिस्थितिकी, प्रवाह
4. भारत डोगरा (23 फरवरी 2024), संकटग्रस्त दुनिया को नई चेतावनी, अमर उजाला, पर्यावरण, प्रवाह
5. Jan Antonnan Zenten, Rob van Tulder (2020); Towards nexus-based governance : defining interactions between economic activities and sustainable development Goals (SDGS): international journal of sustainable development and world ecology 2021, Vol.28, no 3, 210-226
6. Kumar, Sandeep, Sharma, Kumar, Amit (2020); Sustainable development: some dimensions, UPUEA Economic journal, Vol.17, ISSN-0975-2382

खडिया खनन से सम्भावित रोजगार व पर्यावरण पर प्रभाव (बागेश्वर जनपद के रीमा क्षेत्र के विशेष संदर्भ में)

डॉ0 स्वाति टम्टा [1] एवं संतोष सिंह बिष्ट [2]

सारांश (Abstract)

खनन कार्य किसी भी क्षेत्र के आर्थिक विकास में महत्वपूर्ण भूमिका निभाता है, लेकिन साथ ही इसके पर्यावरणीय प्रभाव भी गंभीर हो सकते हैं। बागेश्वर जिले का रीमा क्षेत्र खडिया (सोप स्टोन) के भंडार के लिए जाना जाता है। खडिया पाउडर का प्रयोग सौंदर्य प्रसाधनों में तथा कागज उद्योग में किया जाता है। यहाँ खनन से स्थानीय लोगों को रोजगार मिलता है, लेकिन इसके कारण जल, वायु और मृदा प्रदूषण जैसी समस्याएँ भी उत्पन्न हो रही हैं। इस शोध का उद्देश्य रीमा क्षेत्र में खडिया खनन के सामाजिक-आर्थिक लाभों और पर्यावरणीय चुनौतियों का विश्लेषण करना है।

***खोजशब्द (Keywords)** - खडिया खनन, रोजगार, पर्यावरण प्रभाव।*

परिचय (Introduction)

बागेश्वर जिला, उत्तराखंड के कुमाऊँ मंडल में स्थित है। रीमा, बागेश्वर जिले का एक प्रमुख क्षेत्र है, जहां खडिया खनन व्यापक रूप से किया जाता है। यह खनिज मुख्यतः कागज, पेंट और सौंदर्य प्रसाधन उद्योगों में उपयोग होता है, जिससे इसकी मांग बनी रहती है। खनन गतिविधियों से स्थानीय अर्थव्यवस्था को बढावा मिलता है, लेकिन इसके साथ ही पर्यावरणीय चुनौतियाँ भी उत्पन्न होती हैं। यह क्षेत्र पारिस्थितिक दृष्टि से संवेदनशील क्योंकि यह भूकम्प के जोन 5 में स्थित है और यहाँ के निवासी मुख्यतः कृषि एवं खनन पर निर्भर हैं। यह क्षेत्र ग्रामीण अर्थव्यवस्था के लिए महत्वपूर्ण है। जहाँ खनन से जुडे श्रमिकों, ट्रांसपोर्टरों और छोटे उद्यमियों को रोजगार मिलता है।

उद्देश्य (Objectives)

1. खडिया खनन से उत्पन्न रोजगार के अवसरों का आंकलन करना।
2. खनन क्रियाओं का स्थानीय पर्यावरण पर पड रहे प्रभाव का अध्ययन करना।
3. स्थानीय समुदाय की खनन गतिविधियों के प्रति धारणा को समझना।

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शोध पद्धति (Methodology)

1. प्राथमिक डेटा संग्रह (Primary Data Collection)

- सर्वेक्षण (Survey) : स्थानीय खनन श्रमिकों, निवासियों और अधिकारियों के साथ संरचित प्रश्नावली के माध्यम से साक्षात्कार।
- प्रत्यक्ष अवलोकन (Field Observation) : खनन स्थलों का भ्रमण कर पर्यावरणीय प्रभावों का अध्ययन।

2. द्वितीयक डेटा संग्रह (Secondary Data Collection)

- सरकारी रिपोर्ट्स, जिला खनन विभाग के आँकडे, और पूर्व शोधपत्रों का विश्लेषण।
- पर्यावरण प्रभाव आंकलन (EIA) रिपोर्ट्स का अध्ययन।

3. डेटा विश्लेषण (Data Analysis)

- गुणात्मक एवं मात्रात्मक विधियों का उपयोग कर डेटा का विश्लेषण।
- सांख्यिकीय सॉफ्टवेयर (Excel) का उपयोग।

खडिया खनन से स्थानीय समुदाय को प्रत्यक्ष और अप्रत्यक्ष रूप से रोजगार के अवसर मिलते हैं। खनन कार्यों में श्रमिकों की आवश्यकता होती है, जिससे स्थानीय निवासियों व बाहरी निवासियों को काम मिलता है। इसके अलावा, खनिज के परिवहन, प्रसंस्करण और विपणन से जुडे कार्यों में भी रोजगार सृजित होते हैं। हालांकि, अक्टूबर से मई तक खडिया का कार्य चलता है। खनन से उत्पन्न रोजगार अक्सर अस्थायी होते हैं और खनन समाप्त होने पर ये अवसर भी समाप्त हो सकते हैं। खडिया (सोप स्टोन) से विभिन्न स्तरों पर रोजगार के अवसर उत्पन्न होते हैं। ये अवसर प्रत्यक्ष और अप्रत्यक्ष रूप से स्थानीय लोगों को आजीविका प्रदान करते हैं।

प्रत्यक्ष रोजगार अवसर (Direct Employment Opportunities)

ये वे रोजगार हैं जो सीधे खनन प्रक्रिया से जुडे होते हैं। शोधार्थिनी द्वारा 50 व्यक्तियों का प्रश्नावली विधि से सर्वेक्षण किया गया है। जिसे तालिका 1 में दर्शाया गया है।

- खनिक (माइन वर्कर) – खदानों में खडिया निकालने का कार्य करने वाले व्यक्ति।
- ड्रिलिंग और ब्लास्टिंग ऑपरेटर – चट्टानों की खुदाई के लिए।
- मशीन ऑपरेटर – खुदाई, लोडिंग, और ट्रांसपोर्टिंग मशीनों को चलाने वाले व्यक्ति।
- ट्रक ड्राइवर और लोडर ऑपरेटर – खडिया को एक जगह से दूसरी जगह ले जाने वाले व्यक्ति।
- सेफ्टी ऑफिसर और इंजीनियर – खदान की सुरक्षा और प्रबंधन के लिए व्यक्ति।
- सुपरवाइजर और टेक्नीशियन – खदान संचालन की निगरानी करने वाले व्यक्ति।

तालिका 1 : प्रत्यक्ष रोजगार में लगे व्यक्ति

क्रम संख्या	रोजगार	संख्या	प्रतिशत
1	खनिक (माइन वर्कर)	18	36%
2	ड्रिलिंग और ब्लास्टिंग ऑपरेटर	05	10%
3	मशीन ऑपरेटर	06	12%
4	ट्रक ड्राइवर और लोडर ऑपरेटर	12	24%
5	सेफ्टी ऑफिसर और इंजीनियर	04	8%
6	सुपरवाइजर और टेक्नीशियन	05	10%

स्रोत - प्राथमिक संकलन 2025

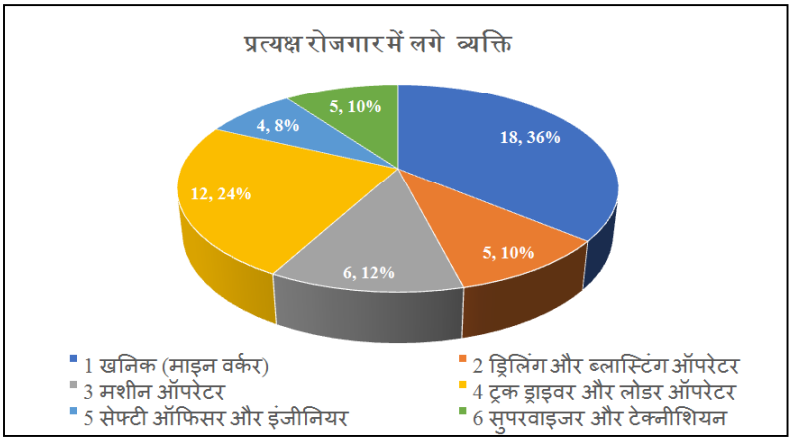


Figure 1 प्रत्यक्ष रोजगार में लगे व्यक्ति

उपरोक्त तालिका 1 में प्रत्यक्ष खनन रोजगार में लगे व्यक्तियों को दर्शाया गया है जिसके अन्तर्गत सर्वाधिक प्रतिशत 36% माइन वर्कर है, उसके बाद ट्रक ड्राइवर और लोडर ऑपरेटर 24%, व सबसे कम सुपरवाइजर और टेक्नीशियन 10% है।

अप्रत्यक्ष रोजगार अवसर (In-Direct Employment Opportunities)

खनन उद्योग के आस-पास कई दूसरे रोजगार अवसर भी पैदा होते हैं। शोधार्थिनी द्वारा 50 व्यक्तियों का प्रश्नावली विधि से सर्वेक्षण किया गया है। जिसे तालिका 2 में दर्शाया गया है।

- ट्रांसपोर्ट और लॉजिस्टिक्स – खडिया को प्रोसेसिंग यूनिट और बाजार तक पहुंचाने वाले व्यक्ति।
- प्रसंस्करण उद्योग (Processing Units) – खडिया को सफेद चाक, सीमेंट, पेंट और कागज उद्योग में उपयोग के लिए तैयार करने वाले व्यक्ति।
- मशीनरी और उपकरणों की मरम्मत सेवाएँ – खदानों में उपयोग होने वाली मशीनों की देख-रेख और मरम्मत करने वाले व्यक्ति।

- कैंटीन और अन्य सुविधाएँ – श्रमिकों के लिए खान-पान और अन्य आवश्यक सेवाएँ उपलब्ध कराने वाले व्यक्ति।
- रियल एस्टेट और हाउसिंग – खदानों के आस-पास श्रमिकों और कर्मचारियों के लिए आवास निर्माण करने वाले व्यक्ति।

तालिका 2

क्रम संख्या	रोजगार	संख्या	प्रतिशत
1	ट्रांसपोर्ट और लॉजिस्टिक्स	12	24%
2	प्रसंस्करण उद्योग	-	-
3	मशीनरी और उपकरणों की मरम्मत सेवाए	04	8%
4	कैंटीन और अन्य सुविधाएँ	14	28%
5	रियल एस्टेट और हाउसिंग	08	16%
6	दुकानदार	12	24%

स्रोत - प्राथमिक संकलन 2025

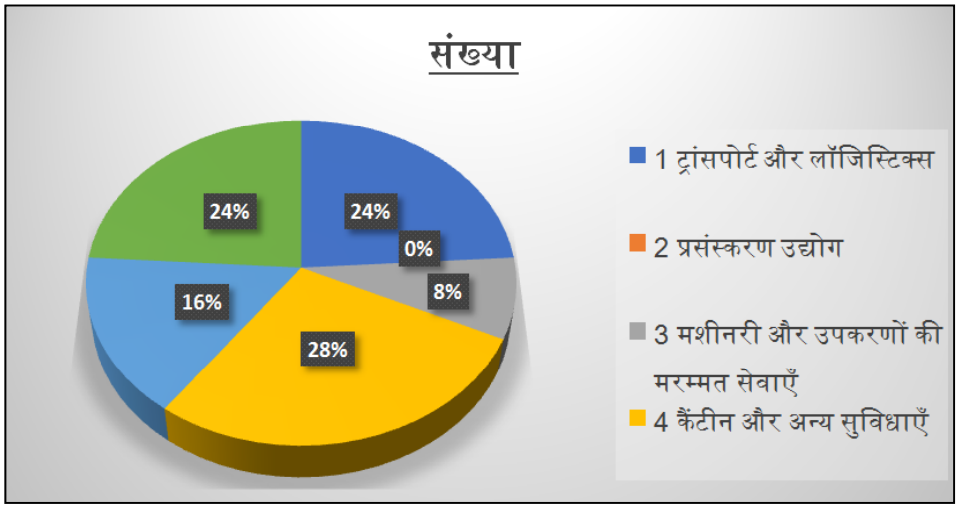


Figure 2

उपरोक्त तालिका 2 में अप्रत्यक्ष खनन रोजगार में लगे व्यक्तियों को दर्शाया गया है, जिसके अन्तर्गत सर्वाधिक प्रतिशत 28% कैंटीन और अन्य सुविधाएँ है, उसके बाद ट्रांसपोर्ट और लॉजिस्टिक्स, दुकानदार 24% है व सबसे कम प्रसंस्करण उद्योग 0% है।

स्वरोजगार के अवसर (Self-Employment Opportunities)

- खडिया व्यापार और आपूर्ति – छोटे व्यापारी खडिया खनिज को अलग-अलग उद्योगों में बेच सकते हैं।

- ठेकेदारी सेवाएँ – खनन क्षेत्र में छोटे ठेकेदार काम कर सकते हैं।
- मशीन किराए पर देने का व्यवसाय – खनन के लिए आवश्यक मशीनरी किराए पर देकर कमाई कर सकते हैं।

स्थानीय अर्थव्यवस्था में योगदान

- रीमा क्षेत्र में लगभग 200 लोग को प्रत्यक्ष या अप्रत्यक्ष रूप से खनन से जुडे हैं।
- महिलाएँ भी छोटे पैमाने पर खनन कार्य में संलग्न हैं।
- स्थानीय बाजारों में खनन से जुडी गतिविधियों (जैसे ट्रैकिंग, मजदूरी) से आय बढी है।

पर्यावरण पर प्रभाव (Impact on Environment)

1. भूमि क्षरण और भू-धंसाव - खनन गतिविधियों के कारण भूमि की सतह कमजोर होती जा रही है, जिससे भू-धंसाव और दरारें उत्पन्न हो सकती हैं। बागेश्वर जिले के कई गांवों में घरों में दरारें और भू-धंसाव की घटनाएँ हुई हैं, जिनका संबंध सीधे खडिया से है।
2. वनस्पति व जैव विविधता पर प्रभाव - खनन से वनस्पति और जैव विविधता पर प्रभाव पड रहा है, खनन के लिए भूमि को साफ करने से वनस्पति कम होती जा रही है, जिससे स्थानीय जैव विविधता पर नकारात्मक प्रभाव पडता है।
3. जल स्रोतों को नुकसान - खनन से जल स्रोतों की गुणवत्ता और मात्रा तेजी से प्रभावित हो रही है, खनन से उत्पन्न अवशेष जल स्रोतों में मिलकर उन्हें प्रदूषित करते हैं।
4. वायुप्रदूषण - खडिया के दौरान उत्पन्न धूल और कण वायु गुणवत्ता को प्रभावित करते हैं, जिससे स्थानीय निवासियों के स्वास्थ्य पर प्रतिकूल प्रभाव पड रहा है।

निष्कर्ष (Conclusion)

खडिया खनन रीमा क्षेत्र में रोजगार का एक प्रमुख स्रोत है, अवैज्ञानिक खनन से पर्यावरणीय क्षति हो रही है। खडिया खनन से रोजगार के कई अवसर उत्पन्न होते हैं, लेकिन यह पर्यावरण पर भी प्रतिकूल प्रभाव डालता है। यदि वैज्ञानिक और पर्यावरण-अनुकूल विधियों को अपनाया जाए, तो इसके नकारात्मक प्रभावों को कम किया जा सकता है। सरकार, उद्योगों, और स्थानीय समुदायों के सहयोग से एक संतुलित दृष्टिकोण अपनाने से यह उद्योग सतत विकास की दिशा में आगे बढ़ सकते हैं, ताकि आर्थिक लाभ और पर्यावरण संरक्षण के बीच संतुलन स्थापित हो सके।

सुझाव (Suggestion)

1. **पर्यावरण-अनुकूल खनन तकनीकों का उपयोग:**
   - अत्याधुनिक और कम प्रदूषण फैलाने वाली मशीनों का उपयोग किया जाए।
   - पर्यावरण के अनुकूल खनन विधियों को अपनाया जाए, जिससे भूमि की सतह को कम से कम नुकसान हो।
   - खनन से सम्बन्धित कानूनों का सख्ती से पालन सुनिश्चित किया जाए।
   - सतत खनन पद्धतियाँ (Sustainable Mining Techniques) अपनाई जाएँ।

2. **पुनर्वनीकरण (Reforestation) एवं पुनर्वास:**
   - खनन के बाद प्रभावित क्षेत्रों में पुनः वृक्षारोपण किया जाए।
   - खनन क्षेत्र में निवास करने वाले लोगों के पुनर्वास की व्यवस्था हो।
3. **जल एवं वायु प्रदूषण को कम करने के उपाय:**
   - जल स्रोतों के आसपास सुरक्षात्मक उपाय किए जाएं।
   - धूल नियंत्रण के लिए नियमित रूप से पानी का छिडकाव किया जाए।
   - फिल्टर और प्रदूषण नियंत्रण यंत्रों का उपयोग किया जाए।
   - पर्यावरणीय प्रभाव आंकलन (EIA) अनिवार्य किया जाए।
4. **सतत विकास पर बल:**
   - सरकार और उद्योगों को मिलकर एक संतुलित खनन नीति तैयार करनी चाहिए।
   - स्थानीय समुदायों को खनन गतिविधियों के लाभों में शामिल किया जाए।
   - स्थानीय समुदायों को प्रशिक्षण देकर वैकल्पिक रोजगार के अवसर उपलब्ध कराए जाएँ।

संदर्भ (References)

1. CPCB (2022), Guidelines for Sustainable Mining Practices.
2. Kumar, A. & Singh, R. (2021). *Impact of Mining on Rural Employment: A Case Study of Uttarakhand.* Journal of Environmental Studies.
3. Mathew, S. (2021). Environmental Impacts of Mining in Himalayan Regions. Springer.
4. Rao, P.N. (2020). Sustainable Development and Mining Practices. Oxford Press.
5. उत्तराखंड खनन विभाग (2023), बागेश्वर जिला खनन रिपोर्ट।
6. उत्तराखंड खनन विभाग (2023), बागेश्वर जिले में खनन गतिविधियाँ।
7. ग्राम- नरगड़ा, तहसील - कपकोट, जनपद- बागेश्वर में खडिया पत्थर के खनन कार्य से संबंधित कार्यकारी सारांश।
8. भारतीय भूवैज्ञानिक सर्वेक्षण (GSI) (2022), खनिज संसाधनों का मूल्यांकन।
9. मिश्र, पी. (2020). उत्तराखंड में प्राकृतिक संसाधनों का दोहन और पर्यावरण।

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