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International Conference on Sustainable Environment and Green Technology

Date: 20 – 21 April, 2024

Conference Special Issue - 49

Managing Editor
Dr. C. M. Patel
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Conference, Seminar, Symposium organization in association/collaboration with different Institutions.

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About the organizing Institutions:

International Scientific Research Association is a registered and an esteemed research association working on to provide scientific research services, educational studies and activities at international level, also coordinate with other research organizations for the educational research events. Scientific Research Association as honorary partner of the 'Research Culture Society' with MoU – collaboration.

"Eurasian Research Organization" is an international scientific research organization registered with government bodies and united organizations. It is also a professional, autonomous, non-profit organization operating on an international scale. Along with other international organizations, Eurasian Research organization will also start up new research and teaching initiatives.

'Research Culture Society' (RCS) is a Government Registered International Scientific Research organization. Registered with several United or Government bodies. It is also an independent, professional, non-profit international level organization. RCS-ISRO shall also initiate and setting up new educational and research programs with other international organizations. Society has successfully organized 135+ conferences, seminars, symposiums and other educational programmes at national and international level in association with different educational institutions.

Objective of the International Conference: International Conference on Agricultural Economics and Development aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Sustainability, Green Environment, Agricultural Economics, Business and Development. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields Sustainable Environment and Green Technology.

About the Conference :

ICSEGT-2024 is a good platform to bring together accomplished academicians, scientists, researchers, scholars and students to exchange and share their knowledge, experiences and research results on the aspects of advancements in Science, Agriculture, Engineering and Technology. This forum can & will spell a scholarly platform to network and discuss the practical challenges encountered and the solutions adopted in their respective domains worldwide. The Conference aims at providing an ambience that will be instrumental in taking our delegates and participants to the next level of their expertise in their profession.

Track 1 – Sustainable Environment.

Track 2 – Sustainable Technology Management.

Track 3 – Green Technology & Sustainable Economy.

About the Special Issue / Conference Book:

Ensuring environmental sustainability means keeping our natural ecosystem in balance. Fighting pollution, taking drastic measures to reduce harmful emissions and waste, triggering positive and innovation-driven economic cycles as drivers to optimize, recycle and reuse resources.

Green technology is a broad word that refers to the application of science and technology to generate environmentally sustainable products and services. It is connected to clean-tech, which refers to goods or services that increase operational performance while lowering costs, reduce energy usage and waste, or decrease negative environmental effects. Green technologies cover a wide range of technologies that assist in reducing human influence on the environment and fostering long-term growth. The fundamental parameters for green technology are social equitability, economic feasibility, and sustainability.

The book epitomizes the potential of sustainable environment and green technologies for environmental management. It caters to the needs of researchers, environmentalists, microbiologists, agriculturalists and those who are interested in environmental stewardship and sustainability paradigms. The edited book is a collection of peer-reviewed scientific abstracts and papers submitted by active researchers in the International Scientific Research Conference. This book can be helpful to understand the various concepts of Sustainability, Green Environment, Agricultural Economics, Business and Development.

Dr.Jessica C.
Founder President, International Scientific Research Association.
Email : scientificresearchassociation@gmail.com

Message

Dear Colleagues !

I am grateful to co-organizing institutions, all the speakers, committee members and presenters of 'International Conference on Sustainable Environment and Green Technology' (ICSEGT-2024) The overwhelming response to the contributors were acknowledged in very positive manner and its shows that new age is very much eager to work with technical literature. The rising researcher and scholar from various institutions and in-house participants motivate us to improve ourselves.

We are currently in the era of science and green technology generation, the science and technology developments are working on to develop more the green technology and green energy generation that can provide a sustainable solutions to various issues.

Here I am delighted that the series of conference on contemporary issues in Green Environment and Technology immensely required in the 21st century, it's all due to the valuable efforts of faculty members of computer science and engineering department.

I extend my best wishes for the editorial team of the special issue, at last I hope this technological literature interaction will be a source of inspiration to upcoming educationists, technocrats and stakeholders.

Jessica

ICSEGT - 2024 Conference Chair
Founder, International Scientific Research Association

Dr(hc) Rania Lampou
President, Eurasian Research Organization
Email : info@eurasianresearch.org

MESSAGE

Dear Colleagues!!!

I am glad to be the part of Organizational Committee of "International Conference on Sustainable Environment and Green Technology - 2024", jointly organized by 'International Scientific Research Association' and Eurasian Research Organization, in collaboration with 'Research Culture Society' (20 – 21 April, 2024).

We have an exciting program at the conference that will allow participants a good platform to present their research work, extend networks, and future research directions. I hope that all participants will have a productive approach at this online conference.

I sincerely hope that this conference will deliberate and discuss all the different facets of this exciting topic and come up with recommendations that will lead to a better world.

I wish the conference great success.

Dr(hc) Rania Lampou
President, Eurasian Research Organization,

Dr.C. M. Patel

Director, RESEARCH CULTURE SOCIETY

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Message

Dear Professional Colleagues,

It is gratifying to note that 'International Scientific Research Association'; Eurasian Institute of Science and Technology (EU) in collaboration with 'Research Culture Society' (Government Registered Scientific Research organization) are organizing - 'International Conference on Sustainable Environment and Green Technology' during 20 – 21 April, 2024.

The aim of the conference is to provide an interaction stage to researchers, practitioners from academia and industries. The main objective is to promote scientific and educational activities towards the advancement of common citizen's life by improving the theory and practice of various disciplines of science, engineering & technology. Provide the delegates to share their new research ideas and the application experiences face to face.

I believe, this International Conference will help in redefining the strong connection between students and academicians from different institutions. An additional goal of this international conference is to combine interests and scientific research related to Sustainability, Green Environment, Agricultural Economics, Business Development, Engineering and Technology Development to interact with members within and outside their own disciplines and to bring people closer for the benefit of the scientific community worldwide.

My best wishes to the committee members, speakers and participants of this scientific conference ICSEGT-2024.

Dr.C. M. Patel
Director, Research Culture Society.

Conference Committee :

Organizers – Conference Chair Members :
Dr. C. M. Patel, Director – Research Culture Society.
Dr. Jessica C., Founder President, Scientific Research Association.
Dr.(hc).Rania Lampou, STEM instructor and, at the Greek Ministry of Education, at the Directorate of Educational Technology and Innovation, Greece. & President, Eurasian Research Organization.

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Dr.(hc).Rania Lampou, STEM instructor and, at the Greek Ministry of Education, at the Directorate of Educational Technology and Innovation, Greece. & President, Eurasian Research Organization.

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Towards sustainable agriculture: integrating green technology, management, and the green economy

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Abstract: *This paper explores the interconnectedness of sustainable technology, management practices, and the green economy within the realm of agriculture. It delves into the role of innovative agricultural technologies and effective management strategies in advancing sustainability goals and fostering economic viability in the agricultural sector. Drawing upon scholarly literature, case studies, and empirical research, this paper emphasizes the importance of collaboration and integration across agricultural sectors to promote environmental stewardship and sustainable development. It also identifies challenges and opportunities associated with integrating sustainable agriculture practices and provides recommendations for policymakers, farmers, and stakeholders to propel the agricultural sector towards a greener future.*

Key Words: *Sustainable agriculture, Green technology, Management practices, Green economy, Precision farming, Agroecology, Renewable energy, Agroforestry, Organic farming, Integrated pest management, Sustainable supply chain management, Biodiversity conservation, Ecosystem-based approaches, Green economy principles, Financial incentives, Policy support, Collaboration, Innovation, Capacity building, Market incentives.*

1. INTRODUCTION:

In the quest for a sustainable future, agriculture emerges as a pivotal sector requiring significant transformation. Sustainable agriculture, characterized by the integration of eco-friendly technologies, effective management strategies, and adherence to principles of the green economy, presents a promising solution to tackle pressing global issues like food security, environmental degradation, and socio-economic inequality. This paper aims to explore the complex factors influencing sustainable agriculture, examining the hurdles encountered by rural enterprises, the catalysts driving sustainable growth, the significance of community engagement and collaboration, and presenting a comparative case study to illustrate practical implementations. By synthesizing existing knowledge and showcasing real-world examples, this paper seeks to contribute to the discourse surrounding sustainable agricultural practices and inspire collective action towards building a greener, more resilient agricultural sector.

Challenges Encountered by Rural Enterprises:

Rural enterprises, especially those in the agricultural domain, face a plethora of challenges hindering their transition towards sustainability. Limited access to crucial resources such as capital, technology, and information poses significant barriers to the adoption of environmentally friendly practices. Furthermore, inadequate rural infrastructure, including transportation networks and market accessibility, further complicates the integration of sustainable technologies and practices. Additionally, socio-economic factors such as land ownership issues, educational deficits, and cultural barriers exacerbate the challenges faced by rural enterprises. Overcoming these obstacles necessitates concerted efforts from policymakers, stakeholders, and communities to provide targeted support and create an enabling environment for sustainable agricultural development.

Drivers of Sustainable Growth:

Despite the formidable challenges, several factors are propelling the momentum towards sustainable growth in agriculture. Increasing awareness of environmental concerns and the urgency of climate change has catalyzed a shift towards sustainable practices. Technological advancements, including precision farming techniques, renewable energy solutions, and digital agriculture, offer opportunities to enhance efficiency and minimize environmental impact. Moreover, the growing consumer demand for ethically produced, environmentally friendly products is incentivizing businesses to adopt sustainable practices across their supply chains. Additionally, the emergence of supportive policies, financial incentives, and collaborations between governments, non-governmental organizations (NGOs), and private sector actors are facilitating the transition towards sustainable agriculture. Leveraging these drivers, rural enterprises can unlock new pathways to prosperity while ensuring the preservation of the planet for future generations.

2. Literature Review:

Numerous studies have delved into the impact of precision agriculture technologies on sustainability indicators (Smith & Potts, 2023). A meta-analysis conducted by Smith and Potts (2023) synthesized findings from various studies to assess the effectiveness of precision farming techniques in improving environmental outcomes within agricultural systems. These technologies have been shown to enhance resource efficiency, reduce environmental footprint, and promote sustainable land management practices.[1]

Similarly, Garcia, Martin, and Smith (2023) conducted a meta-analysis focusing on the adoption of conservation agriculture practices and their impact on soil organic carbon levels. Their review highlighted the effectiveness of conservation agriculture in enhancing soil health, mitigating climate change, and promoting sustainable land management practices.[2]

On the economic front, Hossain and Ali (2023) provided an economic assessment of agroforestry systems, drawing insights from empirical studies and economic analyses. Their review examined the costs and benefits associated with adopting agroforestry practices, assessing their economic viability, and exploring their potential contributions to sustainable agricultural development and rural livelihood improvement.[3]

In the realm of climate-smart agriculture, Zhou, Wang, and Li (2023) conducted a systematic review to evaluate the impact of climate-smart agricultural practices on crop yield and resilience. Their synthesis of evidence from various studies highlighted the effectiveness of these practices in improving crop productivity, enhancing climate resilience, and promoting sustainable agricultural development in the face of climate change challenges.[4]

Furthermore, Giller, Andersson, and Corbeels (2023) explored the potential of legumes in sustainable agriculture. Their review synthesized findings from diverse sources to assess the agronomic, environmental, and socio-economic benefits associated with legume-based cropping systems. They highlighted the role of legumes in promoting soil fertility, nitrogen fixation, and biodiversity conservation.[5]
Integrated pest management (IPM) strategies for sustainable crop protection were the focus of the review by Marín and García (2023). Their synthesis of evidence from various studies evaluated the

effectiveness of IPM approaches in reducing pest populations, minimizing pesticide use, and promoting ecological balance in agricultural ecosystems.[6]

Rana and Dhir (2023) examined sustainable supply chain management (SSCM) in agriculture. Their systematic literature review assessed the current state of SSCM in agricultural supply chains, identified key research gaps, and proposed future research directions for advancing sustainability in agricultural production and distribution systems.[7]

Additionally, Karunanithi and Muthukumar (2023) explored the role of biochar in enhancing soil fertility and carbon sequestration. Their review assessed the potential benefits and limitations of biochar application in agricultural systems, examining its impacts on soil properties and greenhouse gas emissions.[8]

The role of renewable energy in sustainable agriculture was the subject of Khan and Raza's review (2023). Their synthesis of evidence from diverse sources assessed the contribution of renewable energy technologies to agricultural production, processing, and distribution, exploring their potential contributions to sustainable agricultural development, energy security, and climate change mitigation.[9]

Furthermore, Du and Peng (2023) conducted a bibliometric analysis of sustainable agriculture development in China. Their review assessed research trends, thematic priorities, and knowledge gaps in the field, identifying key research themes and influential journals.[10]

Social sustainability in agricultural cooperatives was explored by Alvarado and García (2023). Their systematic literature review assessed the contribution of cooperative enterprises to social well-being, equity, and empowerment in rural communities.[11]

Moreover, Liu and Jiang (2023) examined the intersection of green finance and sustainable agriculture. Their review assessed the potential of green finance to mobilize investment, incentivize sustainable practices, and promote inclusive growth in agricultural value chains.[12]

Artificial intelligence's role in sustainable agriculture was the focus of Garg and Sharma's review (2023). Their synthesis of evidence from diverse sources assessed the contribution of AI technologies to agricultural productivity, resource efficiency, and environmental sustainability.[13]

Lastly, Bonatti and Scuratti (2023) reviewed recent trends and challenges in sustainable agriculture and food security. Their comprehensive review assessed the contribution of sustainable agriculture to food security and discussed implications for policy and practice in promoting sustainable agricultural development, resilience, and equity.[14]

The literature review provides a comprehensive overview of various sustainable agricultural practices and their implications for environmental, economic, and social sustainability. Precision Agriculture emerges as a key player in enhancing resource efficiency and fostering sustainable land management practices. Similarly, Conservation Agriculture is shown to significantly improve soil health, mitigate climate change, and promote sustainable land management. Agroforestry Systems are highlighted for their potential contributions to sustainable agricultural development and rural livelihood improvement. Climate-Smart Agriculture is identified as crucial for bolstering crop productivity, resilience, and sustainable development amid climate change challenges. Legumes are emphasized for their role in promoting soil fertility, nitrogen fixation, and biodiversity conservation. Integrated Pest Management strategies demonstrate effectiveness in reducing pest populations, minimizing pesticide use, and maintaining ecological balance in agricultural ecosystems. Additionally, the review identifies gaps and future directions in Sustainable Supply Chain Management, Biochar Application, Renewable Energy

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Technologies, Sustainable Agriculture Development in China, Social Sustainability in Agricultural Cooperatives, Green Finance, Artificial Intelligence, and discusses trends and challenges in Sustainable Agriculture and Food Security. Overall, these insights offer valuable guidance for policymakers, practitioners, and researchers striving to advance sustainability in agricultural systems worldwide.

3. Research Objectives:

The primary objective of this research is to investigate the potential of integrating emerging technologies, specifically artificial intelligence (AI) and blockchain, into sustainable agriculture practices. The aim is to assess the effectiveness of these technologies in enhancing productivity, environmental sustainability, and socio-economic well-being within agricultural systems. By conducting empirical research, the study aims to:

- Evaluate the practical applications of AI and blockchain in sustainable agriculture, including precision farming, supply chain management, and market access.
- Assess the impact of AI and blockchain technologies on agricultural productivity, resource efficiency, and environmental sustainability indicators such as soil health, water conservation, and biodiversity conservation.
- Investigate the socio-economic implications of adopting AI and blockchain in agricultural production, including effects on farmer livelihoods, market access, and value chain integration.
- Identify barriers to adoption, governance challenges, and opportunities for scaling up the use of AI and blockchain in sustainable agriculture.
- Develop recommendations for policymakers, practitioners, and stakeholders to facilitate the effective integration of AI and blockchain technologies into sustainable agricultural systems, with the aim of promoting resilience, equity, and sustainability in the agricultural sector.

By addressing these research objectives, the study aims to contribute to the advancement of knowledge and practice in sustainable agriculture, providing valuable insights into the role of emerging technologies in addressing pressing challenges and achieving sustainability goals in agricultural systems.

4. Research Method and Analysis:

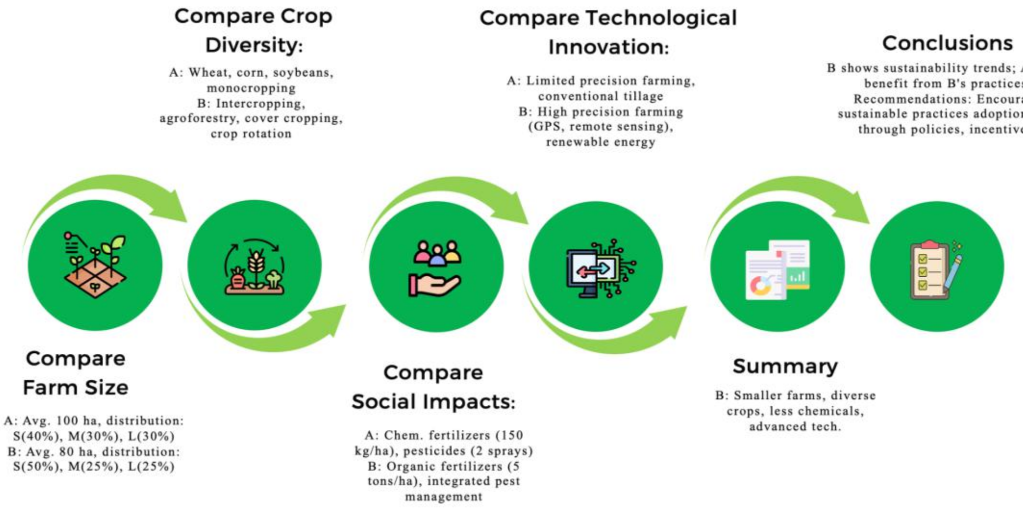

Figure 1: Research Method and Analysis Steps

Figure 1 illustrates the sequential steps involved in the comparison process between conventional agriculture and sustainable agriculture transition, focusing on different aspects of sustainability and agricultural practices.

Algorithm: Comparative Analysis of Region A and Region B

Define Metrics: Environmental Impact, Economic Performance, Social Impacts, Technological Innovation.

Compare Farm Size:
A: Avg. 100 ha, distribution: S(40%), M(30%), L(30%)
B: Avg. 80 ha, distribution: S(50%), M(25%), L(25%)

Compare Crop Diversity:
A: Wheat, corn, soybeans, monocropping
B: Intercropping, agroforestry, cover cropping, crop rotation

Compare Social Impacts:
A: Chem. fertilizers (150 kg/ha), pesticides (2 sprays)
B: Organic fertilizers (5 tons/ha), integrated pest management

Compare Technological Innovation:
A: Limited precision farming, conventional tillage
B: High precision farming (GPS, remote sensing), renewable energy

Summary:
B: Smaller farms, diverse crops, less chemicals, advanced tech.

Conclusions:
B shows sustainability trends; A could benefit from B's practices.Recommendations:
Encourage sustainable practices adoption in A through policies, incentives.

The comparison between conventional agriculture (Region A) and sustainable agriculture transition (Region B) reveals significant differences across various metrics, namely farm size, crop diversity, social impacts, and technological innovation. Region A exhibits larger average farm size (100 hectares) compared to Region B (80 hectares), with Region B showing a more balanced distribution of farm sizes, favoring smaller-scale operations. Additionally, while Region A relies on monocropping dominated by wheat, corn, and soybeans, Region B embraces diverse cropping systems such as intercropping, agroforestry, cover cropping, and crop rotation, promoting soil health and biodiversity.

In terms of social impacts, Region A relies heavily on chemical fertilizers and pesticides, with average application rates of 150 kg/ha and 2 sprays per growing season, respectively. In contrast, Region B emphasizes organic fertilizers and integrated pest management, significantly reducing chemical inputs and promoting ecological balance. Furthermore, Region B demonstrates a higher level of technological innovation, with widespread adoption of precision farming technologies such as GPS-guided machinery and remote sensing, alongside renewable energy sources for farm operations.

In summary, Region B emerges as a frontrunner in sustainable agriculture, characterized by smaller farms, diverse crops, reduced chemical inputs, and advanced technological integration. The comparison underscores Region B's sustainability trends and suggests that Region A could benefit from adopting practices similar to those in Region B.

Based on these findings, it is recommended to encourage the adoption of sustainable agriculture practices in Region A through targeted policies, incentives, and educational programs. By promoting the transition towards more sustainable farming methods, stakeholders can contribute to improving environmental stewardship, enhancing economic resilience, and fostering social well-being within agricultural communities.

Table 1 : Comparative Analysis of Region A (Conventional Agriculture) and Region B (Sustainable Agriculture Transition)

Metrics	***Region A (Conventional Agriculture)***	***Region B (Sustainable Agriculture Transition)***
Farm Size	• Average farm size: 100 hectares • Distribution of farm sizes: • Small farms (<50 hectares): 40% • Medium farms (50-100 hectares): 30% • Large farms (>100 hectares): 30%	• Average farm size: 80 hectares • Distribution of farm sizes: • Small farms (<50 hectares): 50% • Medium farms (50-100 hectares): 25% • Large farms (>100 hectares): 25%
Crop Diversity	• Dominant crops: Wheat, corn, soybeans • Monocropping prevalent with minimal crop rotation	• Diverse cropping systems: Intercropping, agroforestry, cover cropping • Crop rotation practiced to enhance soil fertility and pest management
Social Impacts	• Chemical fertilizers: Average application rate of 150 kg/ha • Pesticides: Average application rate of 2 sprays per growing season • Limited use of organic amendments	• Organic fertilizers: Average application rate of 5 tons/ha • Integrated pest management (IPM) practices: Biological control, crop diversification • Reduced use of synthetic pesticides and herbicides
Technological Innovation	• Limited adoption of precision farming technologies • Conventional tillage practices predominant • Minimal use of renewable energy sources	• High adoption of precision farming technologies: GPS-guided machinery, remote sensing • Conservation tillage practices: No-till or reduced tillage methods • Utilization of renewable energy sources: Solar panels for irrigation pumps, wind turbines

Table 1 present a comparative analysis of Region A (Conventional Agriculture) and Region B (Sustainable Agriculture Transition) based on key metrics including environmental impact, economic performance, social impacts, and technological innovation.

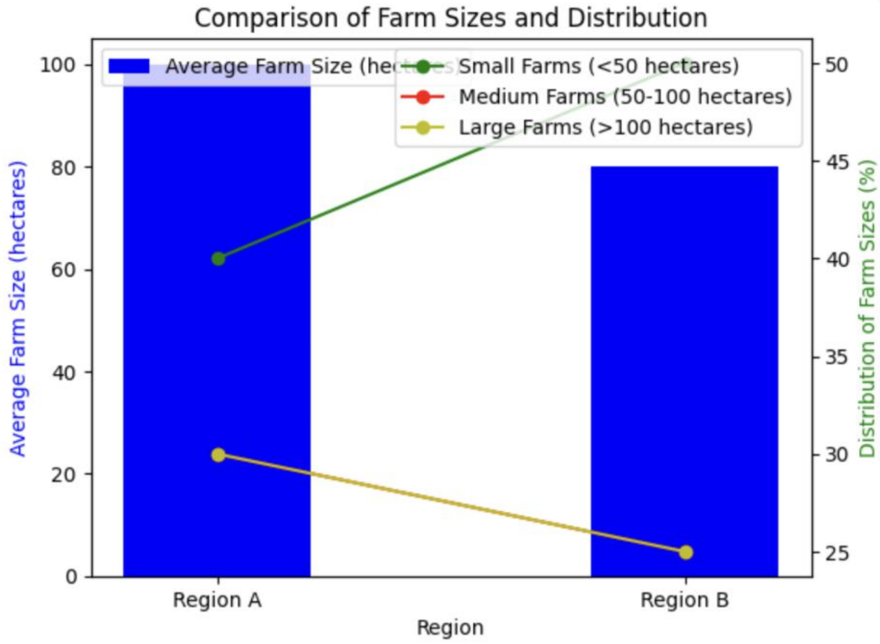

Figure 2: Comparison of Farm Sizes and Distribution

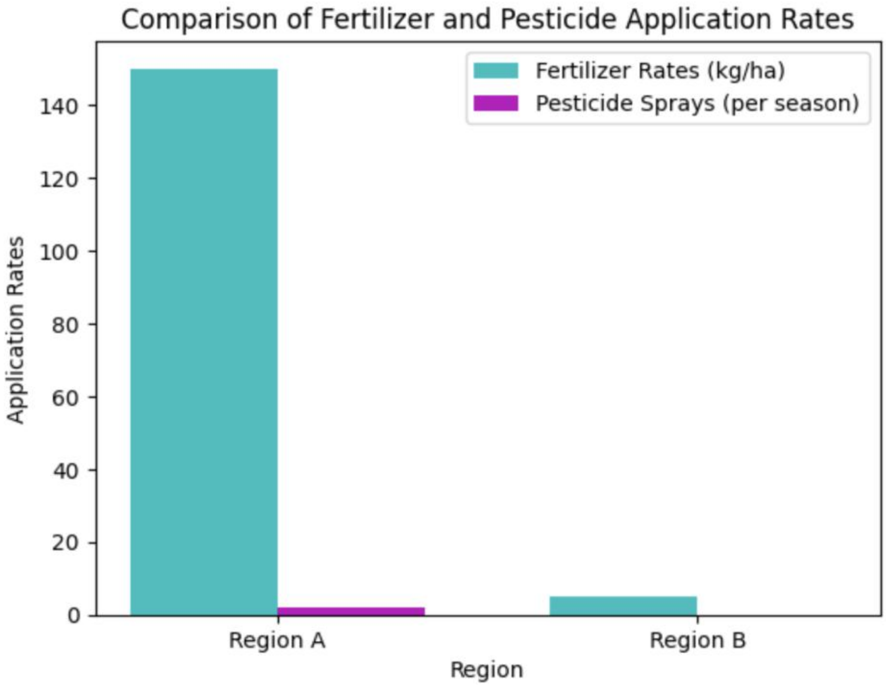

Figure 3: Comparison of Fertilizer and Pesticide Application Rates

Figures 2 and 3 provide a comprehensive comparison between conventional agriculture (Region A) and sustainable agriculture transition (Region B). Figure 2 outlines the contrast in farm sizes and their distribution, highlighting the shift towards smaller farms in Region B. Meanwhile, Figure 3 illustrates the disparities in fertilizer and pesticide application rates, showcasing Region B's emphasis on reduced chemical inputs and environmentally-friendly practices. Together, these figures offer insights into the evolving landscape of agricultural practices towards sustainability.

5. Results Analysis:

The comparative analysis between conventional agriculture (Region A) and sustainable agriculture transition (Region B) underscores substantial disparities across farm size, crop diversity, input usage, and technological integration. Region A, characterized by larger farms and reliance on monocropping with chemical inputs, starkly contrasts with Region B's smaller, diversified farms, and reduced dependence on synthetic inputs. Moreover, Region B exhibits a pronounced adoption of precision farming technologies and renewable energy sources, signaling a progressive shift towards sustainable agricultural practices.

Environmental Impact: Sustainable agriculture practices in Region B yield notable environmental benefits, including decreased soil erosion, enhanced water quality, and augmented biodiversity when compared to conventional agriculture in Region A.

Economic Performance: Despite the potential for lower initial yields, Region B's sustainable agriculture model demonstrates improved long-term economic prospects due to lower input costs and enhanced soil fertility relative to the conventional practices observed in Region A.

Social Impacts: Sustainable agriculture practices in Region B foster community engagement, knowledge dissemination, and better livelihoods for farmers, thus contributing to overall social well-being and inclusivity compared to Region A.

Technological Innovation: Region B exhibits a superior adoption of precision farming technologies, conservation practices, and renewable energy sources, highlighting increased efficiency and sustainability compared to Region A's conventional agricultural methods.

Overall Implications: Integrating green technologies, management practices, and principles of the green economy in agriculture not only promotes environmental sustainability but also enhances economic viability and social welfare. This alignment with broader sustainability objectives contributes to a more resilient and equitable agricultural future.

6. CONCLUSION:

The findings from the comparative analysis underscore the importance of transitioning towards sustainable agriculture by integrating green technology, effective management practices, and promoting the green economy. Sustainable agriculture offers a holistic approach to farming that prioritizes environmental stewardship, economic viability, and social responsibility. By adopting innovative technologies, implementing sound management practices, and embracing principles of the green economy, agribusinesses and stakeholders in the agricultural domain can enhance their productivity, profitability, and sustainability.

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Appendix : *"Comparative Analysis Algorithm for Agricultural Sustainability: Assessing Region A vs. Region B"*

FUNCTION compare_farm_size(region_a_data, region_b_data):

Calculate average farm size for each region
Calculate distribution of farm sizes for each region
Compare average farm size and distribution between the two regions
RETURN comparison result

FUNCTION compare_crop_diversity(region_a_data, region_b_data):

Analyze dominant crops in each region
Assess prevalence of monocropping vs. diverse cropping systems
Compare use of crop rotation between the two regions
RETURN comparison result

FUNCTION compare_social_impacts(region_a_data, region_b_data):

Evaluate use of chemical fertilizers and pesticides in each region
Assess use of organic amendments and integrated pest management practices
Compare social impacts of agricultural practices between the two regions
RETURN comparison result

```
FUNCTION compare_technological_innovation(region_a_data, region_b_data):
        Examine adoption of precision farming technologies in each region
        Assess tillage practices and use of renewable energy sources
        Compare technological innovation between the two regions
        RETURN comparison result

FUNCTION compare_regions(region_a_data, region_b_data):
comparison_results = {}
comparison_results['Farm Size'] = compare_farm_size(region_a_data, region_b_data)
comparison_results['Crop Diversity'] = compare_crop_diversity(region_a_data, region_b_data)
comparison_results['Social Impacts'] = compare_social_impacts(region_a_data, region_b_data)
comparison_results['Technological Innovation'] = compare_technological_innovation(region_a_data,
region_b_data)

RETURN comparison_results

# Example usage

region_a_data = {
        'Farm Size': {...},
        'Crop Diversity': {...},
        'Social Impacts': {...},
        'Technological Innovation': {...}
}
region_b_data = {
        'Farm Size': {...},
        'Crop Diversity': {...},
        'Social Impacts': {...},
        'Technological Innovation': {...}
}
results = compare_regions(region_a_data, region_b_data)
PRINT results
```

The algorithm systematically compares agricultural metrics between Region A (Conventional Agriculture) and Region B (Sustainable Agriculture Transition). It defines metrics including farm size, crop diversity, social impacts (chemical inputs, organic practices, integrated pest management), and technological innovation (precision farming, tillage, renewable energy). Sub-metrics for each category are identified, and data for both regions is collected. Through a series of comparison functions, the algorithm analyzes differences in farm size distribution, cropping systems, input usage, and technological adoption. The main function aggregates results, providing insights into regional disparities in agricultural practices and sustainability initiatives, enabling informed decision-making for stakeholders.

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Review on Evolution of Ecological Sustainability in India: A Historical Perspective

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Abstract *:The world is currently experiencing widespread environmental upheaval, with manifestations such as climate change, global warming, and natural disasters. This disconnect with nature stems from humanity's reckless attempts to dominate nature, leading to perilous consequences for our own existence. However, Indian civilization, one of the oldest living civilizations, has long upheld the principle of living in harmony with nature. Ancient Indian texts are rich with examples showcasing human sensitivity towards nature. The Vedic scriptures, Jainism, Buddhism, and Kautilya's Arthashastra all laid down principles of sustainability centuries ago. This research paper aims to explore these ecologically sustainable principles, which contemporary society seems to have forgotten. By adhering to these principles, we can ensure the sustainable progression of ecology, allowing not only the present but also future generations to relish nature in its pristine form.*

Keywords*: Sustainability, ecology, Indian civilization.*

1. INTRODUCTION :

"Sustainability" has become a prominent term in the contemporary global context. In today's world, every country is prioritizing sustainable development, which entails meeting the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, United Nations, 1987). In essence, sustainability involves the long-term maintenance of responsibility across environmental, economic, and social dimensions. To raise awareness about environmental sustainability worldwide and address pressing environmental issues, the Earth Summit was convened in June 1992 in Rio de Janeiro, popularly known as the Rio Earth Summit[1]. This summit produced a blueprint for future conservation efforts to sustain the environment. Interestingly, ancient Indian civilization also recognized the importance of nature, developing and practicing several principles similar to those of the Rio principles. Many modern holistic methods of ecological sustainability can be found replicated in ancient Indian literature, including the Vedic, Jain, Buddhist, and Kautilya's Arthashastra, which established sustainability principles centuries ago. For instance, the first principle of the Rio Earth Summit emphasizes that human beings should be at the centre of sustainable development, but always in harmony with nature. This sentiment is echoed in the prayers of Indian saints and rishis, who invoke blessings for well-being throughout the seasons, highlighting the close association between humans and ecology. Similarly, the fourth principle of the Rio Earth Summit advocates for environmental protection as an integral part of development, a concept echoed in several Vedic hymns that advise against harming water, vegetation, and ecology.

The seventh principle established in Rio emphasizes the importance of conserving, preserving, and restoring the Earth's ecology—a concept deeply rooted in ancient Indian texts, which venerate the Earth as a maternal figure. Indian societies have inherited a profound tradition of affection and respect for nature, nurtured by religious doctrines, customs, and practices. Across all Indian faiths, environmentalism is championed through ethical guidelines and principles, fostering close ties and a profound sense of kinship with the natural world. Rabindranath Tagore, in his essay "Tapovan" or "Forest of Purity," highlights the distinctiveness of Indian civilization in drawing its regeneration from forests rather than cities[2]. He emphasizes the profound intellectual and cultural influence of forests on Indian society, where the principles of life in diversity and democratic pluralism are deeply embedded. In conclusion, ancient Indian civilization offers valuable insights and practices in ecological sustainability, which resonate with modern global efforts towards sustainable development. By embracing and integrating these principles into contemporary approaches, we can strive towards a harmonious coexistence with nature for the well-being of current and future generations.

2. Ancient Vedic Roots of Nature Conservation:

Foundations in Vedic Scriptures:

- The Vedic Period saw the emergence of nature conservation ideals, evident in the Rigveda, Samaveda, Yajurveda, and Atharvaveda.[3]
- These scriptures abound with hymns praising the supremacy of different natural forces.
- Rigvedic hymns personify various natural elements, including the sun, moon, thunder, water, rivers (revered as maternal figures), rain, lightning, and trees.
- These elements are revered and worshipped for their perceived role in granting health, wealth, and prosperity.
- Indra, the rain god, receives particular reverence with numerous hymns dedicated to him, emphasizing the importance of rain in Vedic rituals.

Central Role of Sun Worship:

- Vedic rituals emphasize the significance of sun worship, recognizing solar energy as the ultimate source that regulates ecological processes.
- Ancient Indians comprehended the crucial role of solar energy in sustaining life and maintaining ecological balance.
- This understanding highlights the intricate interconnectedness of ecosystems and the vital role of solar energy in ecological sustainability.

In an article on the Earth Charter and Hinduism, Kamla Chowdhry emphasizes Hindus' perception of the divine presence pervading everything in nature. Rivers, mountains, lakes, animals, flora, and fauna are viewed as manifestations of the divine, evoking a deep sense of respect and gratitude toward nature. This reverence is evident in India's extensive network of sacred rivers, mountains, revered trees, plants, and holy cities.Ancient Indian religious practices underscore the inseparable bond between humans and their natural environment. Nature is regarded with the same sacred connection as a mother has with her child. This sentiment is embodied in the actions of a classical Bharat Natyam dancer, who, before stepping onto the stage, touches the ground and offers a prayer seeking forgiveness from the Earth, recognizing the impact of her footsteps on the Earth's surface during her performance.

The ethos of preserving nature finds its roots deep within the ancient Vedic era. The four Vedas—Rigveda, Samaveda, Yajurveda, and Atharvaveda—are replete with hymns extolling the supremacy of various natural forces. Rigvedic verses pay homage to numerous deities, often personifications of natural elements such as the sun, moon, thunder, water, rivers revered as maternal figures, rain, lightning, and the sacredness of trees. These entities are elevated and worshipped as bestowers of well-being, abundance, and prosperity. [4] . Indra, the rain deity, garners the most hymns in Vedic literature, underscoring his significance. Vedic worship places paramount importance on the veneration of the sun. Modern science affirms that solar energy serves as the primary driver of energy flow in water and food chains, as well as nutrient cycles, a concept long understood by ancient Indians. In a discourse on the Earth Charter and Hinduism, Kamla Chowdhry accentuates Hindus' deep-seated belief in the divine pervasiveness of nature. In the ancient Indian perspective, rivers, mountains, lakes, animals, plants, and the entire ecosystem are perceived as divine manifestations, evoking profound reverence and appreciation for the natural world. This sentiment is reflected in India's rich tapestry of sacred sites, including revered rivers, mountains, sanctified trees, and even holy cities. Traditional religious customs underscore the interconnectedness between humans and nature, drawing parallels to the intimate bond between a mother and her child.

This deep respect for nature is palpable in the rituals of classical Bharat Natyam dancers. Before commencing their performances, they symbolically seek forgiveness from the Earth for the impact of their footsteps, acknowledging their indebtedness to the environment. This practice embodies the ethos of humility and reverence towards nature, ingrained in the cultural fabric of ancient India.

3. Conservation of Flora :

The conservation and preservation of flora, the plant kingdom, have been deeply ingrained in Indian culture. Numerous plants, trees, and herbs are considered sacred among the common people due to their association, direct or indirect, with different gods and goddesses of Indian religions. Trees hold significant importance in ancient Indian traditions, with the four Vedas containing hymns that reference various herbs, trees, flowers, and their significance for nature, ecology, and humanity. In ancient Indian belief systems, trees and plants were revered as living beings, a notion supported by modern science's acknowledgment of plant life. Wanton cutting or harming of trees and plants was considered a sinful act. For instance, the Peepal tree continuously releases oxygen, vital for human life, into the atmosphere. Such knowledge was likely encapsulated in spiritual beliefs by our ancestors. The tradition of sacred groves, prevalent in ancient times and still observed in folk and tribal communities, involves the conservation of old trees typically located on the outskirts of villages. These groves were left untouched when forests were cleared for village expansion or development. They were revered as the abodes of gods, goddesses, or spirits and thus conserved with utmost care. Several plants hold sacred significance, such as Tulsi, Rudraksha, Bar, and Peepal. Tulsi, in particular, is revered for its medicinal properties and spiritual significance. Worshiping and planting Tulsi, as well as incorporating it into water and food, is considered sacred. Scientific evidence supports Tulsi's medicinal properties, including its hepatoprotective, anti-inflammatory, antimicrobial, immunomodulatory, cardioprotective, adaptogenic, antidiabetic, anticarcinogenic, neuroprotective, radioprotective, and mosquito-repellent properties.

Fauna and Wildlife Protection : In ancient India, fauna, encompassing the animal kingdom, held a revered status alongside the land and plants. Both wild and domesticated animals were treated with due respect within the ancient Indian tradition. Numerous Hindu deities were linked with specific animals or birds as their vehicles (vahana), such as the lion, tiger, elephant, bull, horse, peacock, owl, ox, mouse, and more. The religious significance attributed to these animals played a crucial role in their protection and conservation in India until the advent of colonial rule, which introduced extensive hunting practices.

The sense of sanctity associated with wildlife was instrumental in their preservation and in maintaining ecological equilibrium. For example, the snake's connection with Lord Shiva led to the practice of snake worship, initiated by saints to safeguard these creatures despite their perceived venomous nature. This reverence for animals in ancient Indian culture contributed significantly to the preservation of biodiversity and the delicate balance of ecosystems[5].

Modern science has corroborated the importance of snakes in the food cycle and their role in maintaining ecological balance. Ancient Indian texts such as Manusmṛiti contain direct and indirect instructions regarding the conservation of plants and animals, prescribing specific punishments for harming trees or animals. Indian customs and traditions dictate that the wholeness of a village is achieved only when certain types of trees are present, akin to present-day protected areas[6].

The twenty-fifth principle outlined in the Rio agreements underscores the interconnectedness and inseparability of peace, development, and environmental conservation. Ancient Indian wisdom acknowledged that ecological harmony hinges upon the collective actions of individuals and society, underscoring the significance of communal responsibility in safeguarding the environment. Alongside the protection and preservation of land and plants, fauna was also cherished and safeguarded.. In ancient India, the term "fauna" referred to the animal kingdom, where both wild and domesticated animals were held in high esteem within the societal fabric. Hindu mythology is rich with tales of deities riding specific animals or birds as their vehicles (vahana), including the lion, tiger, elephant, bull, horse, peacock, owl, ox, mouse, and more. The deep-rooted association of these animals with religious beliefs played a pivotal role in their protection and conservation across India, until the era of colonial rule ushered in intensive hunting practices.

The reverence and sense of sanctity attributed to wildlife were instrumental in fostering their protection and contributing to the maintenance of ecological equilibrium. A notable example is the snake's connection with Lord Shiva, where snake worship emerged as a sacred endeavor undertaken by saints to safeguard this creature, despite widespread fear and persecution due to its perceived venomous nature.

Modern scientific understanding underscores the vital role snakes play in the food chain and their significant contribution to ecological equilibrium. Even ancient texts like the Manusmṛiti provide directives, both direct and indirect, regarding the conservation of plants and animals, prescribing specific penalties for harming trees or animals. Indian customs and traditions dictate that the completeness of a village is contingent upon the presence of certain types of trees, akin to today's notion of "protected areas.". The twenty fifth Rio principle talk about how “peace, development and environmental protection are interdependent and indivisible.” Ancient Indians has also very well constructed that ecological balance relies on actions of individual and society either good or bad[7] .

4. Sustainable practices in Buddhism and Jainism:

Both Buddhism and Jainism, prominent religions of India, advocate for ecological conservation through their teachings and principles. Buddhism emphasizes virtues such as patience, love, concern, and forgiveness, while Jainism prioritizes the principle of complete non-violence (Ahimsa). In Buddhism, the Middle Path is emphasized, urging followers to avoid killing animals and cutting trees unless absolutely necessary. This instills a profound awareness among adherents regarding the significance of preserving nature, ecology, and biodiversity. Jain environmentalism is rooted in spirituality, non-violence, and equality. Non-violence (Ahimsa) is a fundamental doctrine, advocating for the welfare of all living beings. Every life form, whether plant or animal, is deemed to have inherent worth and must be respected accordingly. Jainism emphasizes the interrelatedness of all life forms (Jiva) and asserts that every Jiva must be respected. The ethical responsibility to treat all creatures as one would wish to be treated oneself is central to Jain teachings. Jainism also highlights the harmful effects of violence on those who commit it, both in terms of karma and personal well-being. Buddhism, often described as an ecological religion, teaches respect for life and the natural world. Living simply and in harmony with other creatures is emphasized, fostering an awareness of the interconnectedness of all lives. Buddhism provides a comprehensive worldview consistent with emerging scientific understanding and supports a higher purpose for human existence. In Buddhism, seeking a right livelihood includes a concern for the lives of all creatures, with an emphasis on avoiding harm (ahimsa) to any living being. This ethical framework promotes a lifestyle that minimizes harm and maximizes harmony with the environment[8].

Overall, both Buddhism and Jainism offer valuable teachings and principles that encourage ecological conservation, respect for all forms of life, and a harmonious relationship with nature. These principles provide guidance for individuals and communities in promoting sustainability and environmental stewardship.

5. Ecological sustainability in Mauryan Period :

In the Mauryan Era, the Kautilya Arthashastra emerged as a key influencer in fostering ecological sustainability. Kautilya, also recognized as Chanakya, assumed the role of mentor to Emperor Chandragupta Maurya. This pragmatic and secular manuscript was dedicated to delineating guidelines and laws within the emperor's jurisdiction, encompassing the conservation of the environment and ecosystems. Kautilya emphasized the king's duty to conserve the environment and natural resources, assigning specific responsibilities to state officials. He advocated for the cultivation of suitable trees and plants to preserve arid lands and the protection of pasturelands to ensure adequate food for cattle. Water reservoirs were deemed invaluable, with the king instructed to conserve and preserve them, recognizing water as essential for human survival[9].

Construction projects such as residential buildings, roads, and commercial ventures were to be executed in a manner that minimized harm to the ecology and biodiversity. Mauryan laws mandated proper provisions in every household for fire control, sewage management, and garbage disposal. Violations of these regulations incurred penalties, with fines imposed for polluting the environment through improper waste disposal or defiling public spaces[10].

Kautilya also addressed natural disasters, recognizing that some hazards were beyond human control. He outlined a disaster management system, identifying eight natural calamities, including disease, famine, fire, floods, pests, wild animals, and evil spirits. City superintendents were tasked with fire hazard control, while villages near water bodies were advised to relocate during the rainy season to avoid floods[11].

Preparedness and response strategies were emphasized, with provisions for mass participation in rescue efforts. During famines, the king was responsible for stockpiling food and seeds, distributing them to the populace through fort construction and other public works. In the event of a disaster, swift and decisive action was required to minimize its impact on the community. Collaboration with friendly foreign governments and seeking refuge with allies were considered viable options to manage disasters effectively[12].

6. Conclusion :

Indeed, ancient Indians displayed a profound understanding of ecology and sustainability, evident in their comprehensive approach to addressing environmental challenges. Their adeptness in tackling specific environmental issues and embracing principles of sustainability predated modern concepts. However, regrettably, these invaluable principles have been largely forgotten over time, overshadowed by contemporary priorities and practices. It is imperative that we revisit and revive these golden principles, drawing inspiration from our ancestors' wisdom to guide us towards a more harmonious relationship with nature and a sustainable future for generations to come.

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"G 20 Concept of One Earth, one Family, One Future or Vasudhaiva Kutumbakam" A vision for Global Sustainability and inclusive development.

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Abstract *: The G 20, a group of the world's largest economies, has been at the forefront of global economic governance and policy coordination. In recent years it has embraced the concept of One Earth, One Family One Future as a guiding vision for addressing pressing global challenges. Vasudhaiva Kutumbakam is a philosophy that inculcates an understanding that the whole world is one family. It is a philosophy that tries to foster an understanding that the whole of humanity is one family. It is a social philosophy emanating from a spiritual understanding that the whole of humanity is made of one life energy. Hitopadesha is a collection of Sanskrit fables in prose and verse. According to the author of Hitopadesha, Narayana, the main purpose of creating the Hitopadesha is to instruct young minds the philosophy of life in an easy way so that they are able to grow into responsible adults. It is almost similar to the Panchatantra. This research paper aims to deleve in to the origins and implications of this concept, highlighting its potential to reshape global governance and foster sustainable development and inclusivity on a planetary scale.*

1. INTRODUCTION :

The G20 was founded in 1999 after the Asian financial crisis as a forum for the Finance Ministers and Central Bank Governors to discuss global economic and financial issues. The G20 was upgraded to the level of Heads of State/Government in the wake of the global economic and financial crisis of 2007, and, in 2009, was designated the "premier forum for international economic cooperation". The G20 Summit is held annually, under the leadership of a rotating Presidency. The G20 initially focused largely on broad macroeconomic issues, but it has since expanded its agenda to inter-alia include trade, sustainable development, health, agriculture, energy, environment, climate change, and anti-corruption. The G 20 comprised of 20 individual countries and the European Union, represent a significant portion of worlds economy and population. Over the years, it has evolved from being primarily an economic forum to a platform addressing a broad spectrum.

The Origin of the Concept- Vasudhaiva Kutumbakam is a philosophy that inculcates an understanding that the whole world is one family. It is a philosophy that tries to foster an understanding that the whole of humanity is one family. It is a social philosophy emanating from a spiritual understanding that the whole of humanity is made of one life energy. If the Divine source is one then how we as individuals are different? If the whole ocean is one then how a drop of the ocean is different from the ocean? If the drop is different from the ocean how then it can ultimately be dissolved in the ocean? Meaning: It is a Sanskrit phrase meaning that the whole earth is one rst word is made up of three Sanskrit words -family. The Vasudha, Eva and Kutumbakam. Vasudha means the earth, Eva means emphasizing and Kutumbakam means a family. The concept of Vasudhaiva Kutumbakam originates from Hitopadesha. Hitopadesha is a collection of Sanskrit fables in prose and verse. According to the author of Hitopadesha, the main purpose of creating the Hitopadesha is to instruct young minds the philosophy of life in an easy way so that they are able to grow into responsible human beings. Origin of the concept:

The concept of Vasudhaiva Kutumbakam originates from Hitopadesha. Hitopadesha is a collection of Sanskrit fables in prose and verse. According to the author of Hitopadesha, Narayana, the main purpose of creating the Hitopadesha is to instruct young minds the philosophy of life in an easy way so that they are able to grow into responsible adults. It is almost similar to the Panchatantra. The whole philosophy of Vasudhaiva Kutumbakam is an integral part of the Hindu.

The One Earth, One Family, One future concept emerged in the context of growing awareness about the interconnections of global challenges. It draws inspiration from several sources including

a- Globalization and Interdependence. – The deepening interdependence of economics, societies and ecosystems across boarders has highlighted the need for collaborative solutions to global problems.
b- Environmental Sustainability- Concerns about climate change, biodiversity loss and resources depletion underscore the urgency of safeguarding the planet for future generations.
c- Inequality and inclusive. – Rising income inequality and social disparities have emphasized the importance of inclusive development.
d- Humanitarian Crises- Humanitarian crises such as the global refugee crises and the COVID 19 pandemic have under crossed the shared vulnerability of humanity.

Pillars of "One Earth, One Family, One Future" The concept can be broken down in to three interrelated pillars.

2. One Earth :
This pillar emphasizes the need for sustainable development and responsible stewardship of the planet. It includes commitments to combat climate change, protect biodiversity and promote sustainable resource management. We all reside on the same blue orb, suspended in the vast expanse of space. This Earth is not just an inanimate chunk of rock; it's a living, breathing entity. It provides for us, nurtures us, and sustains every facet of our existence. Our rivers, mountains, forests, and every speck of sand are interconnected, forming the intricate web of life.

However, the modern era, marked by rampant industrialization and heedless consumption, has imposed unprecedented stress on our planet. The environmental crises we face today, from climate change to deforestation and the loss of biodiversity, are a testament to our collective negligence. Recognizing that we have "One Earth" is a call for collective action. It's an acknowledgment that environmental protection isn't just a local or national concern but a global imperative.

3. One Family :
This pillar highlights the importance of social inclusive and reducing inequalities. It encompasses efforts to address poverty, promote gender equality and ensure access to education and healthcare for all. While diverse in culture, language, religion, and ethnicity, humans share more similarities than differences. Our shared emotions, aspirations, and dreams knit us into a global family. It's this shared humanity that has the potential to bridge divisions and create a world rooted in mutual respect and understanding.

The concept of "One Family" is a challenge to the artificial barriers we've constructed over millennia. It pushes against prejudices, biases, and divisive ideologies. In today's globalized world, issues such as migration, international trade, and even technological innovations underscore the reality that our fates are intertwined. The COVID-19 pandemic further highlighted this interconnections, reminding us that a challenge to one is a challenge to all.

One Future- This pillar focuses on global solidarity and cooperation. It includes initiatives to strengthen international institutions, foster peace and security and respond collectively to global crises. Our collective actions today are shaping the world of tomorrow. Every decision, no matter how minuscule, sets forth a ripple in the vast ocean of time, influencing future outcomes. Recognizing that we have "One Future" means understanding that our destinies are intertwined. A drought in Africa, a technological revolution in Asia, or a political upheaval in Europe can have repercussions across continents.

The idea of "One Future" necessitates global cooperation. In facing challenges such as climate change, poverty, or even the next big technological advancement, a collaborative approach is imperative. We must recognize that the sacrifice made for the greater good today ensures a brighter and more sustainable future for all.

The theme is intended to focus the G20's efforts on the following priorities:

4. Climate change:

The G20 countries are responsible for about 80% of global greenhouse gas emissions. The theme calls on the G20 to take urgent action to address climate change, including by reducing emissions, investing in renewable energy, and adapting to the impacts of climate change.

- Sustainable development: The G20 countries are also responsible for about 80% of global GDP. The theme calls on the G20 to promote sustainable development, which is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This includes ensuring that economic growth is inclusive and equitable, that natural resources are used sustainably, and that environmental protection is integrated into all aspects of development.

- Global health: The G20 countries are home to about 60% of the world's population. The theme calls on the G20 to work together to improve global health, which is essential for sustainable development. This includes addressing the COVID-19 pandemic, strengthening health systems, and promoting universal health coverage.

- Food security: The G20 countries are also responsible for about 80% of global food production. The theme calls on the G20 to ensure food security for all, which is essential for human well-being and sustainable development. This includes addressing the challenges of climate change, population growth, and urbanization.

- Gender equality: The G20 countries are committed to promoting gender equality. The theme calls on the G20 to accelerate progress towards gender equality, which is essential for sustainable development. This includes ensuring that women and girls have equal access to education, health care, economic opportunities, and political participation.

5. Implications of Global Governance :

The One Earth, One Family, and One Future concept have significant implications for global governance.

- Strengthening Multilateralism- It reinforces the importance of multilateral institutions like the United Nations and addressing global challenges. The global crisis enhanced the significance of global governance, particularly with regards to the governance structures of the international financial institutions since it is expected that the international conflicts over international monetary system and currency policy will intensify. Effective cooperation among major economies and collective action are essential since if mercantilist strategies are followed by all major countries, it may lead to deflationary pressure on the world economy. Global governance and multilateralism gained importance as states started to deal with economic, political and security issues in and around multilateral forums. Even before the global crisis, it was argued that credibility of the G-8 and global governance system waned in terms of who sets the rules of the game and why these rules are in place. It was argued that the systemic shift in the global balance of power from advanced countries to developing countries and the gradual evaporation of US leadership led countries to seek for global governance reforms. As the US declined in relative terms as a hegemon, it lost the capability to railroad through decisions in international summits without minding to win the argument in advance. Global crisis intensified the debates and accelerated the reform process
- Alining National Interests with global goal- G 20 members states must be align their national policies with the shared objectives of sustainability, inclusive and global cooperation. The Group of Twenty (G20) has been evolving as a widely recognized, yet controversial, power center of the global economy. While this self-selected club has performed important functions for member states and the

world at large, criticism persists with regard to its effectiveness and legitimacy. The G20 still struggles with the critical challenge of how to balance the legitimate pursuit of national interests with a genuine commitment to the global common good. At present, the G20 Development Working Group (DWG) is tasked with coordinating and monitoring G20 activities on the UN 2030 Agenda for Sustainable Development. However, real progress will only happen if and when the personal representatives of the G20 members, or the Sherpa's, take full responsibility of the process and assert their authority toward the G20 Finance Track on this issue. The current Chinese presidency has strengthened the globalist orientation of the G20 by placing the UN 2030 Agenda on the central stage. The G20 Hangzhou Summit is very likely to adopt a 2030 Action Plan which addresses three transformative dimensions: domestic actions within each G20 country, collective actions toward global public goods, and support for low-income and developing countries. The upcoming German presidency should build on the Chinese agenda by focusing on five priorities: First, to promote the implementation of the Sustainable Development Goals (SDGs); second, to create synergies between South-South and North-South development cooperation; third, to become role models for structural transformation; fourth, to support sustainable urbanization; and finally, to enhance the evolution of global knowledge communities. As demonstrated by Chinese research institutions, knowledge organizations in the Think tank 20 (T20) can play an important role by providing critical analyses and policy recommendations to G20 leaders.

- Accountability and monitoring- Mechanism for monitoring progress and holding member states accountable for their commitments are essential for realizing the vision. The first element of accountability, transparency, is perhaps the most widely discussed element within the context of institutions of global governance. Thomas Hale stresses that transparency is often treated as a “buzzword solution” (Hale, 2008, p. 73) to the hotly debated democratic deficit of global governance. Transparency requires that past policy measures and decisions on future plans are knowable to the addressees of accountability. In addition, of similar importance is that the addressees have access to information about decision-making procedures. A prerequisite for transparency is that measures taken by the institutions and the behavior of its decision-makers are documented (Take, 2009, p.15). A fully transparent institution will provide relevant information even when unsolicited, as well as being responsive to additional inquiries, for instance by journalists or researchers. (Hale, 2008, p.75) Transparency allows the addressees of accountability to find out if the institution is achieving its objectives. The second element of accountability requires policymakers to justify their decisions towards the addressees of accountability. The reasons why policymakers decide on certain measures should be disclosed, at least with regard to “the more controversial and consequential institutional policies” (Buchanan & Keohane, 2006, p. 428). The provision of justification is a prerequisite for meaningful debates about the underlying rationale and normative goals of policy measures. The third element of accountability is that the addressees of accountability have the opportunity to impose sanctions. This means that the addressees are able to inflict negative or positive consequences on the institution or its decision-makers in response to the decisions and actions taken. The form of sanctions available will depend on the nature of the institutions and the type of addressees of the accountability mechanisms. 5 Transparency and justification are sometimes summarized as the “answer ability”-component of accountability while the possibility of sanctions is described as the “enforcement”-component of accountability (Schedler, 1999, p. 14f.). Answer ability and enforcement mark different directions of the accountability relationship. Answer ability describes a flow of information from the decision-makers to the addressees while enforcement is directed the other way around. Answer ability is a prerequisite for enforcement as it is only sensible that sanctions are imposed by agents who know about the actions they are sanctioning and understand the reasoning underlying the decisions of the institution in question.

6. Challenges and Criticism :

The ambitious nature of the concept raises questions about the feasibility of its implementations especially in a world marked by geopolitical tensions. However, as the war in Ukraine drags on and calls for international condemnation, isolation, and increased punishment directed at Moscow, it is not too early to suggest that India could face questions about its continued political, economic, and military connection to Russia. Although the political exclusion of any large country is ultimately unlikely, pressures can still mount leading up to the G20. After all, the calls, despite the Indonesian projection of normalcy, will continue to grow and grow as there is no sign of an end to the war. Russia's warning that it could deploy nuclear weapons in the Baltic region if neutral states like Finland and Sweden join NATO has created additional headaches in important world forums such as the G7 and G20, and more so for countries like India which have traditionally been in vocal support of nuclear disarmament. G7 countries, which removed Russia from the G8 framework after Putin's annexation of Crimea in 2014, issued a statement that "international organizations and multilateral fore should no longer conduct their activities with Russia in a business-as-usual manner." Much of these apprehensions emanate from the ongoing steps and debate about isolation of Russia and getting more countries to join this effort. There were some false rumors bout Germany considering India's exclusion from attending an upcoming G7 meeting in June.

There are ample reasons to both dismiss and retain Russia's involvement in the G20. On the one hand, the repercussions of the Ukraine conflict are driving world food prices and oil much higher, and close relations between Moscow and China have increased regional security fears in border Asia.. However, Russia has played a constructive role in the past, particularly during the economic and hunger crisis of 2007, as it is a major global producer of wheat. Ahead of the 2019 G20 Summit in Japan, Russia and China attempted an initiative to denuclearize the Korean Peninsula. But was largely dismissed by the United States.

Equity and fairness- Critics argue that the concept may be skewed towards the interests of G 20 member states and could neglect the concerns of smaller or less powerful nations. The world is at a tipping point for addressing climate change, a crisis that has far-reaching impacts that worsen global inequality, poverty, and humanitarian crises. Many countries face rising and unsustainable debt. Meanwhile, Russia's war in Ukraine has resulted in thousands of deaths and continues to destabilize the region, creating knock-on effects for food and energy security around the globe. These challenges and others are immense yet addressable, and the G7 and G20 are well placed to do so. First, the G7 and G20 provide platforms for countries to coordinate their efforts and collaborate toward common goals. The scale and complexity of the challenges we face mean no single country can tackle them on its own. Second, as multilateral fore, the G7 and G20 promote international cooperation and dialogue. Global challenges such as climate change, debt distress, and achieving the sustainable development goals require multilateral cooperation. The G7 and G20 provide critical space for countries to engage in constructive dialogue. Third, the G7 and G20 have significant power and influence. For example, G 20 account is more than 80% of global gross domestic product (GDP), three-quarters of global trade, and two-thirds of the world's population. G7 countries, a group comprised of the world's richest democracies, account for 27% of global GDP The collective economic power of these countries gives them a unique ability to leverage their resources and influence to address global challenges and achieve common goals. For these reasons, the G7 and G20 are critical for tackling global challenges, and maintaining focus on achieving common goals wherever possible is more important than ever.

7. Conclusion :

The G 20 adoption of the concept of One Earth, One Family, One Future reflects a growing recognition of the need for collective action to address global challenges. While it faces implementation challenges. While it faces implementation challenges and criticism. It offers a compelling vision for reshaping global governance to foster sustainability and inclusivity on a planetary scale. Its success depends on the commitment of G20 member states and their ability to collaborate effectively in pursuit of the shared vision.

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Exploring the Change Detection between Land Surface Temperature, LandUse and Vegetation Health in Surajpur, Uttar Pradesh.

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Abstract: *In the Surajpur area of Uttar Pradesh, India, this study explores the complex interactions between land surface temperature (LST), land use land cover (LULC), and normalized difference vegetation index (NDVI). Gaining understanding of how different land cover typesaffect the dynamics of LST and NDVI is the main goal, since it is essential for efficient environmental monitoring and land management techniques. Spatial patterns and temporal variations were investigated by utilizing Geographic Information System (GIS) techniques and data from remote sensing. Significant relationships between LST, LULC, and NDVI are highlighted by the dramatic effects of changing land cover on surface temperature and vegetation health. This knowledge has consequences for the study area's efforts to mitigate climate change, manage agriculture, and prepare for sustainable urban development.*

Keywords: *Surajpur, Uttar Pradesh, India; land surface temperature; land use; land cover; normalized difference vegetation index; remote sensing; geographic information system (GIS); temporal fluctuations; spatial patterns; environmental monitoring; sustainable urban planning; mitigation of climate change.*

1. INTRODUCTION:

The normalized difference vegetation index (NDVI), land surface temperature (LST), and land use/cover (LULC) are essential indicators for assessing environmental conditions and comprehending land surface dynamics. Their complex interactions provide important insightson a range of topics, including the health of ecosystems, the processes of urbanization, and the effects of climate change. This link takes on particular importance in the context of the Surajpur area in Uttar Pradesh, India, because of the area's fast land use transitions caused byurbanization, intensification of agriculture, and industrialization. As a result, it is crucial to investigate Surajpur's LST, LULC and NDVI relationship because it has consequences for both successful environmental management plans and sustainable development projects.

Although prior research has recognized the significance of Land Surface Temperature (LST),Land Use Land Cover (LULC), and Normalized Difference Vegetation Index (NDVI) in various environmental applications, including monitoring urban heat islands, classifying landcover, and assessing vegetation health, there has been little focus on examining their complexinteractions in the context of the Surajpur area. This work closes this knowledge gap by recognizing the critical importance of comprehending how various land cover types affect vegetation dynamics and surface temperature. By clarifying these connections, important information is given to guide land management choices and create plans for reducing the negative effects of urbanization and land use change in the area.

This study attempts to analyse the link between Land Surface Temperature (LST), Land Use Land Cover (LULC), and Normalized Difference Vegetation Index (NDVI) in the Surajpur area of Uttar Pradesh, India, to fill in a significant research gap. By combining remote sensing data with Geographic Information System (GIS) methods, the study seeks to reveal the temporal and spatial variations in LST and NDVI in various land cover classes. The knowledge gathered from this study is well-positioned to guide the creation of effective plansfor agricultural management, urban planning, and climate change adaptation in Surajpur and other similar areas facing comparable environmental challenges. Surajpur is a prime example of the worldwide difficulty in balancing urbanization with environmental sustainability. It also highlights the critical importance of understanding the interactions between human activity and natural ecosystems. Deep changes in land cover patterns bring about far-reaching effects for local climate dynamics, biodiversity, and ecological equilibrium as urbanization soars and agricultural landscapes change. This work attempts to clarify the complex link between LST, LULC, and NDVI, which is essential to navigating these changes.

As a measure of the thermal energy exchange between the Earth's surface and atmosphere, land surface temperature is essential. Many variables, such as the amount of solar radiation,the surface's albedo (or reflective quality), the presence of vegetation cover, and changes made to the landscape by humans, all have a complex influence on this parameter.

Conversely, Land Use Land Cover (LULC) offers an all-encompassing representation of the spatial organization and characteristics of many land cover types, ranging from populated areas and agricultural lands to woodlands and marine habitats. Because different types of landcover have different capabilities to absorb, reflect, and emit radiation, each form of land cover has a particular effect on surface temperature.

Using differences in the near-infrared and red-light reflection from vegetation, the Normalized Difference Vegetation Index (NDVI) is an essential indicator of vegetation density and Vigor. Lower NDVI values imply stressed or scant vegetation, while higher values suggest a robust and healthy plant cover. The NDVI's temporal variability provides valuable information about changes in land cover, land use, and environmental conditions. Assuch, it is an essential tool for tracking ecosystem dynamics and assessing vegetation responses to stressors in the environment. In the Surajpur region, which is characterized by fast urbanization, increased agricultural productivity, and growing industrialization, it is critical to understand how Land Surface Temperature (LST), Land Use Land Cover (LULC), and NDVI interact. Developing solutions for sustainable development and reducing environmental deterioration require an awareness of this. This research aims to clarify the complex processes forming the surrounding environment by explaining how different forms of land cover affect both surface temperature and vegetation health.

This study applies an integrated approach to analyse spatial patterns and temporal trends in Land Surface Temperature (LST) and Normalized Difference Vegetation Index (NDVI) across different land cover classes within the Surajpur area. It does this by using remote sensing data and Geographic Information Systems (GIS) techniques. The findings of this study contribute to our understanding of the intricate interactions between these variables andprovide helpful insights for supporting data-driven decision-making processes related to regional efforts to adapt to climate change, manage agriculture, and plan urban areas. The study's goal is to significantly advance the conversation about promoting sustainable land useand efficient environmental management techniques, both in Surajpur, Uttar Pradesh, and in analogous rapidly undergoing regions across the globe.

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2. Study area:

In the Yamuna River basin, the Suarjpur wetland, located at 28°31.425'N; 77°29.714'E, is a rare example of an urban wetland successfully restored. Located at an elevation of 184.7 meters above Mean Sea Level (MSL), this wetland is strategically located inside the Gangeticlowlands Biographic Zone in Dadri Tehsil of District Gautam Budh Nagar, Uttar Pradesh.
This sanctuary, which covers a vast area of 308 hectares (3.08 square kilometres), contains 60hectares (0.060 square kilometres) of natural wetland that is tucked away among reserve forest. The Suarjpur wetland area's topography is primarily flat, yet it is divided into both flat land areas and deeper wetland areas. The lake region, which is distinguished by fine-grained lacustrine soil, is home to a diverse array of tropical moist and dry deciduous vegetation.
While the Suarjpur wetland is mostly dependent on rainfall, it also receives replenishment from the watershed of the Hawaliya drain, which empties into the Hindon River, and the Tilapta Minor irrigation canal, which empties into the Kulesra Bund Hindon River. This comprehensive account highlights the significance of the Suarjpur wetland as a restored urban oasis in the middle of Uttar Pradesh by capturing its distinctive ecological tapestry andhydrological dynamics.

3. Data Collection:

Satellite images of Surajpur Wetland in Greater Noida, Uttar Pradesh, were downloaded fromUSGS Earth Explorer for the years 2013, 2016, 2019, and 2023. The images were obtained to assess temporal changes in land cover over the specified period. Each image provides multispectral data capturing various wavelengths, allowing for the identification and analysisof different land cover types such as wetlands, vegetation, built-up areas, and water bodies. The data will be utilized for change detection analysis to understand the dynamics of the wetland ecosystem and monitor any alterations in land use patterns over time.

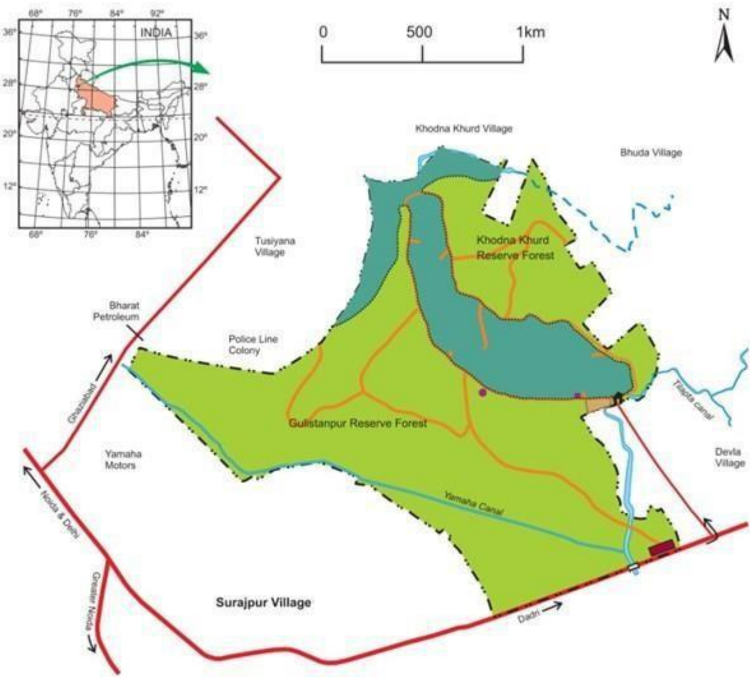

Figure 1: Map of Study area.

4. Methodology:

To investigate the relationship between land surface temperature (LST), land use land cover(LULC),

and normalized difference vegetation index (NDVI) in the Surajpur area of Uttar Pradesh, India, this study presents a robust methodology that combines geographic information systems (GIS) techniques and remote sensing data analysis. The technique records seasonal fluctuations by using satellite imagery from several temporal periods usingsensors such as Sentinel or Landsat. To guarantee data accuracy and consistency, pre- processing procedures such as atmospheric correction and geometry correction are carefullyimplemented. Land cover categories are then categorized using supervised or unsupervised classification approaches, producing LULC maps for each time under consideration. The accuracy of these maps is improved by rigorous validation using ground truthing and accuracy assessment. This thorough technique provides insightful information on the dynamic interactions.
Simultaneously, radiometric temperature conversion methods are used to extract Land Surface Temperature (LST) maps from the thermal bands of satellite data. Emissivity correction methods are used to account for atmospheric effects and guarantee accurate surface temperature representation. We then apply spatial analysis techniques to evaluate variations in LST over different land cover classes and time intervals. Simultaneously, multispectral satellite bands are used to calculate Normalized Difference Vegetation Index(NDVI) metrics, which provide information on vegetation Vigor and density. We examinetemporal NDVI trends to identify changes in vegetation cover across time periods.

Additionally, to examine the complex interactions between land surface temperature (LST),land use land cover (LULC), and normalized difference vegetation index (NDVI), this study uses statistical techniques such as regression modelling and correlation analysis. The spatialrelationships between various land cover types, fluctuations in surface temperature, and vegetation indices are examined using spatial overlay approaches. Using spatial measurements and landscape pattern analysis, the effects of urbanization, agricultural practices, and other environmental factors on the dynamics of LST and NDVI are carefully assessed. In the end, the results are meticulously analysed to reveal the intricate interactions between these factors, illuminating their consequences for efficient environmental governance and well-informed land use planning tactics customized for the Surajpur region.

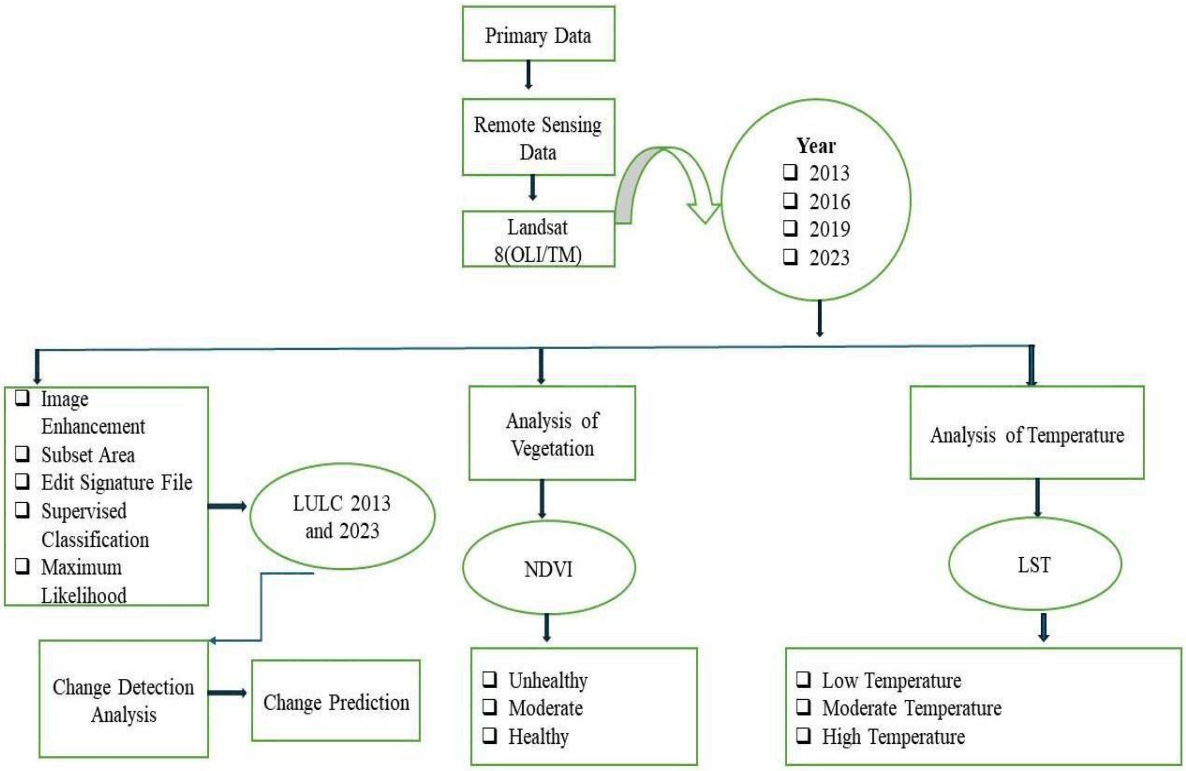

Figure 2: Methodology of the study area.

5. Result and Discussion:

LULC, NDVI, and LST have all shown notable shifts over time.
consequences for management approaches and the health of wetland ecosystems.

Land Use and Land Cover:

In the Surajpur wetland area (2013, 2016, 2019, 2023), supervised classification approacheswere used to classify land use and land cover. These techniques distinguished between several classifications of land cover, such as vegetation, wetlands, built-up areas, and agricultural fields, as well as water bodies. The use of classification methods like Random Forest, Support Vector Machine, and Maximum Likelihood was made. Within its reserve forest area, the sanctuary, which covers 308 hectares (3.08 square kilometres), is home to 60hectares (0.060 square kilometres) of natural wetland.

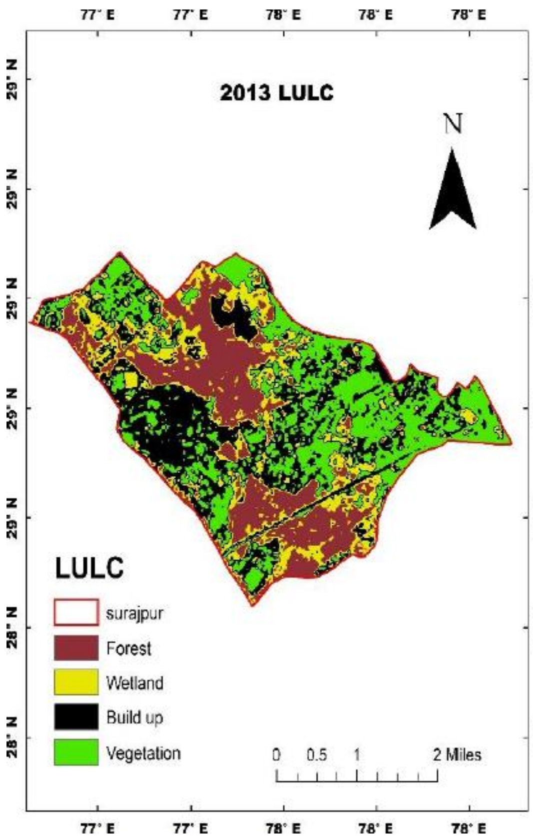

Figure 3: Map of LULC 2013.

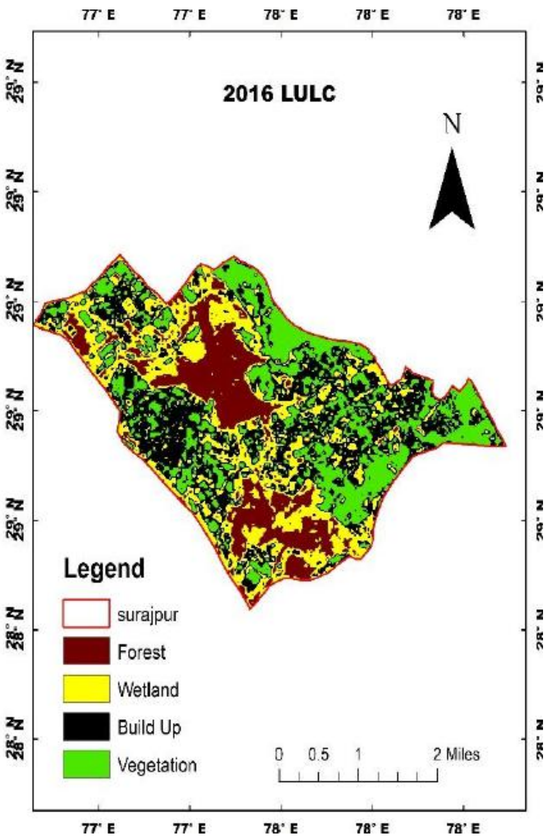

Figure 4: Map of LULC 2016.

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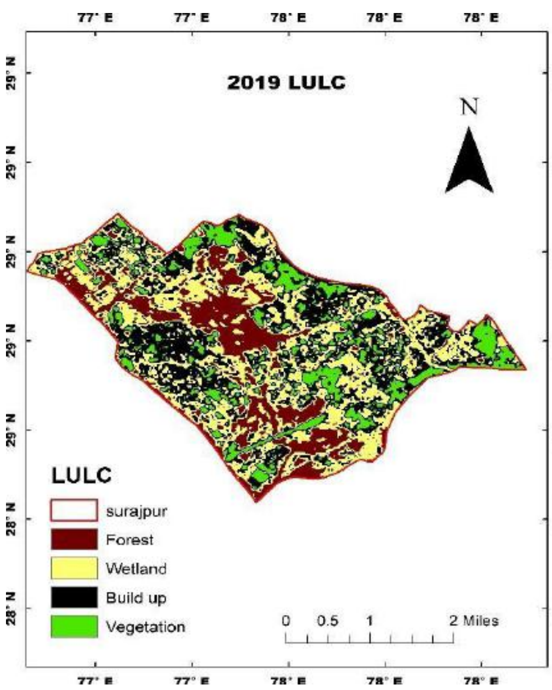

Figure 5: Map of LULC 2019.

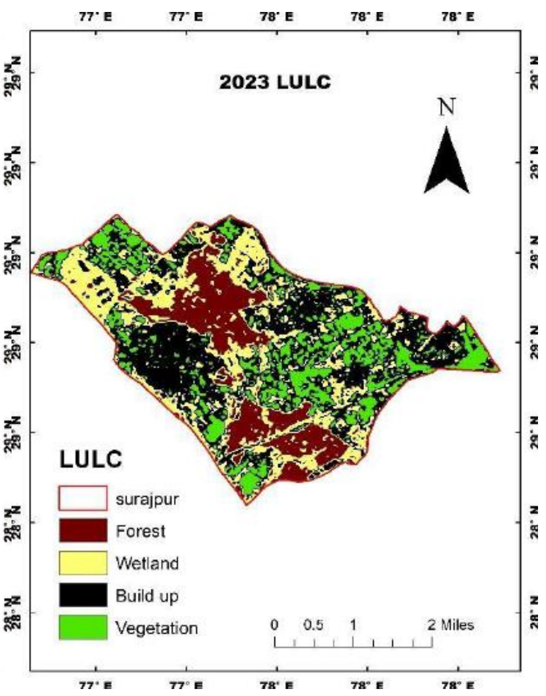

Figure 6: Map of LULC 2023.

Calculation of LULC

S. No.	Classes	2013	%	2016	%	2019	%	2023	%
1.	Forestkm*2	5.5206	23.75	4.0545	17.44	4.5	55.44	4.0626	17.48
2.	Wetland km*2	3.9312	16.91	5.9904	25.77	8.1162	34.92	6.1128	26.30
3.	Build up km*2	6.5952	28.38	6.9723	30.00	7.2126	31.03	8.6877	37.38
4.	Vegetation km*2	7.1901	30.94	6.2199	26.76	3.4083	14.66	4.536	18.82
	Total	23.2371	100	23.2371	100	23.2371	100	23.2371	100

Table 1: Calculation of LULC.

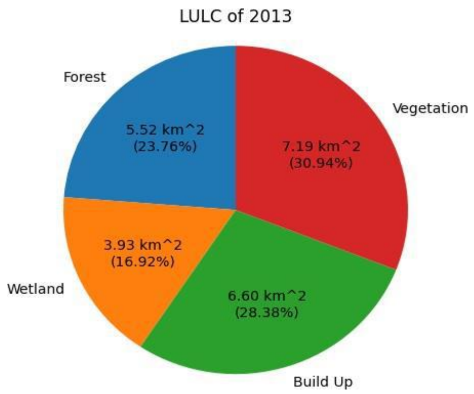

Figure 7: Graph of LULC 2013.

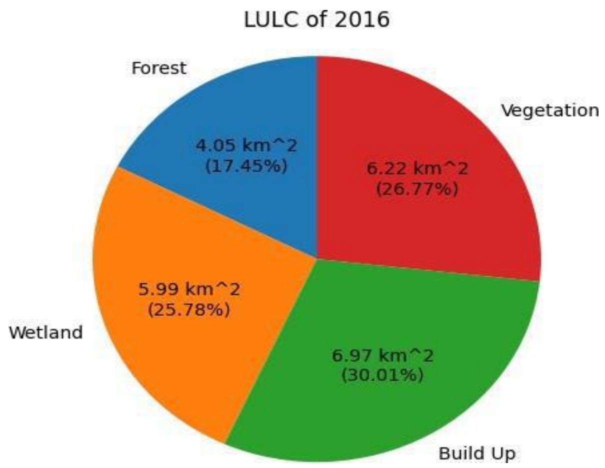

Figure 8: Graph of LULC 2016.

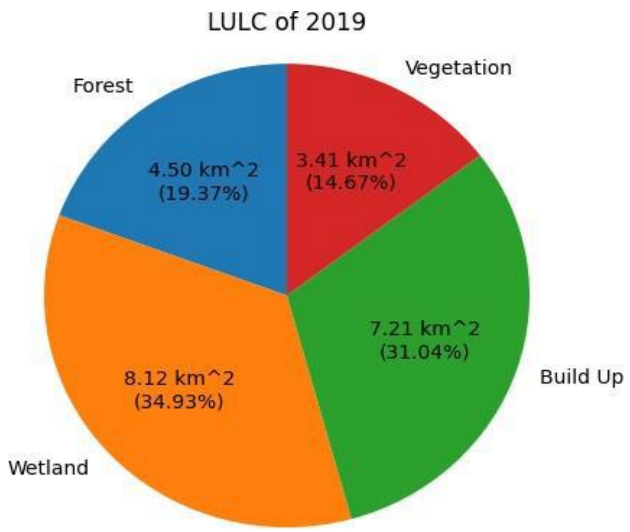

Figure 9: Graph of LULC2019.

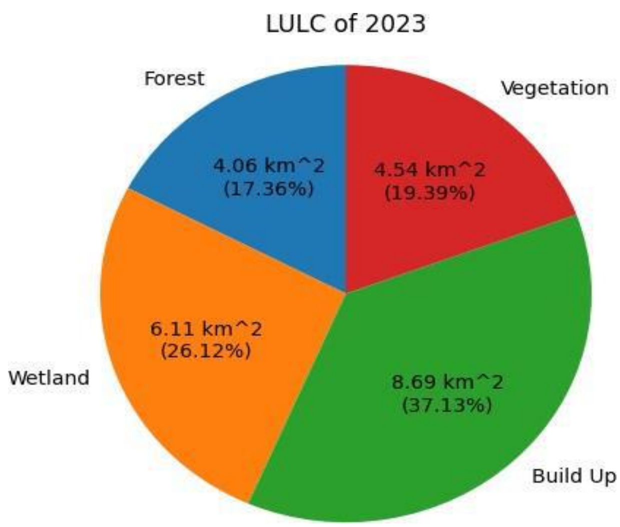

Figure 10: Graph of LULC 2023.

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LULC Map	Accuracy Assessment	Kappa coefficient
2013	81%	83%
2016	92%	80%
2019	83%	97%
2023	87%	92%

Table 2: Accuracy and Kappa coefficient.

Year	Minimum	Maximum	Mean	Standarddeviation
2013	3.9312 sq.km(wetland)	7.1901 sq.km (vegetation)	5.8093 sq.km	1.0172 sq.km
2016	4.0545 sq.km (Forest)	6.9723 sq.km (Build up)	5.8092 sq.km	0.9140 sq.km
2019	3.4083 sq.km (vegetation)	8.1162 sq.km (wetland)	5.8093 sq.km	1.9224 sq.km
2023	4.0626 sq.km (Forest)	8.6877 sq.km (Build up)	5.8498 sq.km	1.8097 sq.km

Table 3: Statistics of study area of LULC.

Change Detection:

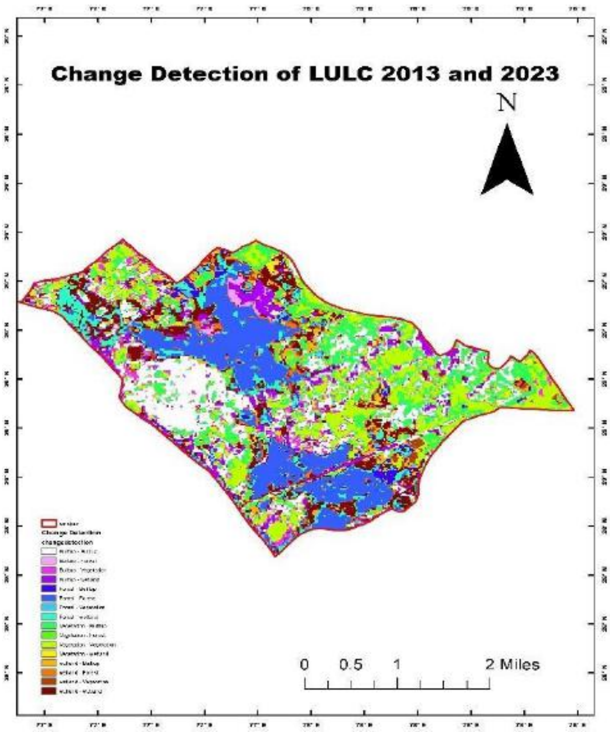

Figure 11: Map of Change detection 2013 and 2023.

Year	Area change sq.km
Forest-Forest	3.536
Forest-wetland	1.497

Forest-Buildup	0.362
Forest-Vegetation	0.134
Wetland-Forest	0.314
Wetland-wetland	2.330
Wetland-Buildup	0.916
Wetland-vegetation	0.286
Buildup-Forest	0.163
Buildup-wetland	1.694
Buildup-Buildup	3.949
Buildup-Vegetation	0.748
Vegetation-forest	0.015
Vegetation-wetland	0.474
Vegetation-Buildup	3.421
Vegetation-vegetation	3.253

Table 4: Change detection.

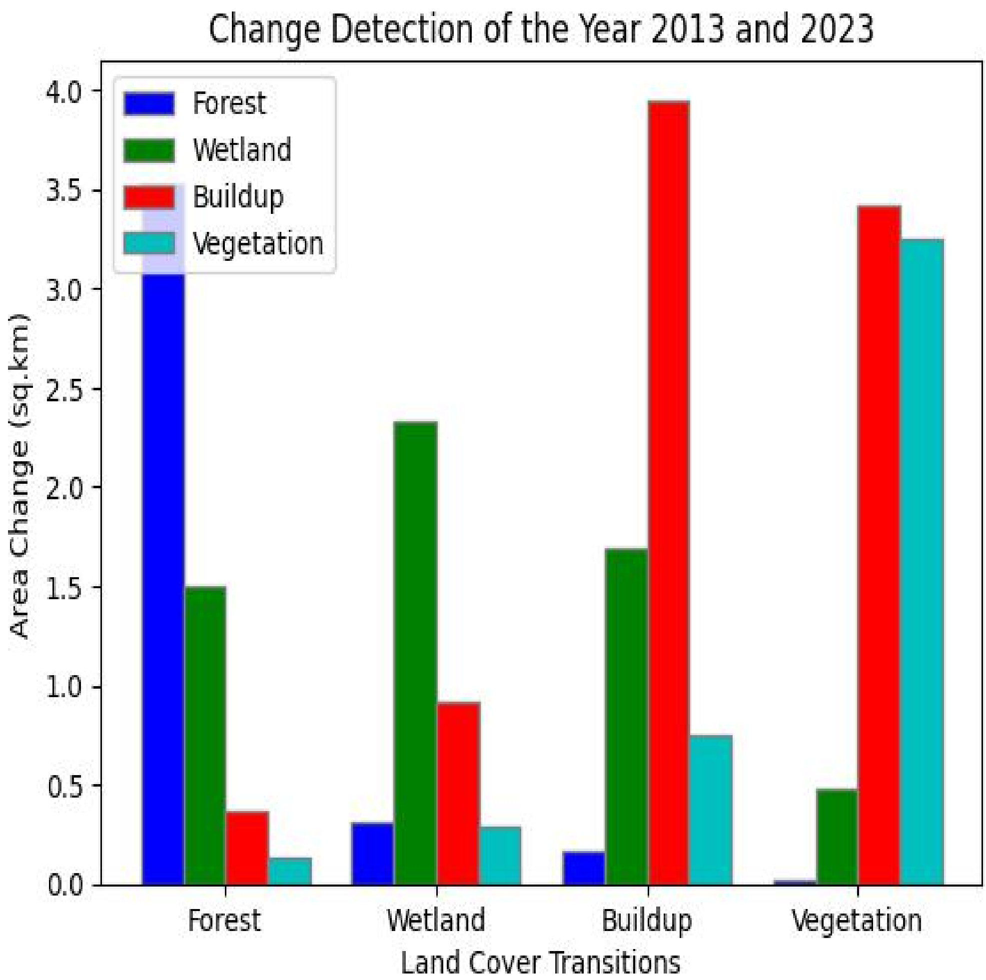

Figure 12: Graph of change Detection.

Normalized Difference Vegetation Index:

The Surajpur wetland region has made extensive use of the Normalized Difference Vegetation Index (NDVI) to evaluate the dynamics and health of vegetation throughout a range of time periods (2013, 2016, 2019, and 2023). The NDVI, which is derived from satellite images, offers important insights about the composition of the vegetation and how it evolves over time.

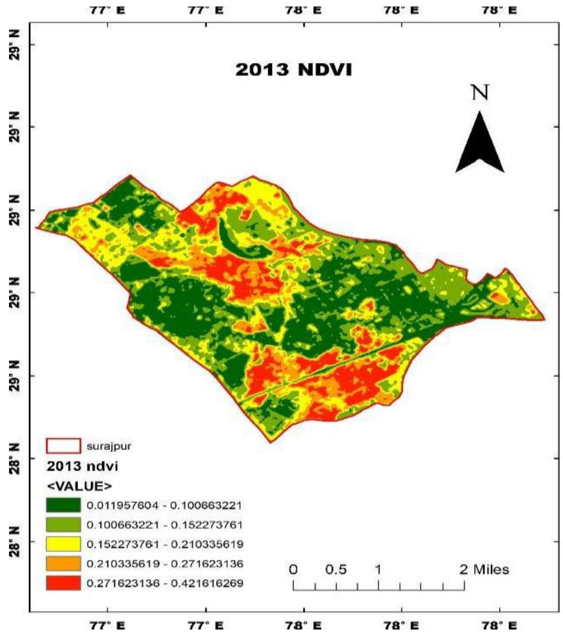

Figure 13: Map of NDVI 2013.

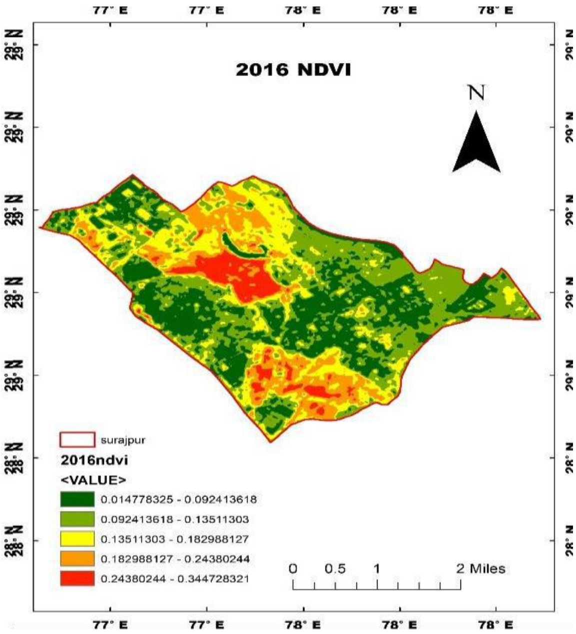

Figure 14: Map of NDVI 2016.

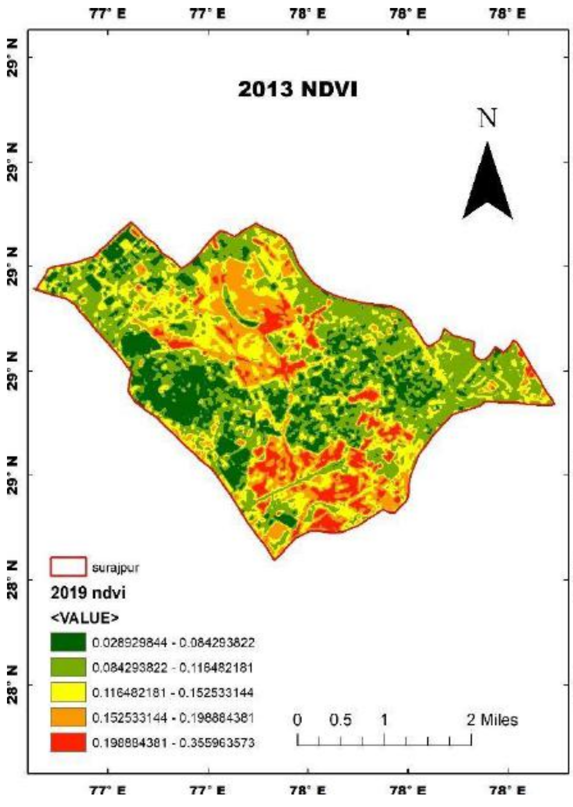

Figure 15: Map of NDVI 2019.

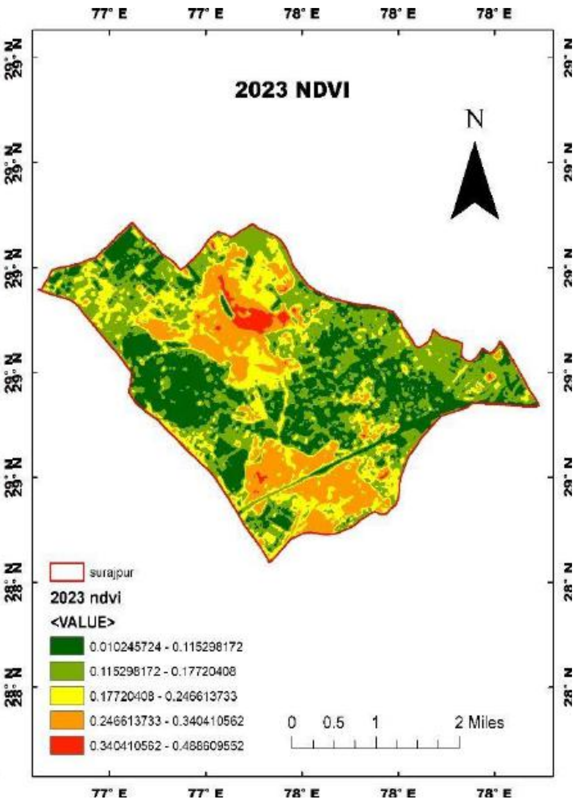

Figure 16: Map of 2023.

Difference of NDVI among the 4 yearsIn 2013:

High Vegetation	0.271 to 0.421
Moderate Vegetation	0.1522 to 0.271
Unhealthy Vegetation	0.011 to 0.100

In 2016:

High Vegetation	0.243 to 0.334
Moderate Vegetation	0.135 to 0.243
Unhealthy Vegetation	0.014 to 0.092

In 2019:

High Vegetation	0.1988 to 0.355
Moderate Vegetation	0.116 to 0.1988
Unhealthy Vegetation	0.028 to 0.084

In 2023:

High Vegetation	0.340 to 0.488
Moderate Vegetation	0.177 to 0.340
Unhealthy Vegetation	0.010 to 0.115

Table 5: Difference of NDVI among 4 years.

Descriptive details for NDVI

Healthy Vegetation	Moderate Vegetation	Unhealthy vegetation
Min = 0.1988 Max = 0.488 Mean = 0.3434 Standard deviation = 0.0728	Min = 0.116 Max = 0.340 Mean = 0.228 Standard deviation = 0.056	Min = 0.010 Max = 0.115 Mean = 0.0625 Standard deviation =0.0262

Table 6: Descriptive details of NDVI.

Let's now contrast the amounts of vegetation in different years:

High Vegetation: The range of high vegetation has tended to grow with time, with 2023 seeing the highest values. This suggests future developments or additions in regions with a lotof greenery.

Moderate Vegetation: This type of vegetation has an annual range that changes. When compared to subsequent years, the NDVI value is higher in 2013. The lower limit of the moderate vegetation range is greater between 2019 and 2023, indicating a movement in thiscategory's vegetation density in that direction.

Unhealthy Vegetation: There are variations in the range of unhealthy vegetation over time. Itsgreatest range in 2013 suggests that the vegetation may not be as robust as in previous years. The range does, however, start to get smaller in 2023, which may indicate changes in land use or cover or improvements in the health of the vegetation.

Land Surface Temperature:

To comprehend thermal trends and fluctuations across distinct land cover types, an analysisof Land Surface Temperature (LST) has been carried out in the Surajpur wetland area usingremote sensing data and several classification techniques. The LST analysis helps with environmental monitoring and management by offering insightful information about the temperature distribution in the area. the years 2013 through 2016 and 2019 through 2023.

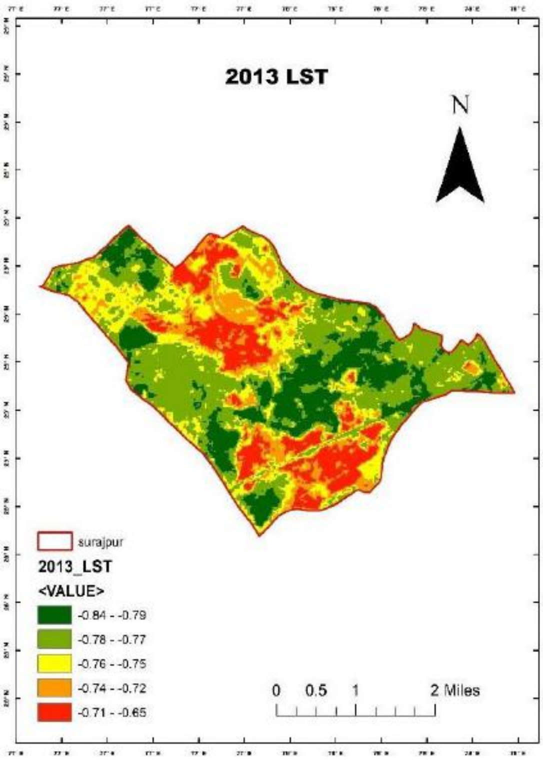

Figure 17: Map of LST 2013.

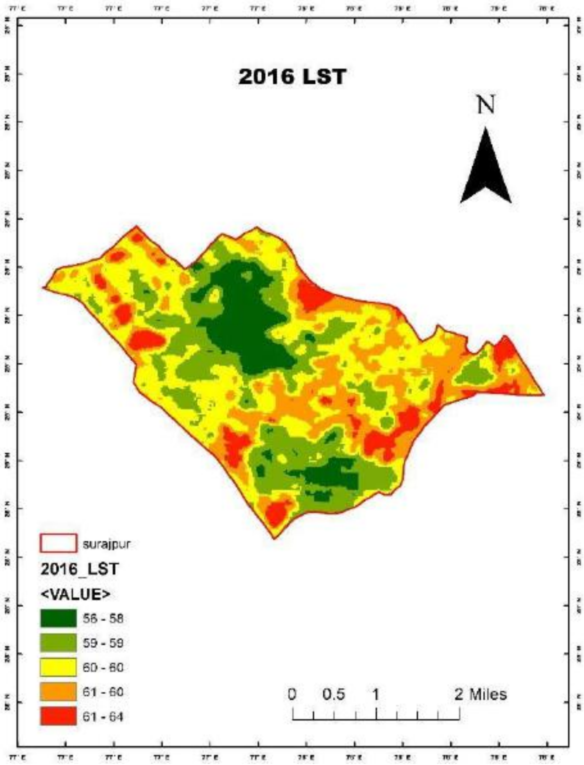

Figure 18: Map of LST 2016.

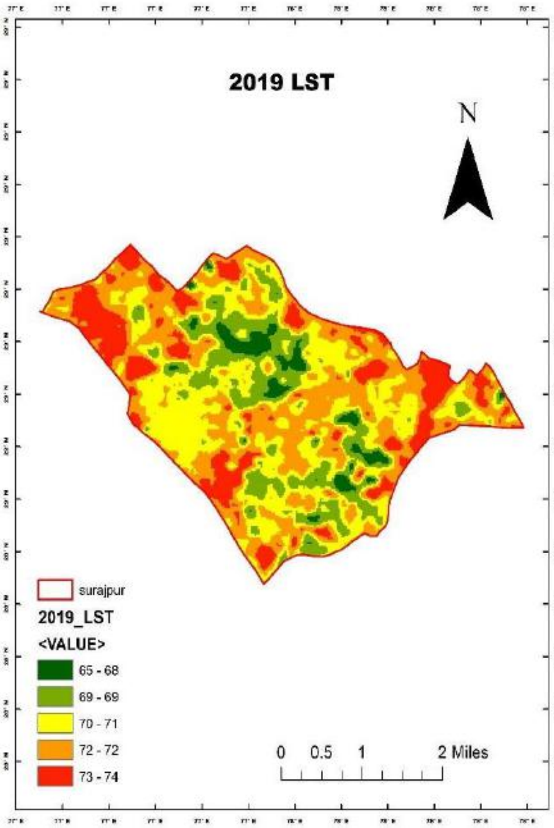

Figure 19: Map of LST 2019.

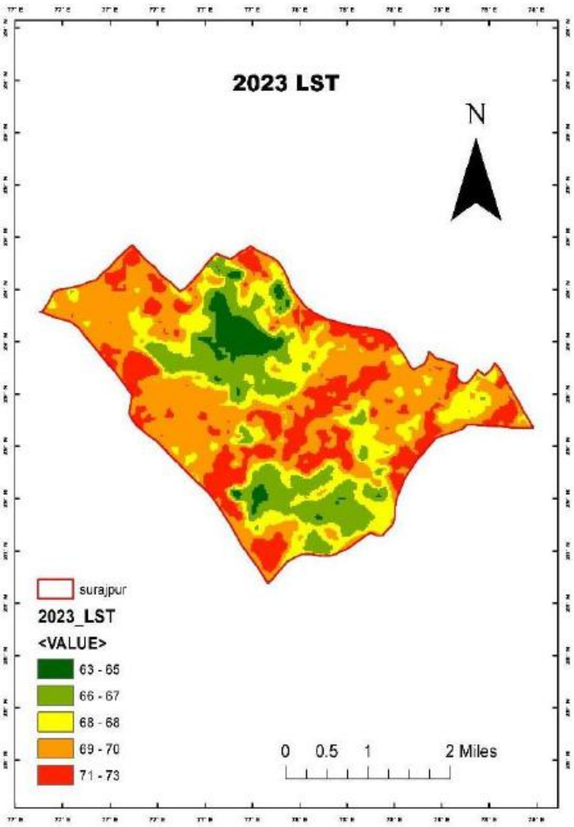

Figure 20: Map of LST 2023.

In 2013:

Very low temperature	-0.84 to -0.79
Moderate temperature	-0.78 to 0.77
Low temperature	-0.76 to -0.75
High temperature	-0.74 to 0.72
Very high temperature	0.71 to -0.65

In 2016:

Very low temperature	56 to 58
Low temperature	59 to 59
Moderate temperature	60 to 60
High temperature	61 to 60
Very high temperature	61 to 64

In 2019:

High temperature	65 to 68
Very high temperature	69 to 69
Very high temperature	70 to 71
Very high temperature	72 to 72
Very high temperature	73 to 74

In 2023:

Moderate temperature	63 to 65
Moderate temperature	66 to 67
Moderate temperature	68 to 68
Very high temperature	69 to 70
Very high temperature	71 to 73

Table 7: Difference of LST among 4 years.

Let's now analyse these categories for every year:

In 2013:
Most temperature ranges are classified as moderate to very high, with a few lower valuesbeing classified as low or very low.
In 2016:
There is a greater dispersion of temperature ranges, with some values classified as extremelylow or low and others as high, very high, and moderate.
In 2019:
Most of the temperature ranges fall into the high or very high category, meaning that it iswarmer than it was in prior years.
In 2023:
With fewer lower temperature ranges, most temperature ranges fall into the moderate to veryhigh categories, indicating a similar temperature pattern to 2013.

6. Conclusion :

Nestled in the Greater Noida area of the National Capital Region, the Surajpur wetland provides essential habitat for a variety of plants and fauna. These fragile habitats need to be conserved more and more as urbanization encroaches on them. Using GIS and remote sensingmethods, this study carefully tracked changes in the wetland area in 2013, 2016, 2019, and 2023. Dynamic changes in the landscape were shown through the analysis of land use/cover (LULC), land surface temperature (LST), and normalized difference vegetation index (NDVI). Notable changes in vegetation density and urban growth were suggestive of changing ecological dynamics. For well-informed conservation efforts meant to maintain ecosystem integrity and biodiversity, monitoring these changes is essential. Through a thorough knowledge and charting of these changes, we open the door for focused conservation efforts that are essential to maintaining wetland ecosystems in the face of rapidly expanding urbanization.

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Attitudinal variation in forage biomass productivity & nutritional composition of rangelands of Doodhganga range Pirpanchal Forest division North-western Kashmir Himalaya

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Abstract : *This experiment constitutes part of a two-year research study, which was undertaken in spring 2020. The aim of this experiment was to study the altitudinal variation of the herbaceous Biomass productivity & chemical composition of the grazable material in Doodhganga rangelands of Pirpanchal forest division N-W Kashmir Himalaya. The effect of altitude on aboveground biomass production and chemical composition (crude protein (CP), ash, ether extracts (EE) and crude fiber (CF)) were studied in herbage samples harvested from various quadrates(1m×1m) placed in 3 different altitudes (from 2200 m to 2800 m in two different seasons. Multistage random sampling method was used to collect sample from the whole area. Sample collection was accomplished by cutting aboveground biomass at a height similar to that grazed by small ruminants.*

Almost all nutritional parameters are strongly affected by altitudinal gradient. All the parameters shows strong ($p<0.001$) correlation with each other. The CP and ash content increases with increase in altitude, almost during the whole experimental period. On the contrary, CF content non significantly decreases in value as altitude increases. Above ground biomass (AGB) is strongly affected by altitudinal gradient at both seasons shows significant decreasing value with increase in altitude. Above ground biomass (kg/ha) was found highest in summer season, at low elevations and decreases with increase in altitude. In order to better exploit the pastures of this area it is considered wise, towards the end of spring, to move the herds from pastures of lower altitude to those of higher altitude for the summer.

Keywords: *Variations, forage , Doodhganga range, Pirpanchal forest, nutritional composition, Biomass.*

1. INTRODUCTION :

The rangeland/grasslands of India form distinct categories of their own and differ from one another in terms of origin, structure and composition. However, like all other grasslands of the world, these formations support a large number of wild herbivores, domestic livestock and several agro-pastoral cultures. In India rangeland vegetation cover is spread nearly to 12.15 million ha of land area. Indian Himalaya occupies nearly 35% of the geographical area (Rawat, 1998; Nabi *et al* 2019). Locally Himalayan grasslands are known as Bahaks/Margs are our unique heritage in Jammu and Kashmir for their species-rich, taxonomically vast flora, ecological services which they provide and for their scenic beauty, thus represent an important ecosystem. Grassland area in Jammu, Kashmir and Ladakh region is 3.53%, 13.22% and 5.76% respectively of geographical area. Elevation wise, the vertical distribution of grasslands found highest between 1500-3000 m altitudes (6.72%) of geographical area (Singh *et al* 2018).

Rangelands are largely used for grazing livestock which in turn support human livelihoods with meat, milk, wool and leather products and employment. Besides that, Rangelands play an important role in biodiversity conservation, soil conservation, tourism and recreation, carbon storage, conservation of habitat. Rangelands are very significant to the economy of many countries and still afford about 70% of feed requirements of domestic ruminants and 95% of wild ruminants (Holechek *et al* 1995).

Biomass is a measure of resources of community which is tied up in different species. Vegetation composition based on dry weight is one of the best indicators of species importance within plant community (Bonham, 1989). Biomass is a key property of ecosystems (Chapin and Matson,2002) and (Fahey and Knapp,2007) that results from the mass balance between rates of gain due to productivity and losses due respiration and mortality (Keeling and Philips, 2007).Biomass is an essential attribute of any vegetation for several reasons. Biomass of rangelands and pasturelands is helpful in determining carrying capacity estimation. Biomass helps in prediction of productivity for crops. Plant biomass is often used to analyze ecosystem function for better land management (Guo and Rundel,1997), as it provides a straight-forward metric of plant community health also standing fuel load for fire management decision- making. Biomass is a key structural variable in the revealing of the dynamics of the ecosystems, level of biodiversity ecosystem sustain, its role in the carbon cycle and their sustainability (Warring and Running, 1996).

The most important objective in range management is animal production that is based on nutritional composition of accessible forages (Stoddart *et al* 1975). Ganskopp and Bohnert (2003) projected that wildlife or livestock expert must know the nutritive properties of forage species to maintain reproduction and growth of animals and assure the reasonable importance of grazing land.. The day to day nutrient requirement of grazing stock fluctuates in according to their physiology and therefore growth, gestation, lactation and fattening of body play key roles in determining daily nutrient demands (Cook & Harris,1977).In contrast, the chemical composition of plants and plant communities in rangelands varies according to species, soil type.Nutritional evaluation of pastures is mostly related with the provision of protein, minerals and energy. Generally, in chemical determination of plant materials; dry matter digestion and crude protein are mostly measured for the assessment of forage value (Rhodes & Sharrow, 1990; Arzani *et al* 2001, 2004).

2. Material & Methods :

Study area

The present study on floristic composition was carried out by laying transects along altitudinal gradient in different compartments of Doodhganga Range, Pirpanchal forest division. The lower and subalpine pasture area up to 3100 m altitude of the Doodhganga range were divided into three altitudes and multistage random sampling was carried out in the given area with sampling intensity of 1.38%. In all the 18 sampling plots, blocks of 100× 40m ($4000m^2$) size were laid on all the nine sites of three altitudes. Average data of three sites per altitude is then obtained to represent data for the main site of an altitude.

Estimation of the altitudinal variation in the above ground biomass

Only plants that are available, palatable to grazing animals are classified as forage (Pieper, 1988; Anonymous, 1989).Biomass was calculated by Direct Harvest method (Moore & Chapman, 1986) by clipping the above ground living matter of all the species from quadrants. The harvested material was packed and labeled in paper bags immediately and weighed in the field to get fresh weight and then oven dried at 65ºC for 72 hours in laboratory till constant weight is obtained and then reweighted for biomass estimation. The dry weight of all the quadrates was then be combined and averaged to get the total dry matter production (kg/ha), at each stand (Husain, 1989)

Along each transect soil samples of 1kg was collected from the depth of 0-30cm.Samples were pooled to form one composite sample per site, air dried, thoroughly mixed and passed through 2mm sieve to liberate it from gravel and boulders. The collected samples were stored in polythene bags and labeled for analysis in soil laboratory (Jackson, 1967; Allen & Steiner, 1974) at FOF, SKUAST- Kashmir or at Division of soil science, FOH, SKUAST- Kashmir, Shalimar

Determination of nutrient status of selected palatable forage species of different sites

The samples of selected graze species (leaves, stems and flowers) were air dried under shade then pooled for ground using mill with 2 mm sieve for laboratory analysis. Ground samples were stored in plastic whirl-pack sample bags until put to use for further analysis. Plants were cut at 1cm above ground and then analyzed at Division of Food science & technology Faculty of Horticulture, SKUAST-Kashmir, Shalimar for nutrient analysis. Following observations were recorded as per the methods of AOAC (1990).

Crude protein

Oven dried species containing organic nitrogen will be digested with H_2SO_4. A known aliquant of the diluted sample will be distilled in the presence of 10 ml of 2% boric acid solution and titrated against standard 0.1% N H_2SO_4. The per cent of nitrogen is used for the estimation of CP.

$$\text{Crude protein percentage} = \text{Nitrogen (\%)} \times 6.25$$

$$\text{Where Nitrogen (\%)} = \frac{\text{ml of 0.1N H2SO4 used in titration} \times 0.0014 \times \text{total volume of aliquot}}{\text{Volume of aliquont taken for distillation} \times \text{wt of sample}}$$

Ether extract

The portion The ether extract in a species sample will be determined by extracting with diethyl ether at 60°C in sox let's apparatus for 6-8 hours.

$$\text{Ether extract (\%)} = \frac{\text{wheight of fat}}{\text{weight of sample (g)}} \times 100$$

Wt. of fat= (Wt. of thimble + sample before extraction) - (wt. of thimble + sample after extraction).

Crude Fibre

The fat-free species sample will be reflexed first with 1.25% H_2SO_4 and subsequently with 1.25% NaOH for 30 min each to dissolve acid and alkali soluble component present in it. The residue containing crude fibre were dried to a constant weight and the dried residue will be ignited in muffle furnace at 600°C for 2 hours, loss of weight on ignition will be calculated to express it as Crude fibre.

$$\text{Crude Fibre (\%)} = \frac{\text{Weight of crude fibre}}{\text{Weight of sample (g)}} \times 100$$

Where,

Wt. of crude fibre = Wt. of crucible with dry residue-Wt. of crucible with total ash

Total ash

Total ash is analyzed for expressing mineral matter in the sample. Species sample will be burned at 600°C for 2 hours, all the organic matter will lose from the sample and the residue left after burning is known as total ash.

$$\text{Total Ash (\%)} = \frac{\text{weight of ash}}{\text{weight of sample (g)}} \times 100$$

Where, Wt. of ash = Wt. of crucible with ash-Wt. of empty crucible.

Nitrogen free-extract

It includes all soluble or easily digestible carbohydrates comprising pentose's, hexodes, disaccharides and the polysaccharides, dextrin's and starches.

$$\text{NFE\%} = 100- (\text{\%CP} + \text{\%CF} + \text{\%EE} + \text{\%ash}).$$

Total organic matter

It is remaining portion of total ash (mineral matter) when subtracted from 100. It is calculated as:

OM% = CP% + EE% + CF% + NFE%

Or

OM% = 100-Total ash

Total carbohydrates

The total carbohydrates in sample are expressed as crude fibre and NFE.

TC%= CF% + NFE%

3. Result :

Altitudinal variation in biomass (oven dry qtl./ha) of herbaceous species of Doodhganga range Pirpanchal forest division.

The analysis of data regarding variation in biomass of herbaceous spp. is presented in table 1 that reveals that biomass showed decreasing trends in value as altitude increased in both season (summer and autumn). The maximum biomass (13.01 qtl/ha) was recorded in summer season at site A1 altitude (2200-2500 m) followed by (10.06 qtl/ha) at A2 altitude (2500-2800 m) and (9.14 qtl/ha) at A3 altitude (2800-3100 m). Similarly maximum biomass of (8.53 qtl/ha) in autumn season was recorded at A1 altitude (2200-2500 m) altitude followed by (7.88 qtl/ha) at A2 altitude (2500-2800 m) and (6.16 qtl/ha) at A3 altitude (2800-3100 m). The mean values of biomass for summer season and autumn season recorded at three altitudes was found to be (10.74 qtl/h) and (7.52 qtl/ha) respectively. Similarly mean values of biomass for three altitudes during two seasons is (10.77 qtl/ha), (8.97 qtl/ha) & (7.65 qtl/ha) respectively. Biomass recored significant variation for both factors ie altitude and season

Determination of nutrient status of Dominant & palatable forage species of the different sites

Crude protein (%)

Analysed data regarding nutritional parameters of grass /herbs of range are presented in table - 2**.**Crude protein (%) of most dominant and palatable herb/grass species during autum and summer season . Highest crude protein (%) in summer seson was recorded in *Trifolium repens* (4.55%) at A3 altitude (2800-3100 m) followed by *Trifolium pratense* (4.43%) at A2 altitude (2500-2800 m), *Fragararia vesca* (4.10%) at A2 altitude (2500-2800 m), *Plantago lanceolata* (4.09%) at A2 altitude (2500-2800 m) and *Trifolium repense* (4.00%) at A1 altitude (2200-2500 m). Lowest crude protein (%) in summer season was found in case of *Geum roylei* (2.91%). Similarly highest crude protein (%) in autumn season was recorded in *Trifolium pratense* (4.03%) at A3 altitude (2800-3100 m) and *Polygonum plebeium* (4.03%) at A2 (2200-2500 m) followed by *Plantago lanceolata* (5.71 %) at A3 altitude (2800-3100 m), *Plantago major* (3.87%) and *Trifolium repens* (3.87%) at A1 altitude (2200-2500m).

Crude Fibre (%)

Table 14 presents the Crude fibre (%) of herb/grass spp. at various site and seasons. Highest crude fibre in summer season was recorded in *Fragaria nabicola* (23.16) %) at A1 altitude (2200-2500 m) followed by *Cynodon dactylon* (22.32%) at same site 2200-2500 m), *Cynodon dactylon* (21.87%) at A3 altitude (2800-3100 m), *Poa pratense* (19.65%) at Haigen A1 altitude (2200-2500m*), Alchemilla trolli* (*19.41%) at* A3 altitude (2800-3100 m). Highest crude fibre in autumn season was recorded highest in *Cynodon dactylon* (26.67%) and (24.40%) at A1 altitude (2200-2500m) and A2 altitude (2500-2800m) respectively, *Fragaria nabicola* (23.16%) at A1 altitude (2200-2500 m), *Cynodon dactylon* (22.42%) at A3 altitude, *Fragaria vesca* (21.12%) at (2500-2800m) at A2 altitude.

Ether extract (%)

The value of ether extract in laboratory conditions for different grass/herb spp. is presented in table 15. The data presented in table 15 reveals that ether extract % in summer season was found highest in *Teraxicum officinale* (3.38%) at A1 altitude (2200-2500 m) followed by *Trifolium repense* (3.30%) at same altitude, *Fragaria vesca* (3.14%) at A2 altitude (2500-2800 m), *Geum elatum* (3.06%) at A3 altitude (2800-3100 m), *Poa pratense* (2.99%) at A1 altitude (2200-2500 m). Highest ether extract (%) was found in *Plantago major* (4.08%) at A1 (2200-2500 m) in autumn season followed by *Teraxicum officinalis* (3.29 %) at same altitude, *Fragaria vesca* (3.02%) at A2 altitude (2200-2500 m), *Malva sylvestris* (2.99%) at A3 altitude (2800-3100 m), *Cynodon dactylon* (*2.82%)* at A3 altitude (2800-3100 m)

Total Ash (%)

The data regarding variation in total ash (%) in summer season is presented in Table 16 which revealed that highest total ash (%) was found in *Trifolium Pratense* (20.8 %) at A2 altitude followed by *Trifolium repense* (20.69%) and (20.56%) at A1 altitude (2200-2500 m) and A3 (2800-3100 m) respectively.The ash content recorded in case of *Plantago lanceolata* is (19.11%) at A2 altitude (2500-2800 m) & in case of *Poa pratense* is (13.68%) at A1 altitude (2200-2500 m). Minimum ash content was found in *Teraxicum officinale* (10.11%). Similarly in autumn season highest ash content was found in *Trifolium Pratense* (18.73%) at A3 (2800-3100 m) followed by *Plantago major* (18.62%) at A1 altitude (2200-2500 m) and *Trifolium repense* (17.89%) at same altitude , *Trifolium Pratense* (17.87%) at A2 altitude (2500-2800 m) and *Cynodon dactylon* at same altitude.

Nitrogen free extract (%)

The variation recorded w.r.t. NFE (%) in different grass/herb spp.growing at different altitudes of Doodhganga range, pirpanchal forest division is presented in table 17. The analysis of data done under laboratory conditions reveals that highest total ash (%) was found in *Trifolium Pratense* (20.8 %) at A2 altitude, followed by *Trifolium repense* (20.69%) and (20.56%) at A1 altitude (2200-2500 m) and A3 altitude (2800-3100 m) respectively, *Plantago lanceolata* (19.11%) at A2 altitude (2500-2800m), *Poa pratense* (13.68%) at A1 altitude (2200-2500 m) above MSL.Similarly for autumn season highest ash content was found in *Trifolium Pratense* (18.73%) at A3 altitude (2800-3100 m) followed by *Plantago major* (18.62%) at A1 altitude (2200-2500 m), *Trifolium repense* (17.89%) at A1 altitude (2200-2500m), *Trifolium Pratense* (17.87%) at A2 altitude (2500-2800 m), *Cynodon dactylon* (14.95%) at A2 altitude (2500-2800 m).

Total carbohydrates (%)

The variation recorded regarding total carbohydrate (%) in grass/herb species is presented in Table 18. The data reveals that highest total carbohydrate (%) in plant species during summer season was recorded in *Plantago lanceolata* (83.72 %) at A3 altitude (2800-3100 m) followed by *Cynodon dactylon* (81.61%) at A1 altitude , *Teraxicum officinale* (81.24%) and *Poa pratense* (81.19%) at A1 altitude (2200-2500 m) and *Sibaldeae cuneata* (81.09%) at A3 altitude (2800-3100 m). In case of autumn season highest carbohydrate (%) were found in *Fragaria vesca* (85.38%) and *Sibaldeae cuneata* (84.98%) at A2 altitude (2500-2800 m) followed by *Cynodon dactylon* (84.62 %) and *Fragaria vesca* (84.20%) at A1 altitude (2200-2500 m), *Plantago lanceolata* (83.72%) at A3 altitude site.

Total organic matter (%)

Data tabulated in Table 19 presents the total organic matter (%) in meadow herbs/grasses in different seasons of year.During summer highest total organic matter (%) was recorded in *Geum elatum* (90.01%) and *plantago lanceolata* (88.53%) at A2 altitude (2500-2800 m) followed by *Poa pratense* (88.06%) at A1 altitude (2200-2500 m), *Geum elatum* (87.53%) at A3 altitude (2800-3100 m), *Cynodon dactylon* (87.28 %) at A1 altitude (2200-2500 m). Similarly in case of autumn season highest organic matter (%) was found in *Cynodon dactylon* (90.03 %) and *Teraxicum officinale* (89.82%) at A1 altitude followed by *Trifolium pratense* (89.10) at A2 altitude (2500-2800 m), *Cynodon dactylon* (87.46%) at

A3 altitude (2800-3100 m), *Fragaria vesca* (85.96%) at A2 altitude.

Tab-1:Seasonal and altitudinal variation in biomass (oven dry qtl. /ha) of herbaceous species of Doodhganga range, Pirpanchal forest division

F2 (Altitude) / F1 (Season))	A1 (2200-2500 m) Haigen	A2 (2500-2800 m) Doobkhal	A3 (2800-3100 m) Aayud	Mean
S1 (Summer)	13.01	10.06	9.14	10.74
S2 (Autumn)	8.53	7.88	6.16	7.52
Mean	10.77	8.97	7.65	

C.D. ($p \leq 0.05$)

Factor 1 (Season)) : 0.0177 Factor 2 (Altitude) : 0.0216 Factor (1 × 2) : 0.03

Fig-1 Correlation between nutritional parameters

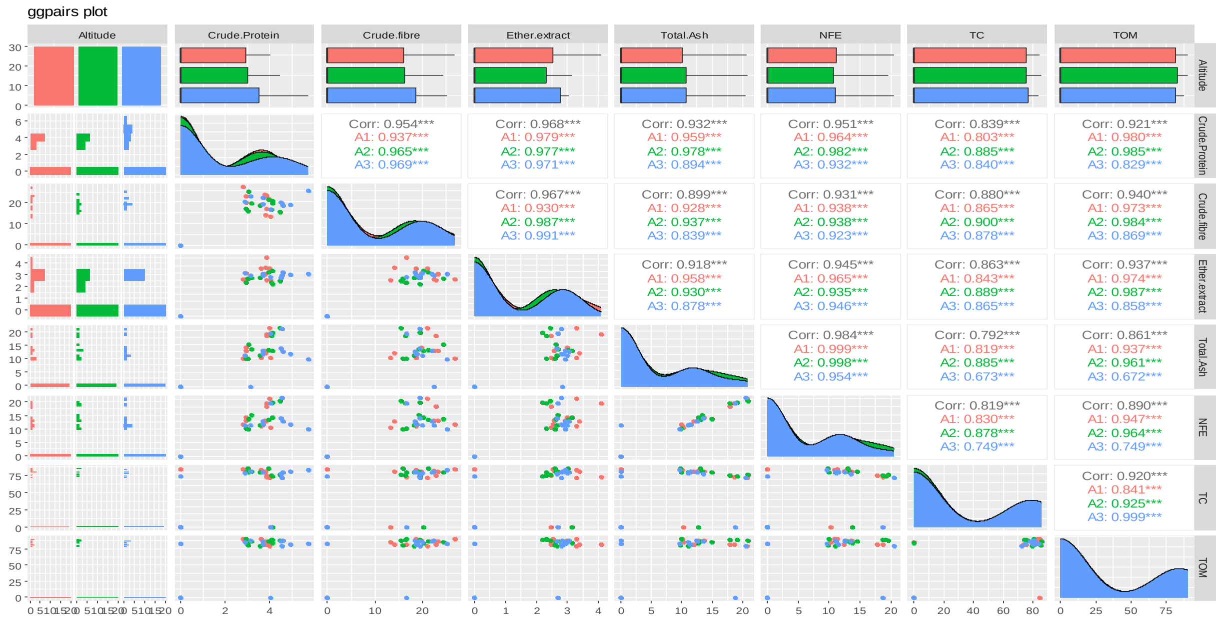

Table-2 Seasonal and altitudinal variation of Nutritional parameters of dominant and palatable herb/grass species of Doodhganga rangelands

F2 / F1		A1 (2200-2500 m) Haigen							A2 (2500-2800 m) Doobkhal							A3 (2800-3100 m) Aayud						
	Sp p.	CP	CF	EE	TA	NFE	TC	TOM	CP	CF	EE	TA	NFE	TC	TOM	CP	CF	EE	TA	NFE	TC	TOM
S1 (Summer)	1	2.92	22.32	2.56	12.72	12.76	81.61	87.28	3.19	19.21	2.68	13.33	14.56	80.82	86.90	3.68	21.87	2.93	12.54	12.54	80.12	86.54
	2	4.00	21.03	3.30	20.69	20.45	72.06	79.31	-	-	-	-				4.55	19.40	2.80	20.56	20.56	72.09	79.44
	3	-		-	-		-		4.43	15.42	2.45	20.84	19.65	76.79	87.23	-	-				-	
	4	3.7	23.	2.	12.	12.	80.	86.				-		-	-	-		-	-	-	-	-

		8	16	93	60	60	53	26														
	5	2.92	19.65	2.99	13.68	13.68	81.19	88.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	3.80	13.92	3.38	11.94	12.45	81.24	81.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-						-		4.90	18.60	2.87	11.45	11.45	81.09	81.03
	9	-	-	-	-	-	-	-	2.91	16.67	2.32	10.00	10.00	80.40	90.01	4.58	18.28	3.06	12.47	12.47	79.69	87.53
	10	-	-	-	-	-	-	-	4.09	19.26	2.21	19.11	19.11	74.30	88.53	-	-		-	-		
	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.51	19.41	2.64	13.51	13.51	77.83	86.90
	12	-	-	--	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	-	-	-	-	-	-	-	4.10	20.19	3.14	12.77	13.82	-	84.02	-	-	-	-	-	-	-
	14	-	-	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-
	15	-		-	-	-	-	-	-		-	-	-	-	-	-		-		-	-	-
S2 (Autumn)	1	2.78	26.67	2.54	9.94	11.30	84.62	90.03	3.03	24.40	2.61	14.95	13.31	79.52	85.05	3.12	22.42	2.82	-	11.06	81.40	87.46
	2	3.87	22.80	2.47	17.89	17.68	75.74	82.11	-	-		-				-	-		-		74.55	83.27
	3	-		-	-		-		4.05	16.45	2.32	17.87	18.72	75.66	89.10	4.03	16.52	2.69	18.73	18.73	-	
	4	-		-	-		-	-	-			-		-	-	-		-	-		-	-
	5	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	3.59	18.50	3.29	10.11	10.87	82.80	89.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	3.87	16.57	4.08	18.62	18.62	73.43	81.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	2.99	15.75	2.59	9.80	9.80	84.98	80.20	3.67	18.85	2.81	11.42	11.42	79.78	81.20
	9	-	-	-	-	-	-	-	-	-				-	-	-	-	-	-	-	-	-
	10	-	-	-	-	-	-	-	-	-		-	-	-	-	5.71	25.06	2.92	9.71	9.71	83.72	82.40
	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-	-
	12	-	-	-	-	-	-	-	3.56	18.11	2.65	11.03	11.03	79.56	78.80	-		-	-	-	-	-
	13	-	-	-	-	-	84.20	-	3.92	21.12	3.02	13.03	13.03	85.38	85.96	-			-	-		-
	14	4.03	13.22	2.48	10.20	10.20	-	85.35	-		-	-	-	-	-	-		-	-	-	-	-
	15	-		-	-	-	-	-	-		-	-	-	-	-	2.89	19.95	2.99	11.09	11.09	78.33	84.56

- **S Summer, A Autumn, _ Not found dominant, A1 (2200-2500 m), A2 (2500-2800 m), A3 (2800-3100 m)**
- **CP –Crude protein(%),CF-Crude fibre(%),EE-Ether extract(%),TA-Total ash(%),NFE-Nitrogen free extract(%),TC-Total carbohydrates(%),TOM-Total organic matter(%)**

- **1 *Cynodon dactylon* pers 2 *Trifolium repens* L. 3*Trifolium Pratense* L. 4 *Fragaria nabicola* Lindl. 5 *Poa pratense* L.**
- **6 *Teraxicum officinale* Weber. 7 *Plantago major* L. 8 *Sibaldeae cuneata* Edgew. 9 *Geum elatum* wall.10 *Plantago lanceolata* L.11 *Alchemilla trollii* L.12 *Rumex nepalensis* Spreng.13 *Fragaria vesca* Lindle.14 *Polygonum plebeium* R.Br.15 *Malva sylvestris* Linn.**
- **F1 –Factor 1(Season),F2-Factor2(Altitude)**

4. Discussion :

Present study revealed that percentage of crude fibre, total carbohydrates and total organic matter of different grasses/herbs was found highest in autumn season as compared to summer season where as percentage of crude protein, total ash, ether extract and nitrogen free extract were found maximum in summer season as compared to autumn season at all three altitudinal sites. Further as plant species starts proceeding to maturity crude protein percentage and ether extract shows increasing trend along increasing altitude.This is supported by findings of Magray *et al.,* (2019) who estimated and revealed that protein content in grasses increases with increase in elevation in Langate forests of Jammu and Kashmir. Mountousis *et al*., (2008**)** obtained similar trend regarding crude protein, fibre, ether extract along altitudinal gradient in rangelands of northern Greece. Nutritive value of any range forage is influenced by number of factors like maturity stage, plant species, edaphic factors, climate prevailing in area, range conditions and animal class. The reason for increase of percentage of crude fibre, total carbohydrates, total organic matter with increasing age of plant is that proportion of potentially digestable components that includes lignin, hemicelluloses and other indigestible fractions such as cuticle, silica increases with age of grasses/herbs (Mwale, 1993). Our results are in conformity with Kermit Oelberg (1956) who studied Crude protein (%), ether extracts and nitrogen free extracts are more in young juvenile stage than in old stage. Protein are essential for plant growth, body weight gain, milk secretion etc. Mountousis et al., 2008 revealed that crude protein, ash, ether extract, crude fibre and IVDMD affected significantly (P<0.01) by both harvest month and altitudinal zone. The decrease in protein content from summer to autumn is attributed to relative increase of fibre content in plant. Present findings is also supported by Dogra *et al*. (1994) and Butler and Bailey (1973) who also concluded that there was decrease in crude protein content from summer to autumn as plant matures.

Further present study recorded maximum crude protein percentage in legumnacious forage like *Trifolium repens* and *Trifolium pratense* as compared to non legume herbs or grasses. These legumes were found slightly low in fibre content but high in protein content.Pure grasses like *Cynodon dactylon* were found low in crude proteins and high in fibre content compared to pure legumes.It is general observed fact that the forage legumes contain higher amount of crude protein but less amount of fibre content irrespective of season factor.This results in higher digestability than grasses.present study results are similar to the findings done by Tessema and Baars (2006), who reported pure legumes and grass legumes mixture produce contain higher crude protein and lower fibre concentration. Azim *et al.,* 2011 obtained similar results for legumes.

Present study revealed increase of fibre content, with advancement of season as was expected. Reason for the increase of fibre content is as plant grows there is greator need of fibrous tissue for maintenance of body structure, thereby increases the structural carbohydrates and lignin. Mayouf and Arbouche (2015) studied the seasonal variation in chemical composition and nutritional characteristics on three pastoral species in semi arid Algerian islands and reported that in wet season plant species have good nutritive value as compared to dry season.

Ether extract decreases with advancement of season in present study, same is confirmed from the study of Garmo *et al*.,(1986) in their study on chemical composition and *in vitro* digestibility of indigenous pastures plants.

Present study revealed range of Crude protein percent from 2.89 - 4.55, ether extract (%) from 2.21 - 4.08, crude fibre (%) from 13.22-26.67 and total ash (%) from 9.80-20.69. Tuna *et al*., *(*2004) reported that protein content of grasses ranged from 3.85-7.80 (%) and our results got conformity from his findings. Rafay *et al., (*2013) also reported similar range values of Cholistan desert grasses, ether extract was in range of 1-2.51(%), ash between 4.62-20.69 (%), total ash content was between 30.89-58.80 (%) which is much higher than recorded in present study.

Plant biomass is a vital aspect of ecosystem functioning. Biomass is one of the important characteristic of pastures vegetation and is considered as an important indicator of ecological and management processes in the vegetation. Plants that control nutrient, water and light become dominant in site. Therefore, ecological status of site is often measured by biomass .The total biomass content present study revealed maximum biomass of (10.97 qtl/ha) at lower altitude A1 (2200-2500 m) and significant decrease to (8.97qtl/ha) at A2 altitude (2500-2800 m) and (7.65qtl/ha) at higher A3 altitude (2800-3100 m) .Significant decrease was also observed from summer season (10.74qtl/ha) to autumn season (7.52qtl/ha).Our findings are in conformity with findings of Amjad *et al* (2014) who studied Nikyal range lands of District Kotli, Pakistan and reported average dry biomass production of 854 Kg/ha with July and August were found most productive months (1387 Kg/ha and 1335 Kg/ha, respectively). The total dry biomass, biomass contributed by grasses and herbs generally increased from July to october and thereafter it progressively decreased till February and then again started increasing from March.The study concluded that variation in biomass is controlled by the amount and timing of precipitation and temperature inputs during the growing season. Mohit *et al* (2021) obtained almost similar value of 3.9qtl/ha in winter and 15.4 qtl/ha in summer biomass on grazed sites of the grasslands of Gulmarg, UT of Jammu & Kashmir. The presence of maximum biomass at lower sites can be attributed to growth favourable factors like temperature etc and presence of high species diversity in present study.

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Going Green by radiating right kind of Energy

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Abstract: *Nowadays we are in awareness of sustainable environment and green technology through many gateways, e.g. social media, newspaper, electronic media, books etc.,and we also have multiple resources to implement the same. We have variety of physical facilities and man power, not only this we are good in managing it by successful organization of conferences to create awareness regarding planting more trees, preserving seeds, reducing e-waste and consumption of electronic energy rather replacing it by renewable sources. But still it's a long way ahead for sustainability as one missing component is that we need to understand that what we radiate is what we create. So we can contribute to our environment by radiating right kind of vibration as it is absorbing our vibrations continuously so by raising the level of pure vibrations we can shift to a new paradigm of green technology.*

Key words: *Environment, vibration, sustainable, radiate.*

1. INTRODUCTION :

When we see few years back, we find that all five elements of Nature i.e. air, earth, water, sky and fire are pure and abundant for human being .

If we see purity wise, we find in earlier days no pollution and no such diseases, especially related with air and water e.g. asthma, corona, flu, tuberculosis, typhoid etc. were there which is very common now a days.

And if, we see their abundance, we find that water table of Earth was very high. We can recall the earlier days when the hand pumps and wells were in every houses in villages and could found even in cities. ***But can we imagine today of wells and hand pumps in our homes especially in city or even in some villages?*** Now a days water table has gone below and earth has become dry enough so that no plants and trees can be easily grown on it and fertility of land almost has become spoilt in most of the region.

Recent examples can be seen of Bangaluru and Chennai where water level has gone severely down which affecting green environment and its sustainability .

First question for concern is how it happened ?

In our olden days, there were abundant of food and water. Earth was surrounded with green environment, with high level of water table content but today despite of having large number of advancement in technology and equipments available in hand our earth is gradually depriving of these resources .

For example, in agriculture, earlier we were using cow dung and now it is being replaced by urea which seems useful for plants but soil is losing its fertility and also diseases comes in our homes in one form or another.

But can we make out that regular use of urea make hardened surface on the top layer of land and thus stopped the rainy water to sip in the earth and hence water table has been gone drastically down and in return it affected green environment and its natural sustenance on its own. This may be one of the basic reason of water depletion under the earth permanently.

Though many more concerns are there but major concern is due to all commercialization which again affecting natural vegetation. For example, natural seeds are being replaced by hybrids seeds. Hybrid fruits and vegetables have raised the market but that are not nutritious as natural fruits and vegetables were. Nowadays, we can also see seasonal fruits are available all the time which is due to commercialization but not healthy for human being. So, somewhere it is high time to preserve natural seeds for natural vegetation which is good for human as well as environment.

Now question is how should we go about it to preserve green environment?

2. Objective:

To save the earth from these drastic changes due to technology advancement and human greed. It is needed to develop holistic development of soil, water, trees and plants which can bring sustainability of green technology.

Some measures in villages are being taken like in some agriculture land where earth was dry, soil moistures is maintained by putting some mud on land for months or years so that proper circulation of water, air and earth happened and it helped in maintaining moisture in land and thus in rainy season, rain water sips in underground and helps in maintaining water table. Natural seeds are also taken care of to preserve and grow to help increase in sustainability of green environment.

One as an ordinary man can feel its responsibility to preserve seeds of fruit and vegetables so that in future days our original seeds of fruits and vegetables can give organic fruits and vegetables to our generation.

Our traditional measures where farmer were using earthworms, small insects to fertilize the agriculture land which was helping naturally and thus sustainability of environment was being maintained but due to agricultural advancement in terms of technologies, all these traditional measures are lost and use of commercial measures has bring down the green technology and holistic development of earth, water and air.

And moreover as now a day's noise pollution of technologies and human greed is prevalent in every corner around the world, then to do ***holistic development of our nature earth is major concern in terms of physical order i.e. soil, earth, water, air, useful insects; bio order i.e. vegetation, animal order i.e. goat, donkey etc. and human order i.e. human being.***

Now Question arises how to increase holistic development of environment and its natural and harmonious co-existence with all physical, bio, animal and human order?

3. Analysis and Discussion:

To increase sustainability of green technology a research has been done that among all four orders physical, bio, animals and human order as human order is highly developed ,so human consciousness can bring the shift in large.

Few measures such as growing large number of trees can help in sustaining green technology up to some extent. For example, in Mumbai, Mission Green Mumbai is being run which can be one of the good measurement in paying responsibility and bringing awareness towards mass.

But major shift in environment at large can be brought by reflecting more on human consciousness .In Japan one such experiment was done by scientist Masaru Emoto on water by giving two kinds of human conscious vibrations on it.

Masaru Emoto sent two kinds of vibrations in a glass of water; In one glass of water sending good wishes and in another by sending curse and then this glass of water was seen under microscope and found that water crystal of one glass to which pure and loving vibrations of human consciousness had been sent was making organized and beautiful crystal whereas the glass in which water was sent negative emotions of pain ,anger, anxiousness is not integrated and water crystal was found broken.

Thus, it is seen that sending good positive energy by human consciousness, water can be energized and saved. This concept has been practiced in organic farming in some places and it is found that by doing meditation in farms i.e. radiating pure vibrations in farms, crops are growing faster, flourish well large and huge quantity of juicy fruits and vegetables as compare to the agriculture farm where farmer is doing very hard to grow large number of vegetables and fruits in quantity and quality.

One such land is observed where no use of vehicle horns are there, majority people are humble and humility is around the air is city of Thailand where usually fruits and vegetables are found big enough and more juicy as major factor is that human consciousness is continuously sending cool and pure vibrations and thus fruits and vegetables of that land are naturally more juicy, plants are more green though there are big high rise buildings of sixty and hundred floors but in spite of such urban development knowingly or unknowingly green environment and its sustenance is found natural as human order is more developed and playing a major role in recognizing and fulfilling its role by knowing its power of creating right energy towards environment which is essential and basic need now a days for its sustainability. Another such example is land of Madhuban in Mount Abu where radiating right energy environment sustenance is seen though geographically its a dry land of Rajasthan.

In smaller scale, we can observed the growth of plants in our homes by putting few plants and nurturing them lovingly by paying responsibility, giving water, upturning mud, putting seeds and on the other hand can observe those plants which is growing under compulsory attitude that is watering plants out of compulsion with agitation and forcefully and can see the difference in their growth. So plants and trees recognizes vibration and fulfilled accordingly. Similarly for water, earth and nature too it can be observed i.e. all three orders recognizes the radiating vibration around it and fulfilled accordingly. If high pure vibration is sent to Earth continuously then environment blossoms whereas if negative vibration is sent then Earth becomes dry which is as similar as when we come in surroundings of other person who is filled with anger and frustration and shouting on us and when we are also not strong enough to come under persons influence then we also start behaving like him/her as we consume his/her vibrations of negative emotions and in contrast if we sit with person of pleasing and cheerful personality. We find that by sitting with them we forget our pain and find our mood freshens as there we consume his/her good vibrations, so it's all about consuming good or bad vibrations of our emotions or feelings in our consciousness and it is same with our bio order, physical order and animal order too.

When human being even if one person create feelings of anger, lust, frustration i.e. emotions colored with vices then it spreads around us and it affects and when collective of such consciousness sends vibrations in air ,water, and earth. Our nature (Environment) also consumes such negative energy at all four level i.e. bio-order, physical order and animal order all, gets de-energized with negative emotions which is creating turbulent in our environment. In Iron age, it can be easily witnessed of destruction of Nature. As everywhere around the Earth, unfortunately vibes of human consciousness is not very good hence it is being easily consumed by our own Nature and thus sudden destruction in the form of Earthquake, Tsunami, flood, drought etc. happens frequently can also be seen.

Similarly, in our earlier times, we can also find our pure vibration effect on the Nature. One such example even in the very beginning of Iron Age when negativity had been started emerging but purity was still prevailing is of classical musician Sangeet Samrat Tansen in the kingdom of emperor Akbar who used to sing classical musical note (raag in Hindi) Malhaar and when his pure vibrations used to reach clouds and with the same frequency as of clouds and at such higher vibrations clouds used to energize and as soon as it resonates ,then thunder of clouds used to happen and it rained on Earth.

So realizing too hot in summer days, Sangeet Samrat Tansen used to play classical notes of Malhaar and made relief from heat. But all this were not regular but when feel required they used to create pure vibrations at such higher notes and could seen its pure vibration effect on Nature as when Tansen used to radiate good vibration at higher frequency then Nature was consuming it and was giving its impact in the form of rain in a elegant and beautiful way. And then we can think of that rain not only can beat heat of summer but can also nurture plants and trees which in return naturally gives pleasant environment.

So whether it is today's time or in those earlier days, these are some of natural process of existence in co-existence of human order with physical order and bio order.

Hence, this is the working principle of Nature whatever good or bad we radiates, it is being consumed first by nature and then return back with the same intensity to us.

In Nature, it's a natural process of recognizing and fulfilling of human consciousness whether pure or impure as human order is highly developed.

So, it's a high time if we all work on our emotional energy especially when in the dark age of Iron age (Kalyug in Hindi) everywhere around is chaotic and majority of us are having acquired sanskaras of greed, lust, anger, frustration and ego etc.

So all these vibrations energized or de-energized our Nature according to principle of conservation of energy as energy is neither created nor destroyed and it is being consumed in environment by our earth, water, sky, air and it impacts back and bang in all directions as it is radiating by mass.

We can also find in our pre-history Era that In Golden Age and Silver Age or even in copper age and in beginning of Iron age, there was peace and prosperity around as purity was in air as human consciousness was at higher state and radiating pure vibrations continually in their surroundings i.e. in environment. As during that time, human being was in awareness that his innate nature is happiness and people's mind were stable .They were radiating peace around them which can be seen from their living and it was also being reflected on their faces as souls were very powerful and thus doing any outward activities from small task to big task or meeting people, the energy of innate nature of happiness was radiating continually by them. Thus, all the four order i.e. human order ,animal order, bio order and physical order were recognizing and fulfilling on its own i.e. there was fresh water rivers and seas, high ground water table content, lush green trees, plants, jungles, grasses were around; fertile soil, land, pure air, pure water, mountains were there and all animals order i.e. birds ,animals all were in harmony and mutually fulfilling each other and there was stability in environment and it was not needed to put extra efforts for finding methods of sustainability as like in today's period. As primary concern was for keeping human consciousness in a righteous manner as mutually fulfilling each other unit was the natural way to create harmonious and stable surroundings.

Though all other measures say watering ,seeds preservation etc. were also being required but in a limited or small extent as when all four orders animal, bio, physical and human order mutually recognizes and fulfills each other units then in a natural way there always existence in coexistence happens as universe also obeys principle of universe order that's why there were never been a sign of earthquake, thunder storm, flood, draught i.e. any natural calamities in Golden and Silver Era. Hence, there was prosperity and peace all around the Earth but mix responds was seen in Copper Age and in very beginning of Iron Age whether ecologically, economically or technologically.

Hence, it is seen that environment changes ranges from Golden ages and Silver age in its full bloom then coming down in Copper age and even in very beginning of Iron age it has been becoming semi full but, now in the time period of profound dark last stage of Iron age we can see chaos and uncertainty of Nature i.e. uncertain pattern of seasons, earthquakes, natural calamities, flood etc. as now human nature is unpredictable and uncertain as human consciousness has been gradually shifting towards downfall.

So, environment can be pleasant forever in a natural way whenever there is human order in balance of their inner and outer world i.e. always creating happiness for everyone paying first his prime responsibility towards every units.

4. CONCLUSION :

As water leaks from a tap, we learn it to close it tights, we switch off lights when not in use. We conserve water, we conserve energy, but brooding about past, worrying about future, holding emotional hurt and resentment, gossiping and judgemental conversations all such emotional energy is badly affecting our environment at large and now there is high need to put full stop and thereby conserving emotional energy to save the planet.

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Recycling and Waste Management

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Abstract: *Recycling is an essential part of waste management. Environmental waste pollution is still a great challenges facing by the world up to date, which day by day become a worst scenario to all. The consequences of waste pollution can be seen in the form of severe health diseases, global warming, climate change etc. Waste Pollution creates chaos and nuisance to the environment such as air pollution, soil pollution and water pollution. Waste pollutions impact the biological system and also affect the life, health and survival of every living thing. The rapid growth of population, industrialization, poverty, life style, development which turn blind eye toward sustainable environment, high demand, production and supply of materials which is the main cause for increasing of waste generation at an unprecedented rate. Waste management aims to tackle the problem of waste disposal into the environment by reduce, reuse and recycle. Recycling is a self discipline and self maintain in order to save the environment. Also recycling is the alternative ways to reduce waste pollution or illegal dumping of waste into the environment. Similarly recycling help to reduce the over exploitation of natural resources and energy. Recycling is a continuous process by conversion of waste materials into useful materials. Economically speaking recycling is a process of turning waste into wealth. The researcher aims to conduct a study on the recycling of waste and waste management in order to reduce or minimize the volume of waste from the environment. This chapter examines the waste pollution, cause and effect of waste pollution; recycling, collection, disposal, management of waste and the Indian policy relating to waste management.*

Key Word: *Waste Pollution, waste disposal, waste management, recycling, economic.*

1. INTRODUCTION :

Recycling is an essential part of waste management. Waste management is a problem facing by both developed and under developing countries around the world. Waste pollution is a particular or specific area of pollution with global concern. Recycling of materials was introduced in order to reduce the nuisance and volume of waste especially solid waste landfill dumping or disposal into the environment. The first paper recycling was first recorded in Japan in 1031 A.D.[1]So recycling of waste mainly focus on solid waste even though some liquid waste can be recycles also.

2. AIMS AND OBJECTIVE:

1. To study the impact of waste pollution relating to human being and environment as well.
2. To examine the economic impact of recycling and waste management
3. To raise awareness to the public on environmental issues relating the importance of recycling and waste management

3. RESEARCH QUESTION:

1. Whether recycling of waste can benefit the individual and the environment?
2. Is there any legal or health insurance for the informal waste collectors?

3. Whether the present legislative policy is sufficient to reduce and manage waste pollution?

4. RESEARCH METHODOLOGY:

The reliability and dependability of this study mainly depend upon the methodology adopted. This study is mainly doctrinal. Various sources such as Books, Journals, Internet sources, Law reports etc., are employed in this research for secondary method of data collection.

5. LITERATURE REVIEW:

- In 2021 the World Health Organization describes "Solid Waste", as the improper disposal that can lead to adverse health outcomes, for example through water, soil and air contamination. Hazardous waste or unsafe waste treatment such as open burning can directly harm waste workers or other people involved in waste burning and neighbouring communities. Vulnerable groups such as children are at increased risk of adverse health outcomes. Poor waste collection leads to environmental and marine pollution and can block water drains. Resulting flooding and other standing waters in waste items favour cholera and vector-borne diseases such as malaria and dengue.[2]

- In 2016 Javadekar, 'Solid Waste Management Rules Revised After 16 Years; Rules Now Extend to Urban and Industrial Areas' according to this paper the Scientific disposal of solid waste through segregation, collection and treatment and disposal should be in an environmentally sound manner minimizes the adverse impact on the environment. The local authorities are responsible for the development of infrastructure for collection, storage, segregation, transportation, processing and disposal of MSW.[3]

- According to Vasudevan Rajaram et al. (2022) the main environmental benefit of recycling is a reduction in the extraction of primary resources and their processing, which conserves resources and often reduces the environmental impacts associated with processing.[4]

- The waste recycling informal activities describes by Ewijk Van et al. (2023), are those activities carried out by persons or enterprises involved in the extraction of recyclable materials from the mass of wastes generated within the community .[5]

6. DEFINITION OF WASTE :

The term wastes refer to materials or an object that is no longer useful unwanted or has no value in the opinion of the first owner. Wastes include solid and liquid waste. Waste can be classified into different categorize based on its sources and types. Solid waste can be bio degradable and non–biodegradables.

7. IMPACT OF WASTE POLLUTION :

Health impact: The effects of solid waste pollution on health may vary based on a number of factors, including the type of waste management practices, the traits and behaviors of the population exposed, the period of Interventions for exposure, prevention, and mitigation. The health consequences included mortality, neonatal outcomes, cancer, respiratory illnesses, gastroenteritis, vector-borne infections, cardiovascular disorders, and mental health issues.[6]

Soil pollution: The most common and harmful practice of waste disposal is the soil pollution. Soil pollution creates nuisance to the environments and all being living on it. Landfill is the major issues which hazard the environment in the long run. Landfill leachates contain many pollutants including toxic substances, heavy metals and usually have high COD.[7] Throwing of garbage which is hazard and non- biodegradable not only disturbs the plant or vegetables growth but it also degrades the soil fertility.

Water pollution: Human activities are the main cause for water pollution. People by nature love clean environment and pure water but rather fails to maintain it. Poor management of the collection and disposal of waste may lead to leachate pollution of surface water or underground water. This may cause significant problems if the waste contains toxic substances or if nearby water sources are used for water supplies.[8] Releasing or disposing waste into the water also severely affects the aquatic life.


Soil Pollution (wastes become the hill)


Water pollution

Air Pollution: Waste pollution or throwing garbage into the environment create foul smell which is unhygine, harmful for the health and safety of the people. Solid Waste burning create release black smoke, carbondioxide into the atmosphere. The practice of household waste burning and the process of conversion of recycling waste by burning the waste materials to produce a new useful material/products create another types of air pollution which is harmful to the environment, even though this practice help to reduce waste.

8. WASTE MANAGEMENT:

Waste management is a systematically process of treating, manage, handling waste in a proper manner and environmental friendly. The main concept of waste management is to save environment from any pollution which destroy its natural beauty and quality of the environment. Its primary goal is to control the pollution by minimize the production of waste, reuse and recycle it. The present waste management adopted two pathways for the disposal of the solid waste: (1) **Formal system -** In this system garbage is either hauled directly to landfill at the outskirt or first collected at intermediate transfer points and then transported later to landfill. (2) **Informal system -** In the informal system, metal plastic, paper etc. destined for recycling in the industries are collected by the rag pickers/recycler at the households or the markets or the temporary sites or at the landfills.[9]

Component of solid waste management
Solid waste management can be divided into 6 components:

i. Generation
ii. Storage
iii. Collection
iv. Transportation
v. Treatment
vi. Disposal

9. 3 R'S OF WASTE MANAGEMENT

- **Reduce:** Reduce is the first step of waste management. Waste reduction is also known as "waste prevention" as defined by the US Environmental Protection Agency (EPA).[10] Waste reduction can be achieved in three basic ways: (1) reducing the amount of material used per product without sacrificing the utility of that product, (2) increasing the lifetime of a product, (3) eliminating the need for the product.[10] For instance we should stop using single use plastic but rather buy reusable launch box, water bottle, carry bags, grocery bags etc. Another example of waste reduction is to purchase things wisely, compost and recycle it.

- **Reuse:** Throwing materials which can be still useful will add tones of waste into the environment. Reuse is the process of using the same materials or products as long as it fit either in the same process or different ways.

- **Recycle:** Recycle of waste from old materials into new useful materials is one of the cheapest and quickest methods of waste management. Among the 3r recycle not only reduce the volume of waste but also economically supported the livelihood of the poor and marginalized social groups who resort to scavenging/ waste picking for income generation.[12]

10. RECYCLING :

The main concept of recycling is sustainable waste management. Recycling is the process of separating, collecting, processing, marketing, and ultimately using a material that would have been discarded.[13] Recycling of waste helps to reduce air, waste and soil pollution. Producing new materials from time to time will over exploited the use of natural resources or energy; and also the consumption or generation of materials will adds tones of waste into the environment. So the recycle of the present waste materials into a new and useful material it will helps a lot in reducing the over exploitation of natural resources and energy, reducing the volume of waste landfill dumping.

Types of Recycling:

- **Collection**: Collection of waste is the first process of recycling. Collecting of waste from the community or institution, house by putting them together in one place according to its types and source.
- **Processing**: After collecting of waste materials, processing is the second step to separate the recyclable materials from the non recyclable. After separating and cleaning them according to its types, the waste materials are ready for sending them to the manufacturer for converting them into a new product.
- **Manufacturing**: Manufacturing is the third step of waste recycling. During this time the manufacturer has the responsibility for restoring or converting the waste materials into new useful products.
- **Purchasing**: Purchasing is the recycle process of reselling or purchasing the recycle products.

11. INFORMAL ACTIVITIES OF WASTE RECYCLING:

Recycling is also known as the informal activities of waste collection and management. The informal activities carried out by the informal collectors and recyclers which allow the supply of recoverable materials to the concerned entities. [14] The informal collectors have non-legal status or health insurance to protect their right. The informal sector is characterised by small-scale, labour-intensive, adapted technology, low-paid, unorganized/unplanned, and unregistered/unregulated work which describe their activities as being part of a self-sufficient, shadow economy. [15]

12. ECONOMIC AND SOLID WASTE:

Waste disposal into the environment is not a solution for waste management. Collection and storage of waste should be done properly by separating them according to their types and quality. Not all waste are wasted, some can be recycle and reused it again after proper treatment which is benefit for economic resource of others. The informal collection activities create jobs, reduce landfill dumping, and reduce the quantity of stored wastes. Most of all recycling helps to sustain the economic development of the country by reducing the use of natural resources and energy, and also sustain the livelihood of the waste collectors/recyclers. The recovery of these resources from solid waste would be a positive step toward establishing a balanced world system where society is no longer dependent on extraction of scare natural ores and fuels.[16]

13. BENEFITS OF RECYCLING:

The main benefit of recycling is to reduce the volume of waste from direct disposal into the environment which is environmental hazard and threat to the health and safety of all living beings. Recycling economically benefit the waste picker, poor or marginalised people by turning waste into wealth. Recycling of waste materials helps to reduce the air, water and soil pollution; or the over exploitation of natural resources and energy.

14. HEALTH IMPACT OF THE INFORMAL WASTE COLLECTORs:

Waste collection is a danger job both for life and health of the informal waste collector. Informal waste collectors collect waste from the landfill or dumping site, household roadside etc., without any protection or security for their life and health. Informal waste collectors need health insurance and scheme to maintain and sustain their life in the hazard environment where they working for. However in India there are no specific rules or law to grant any health benefit for the informal waste collector except the only provision which made an indirect reference to improve of public health as one of the primary duties of the states was Article 47 of the Directive Principles of State Policy.

15. INDIAN POLICY ON RECYCLING AND WASTE MANAGEMENT:

Indian Constitution:

The Indian constitutional provisions relating to environmental pollution protection stated clearly under Article 21 "Protection of Life and Personal Liberty: No person shall be deprived of his life or personal liberty except according to procedure established by law." The expansive interpretation of 'life' in Article 21 has led to the salutary development of an environmental jurisprudence in India. According to this Article 'a person has a right to the enjoyment of pollution free water and air to enjoy life fully'.[17]According to Article 48A the central and the state Government requires to take steps to protect and improve the environment and to safeguard the forests and wildlife of the Country.[18] Furthermore under Article 51A (g) it is also an important provision of the constitution which states the duties of every citizen of the country "to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures."[19] Article 243W of the Indian constitution provides a broad framework relating to the powers, authority and responsibilities of Municipalities, etc. in order to protect, maintenance of safe and healthy environment for people and other living ones.[20]

The environmental Protection Act 1986

The main aim for enacting this Act is to establish a sufficient system in protecting the environment. To handle, manage and regulate all forms of waste; the Government confers powers to the central and state government such as the Central Pollution Control Board, the State Pollution Control Board, and the urban local bodies (the Municipal corporations or village committees) to do their distinct work relating to the protection of environment from waste pollution. The primary legislature to protect the environment and regulation of waste and some of the important provisions of this Act is given as under section 7 of this Act places a principal prohibition on harming the environment by stating that "No person carrying on any industry, operation or process shall discharge or emit or permit to be discharged or emitted any environmental pollutant in excess of such standards as may be prescribed"[21].

Polluter Pays Principle– Section 9 (3) of the Act embodies the "Polluter Pays Principle" which states that any expense which has been incurred to restore the environment to its natural state shall be paid by the person who is responsible for such degradation. This concept of a continuing punishment is very important.[22]

The Bio-Medical Waste (Management and Handling) Rules, 1998[23]
The Ministry of Environment & Forests, Government of India notified The Bio-Medical Waste (Management and Handling) Rules, 1998 to regulate management and handling of bio-medical waste in India.

Bio-Medical waste: "Bio-medical waste" means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological and including categories mentioned in Schedule I.

Segregation, Packaging, Transportation and Storage: Bio-medical waste shall not be mixed with other wastes. The segregation, packing, storage, transportation, treatment and disposal of Bio-medical waste shall be in accordance of the rules and regulation specified separately under the Bio-Medical Waste (Management and Handling) Rules, 1998. No untreated bio-medical waste shall be kept stored beyond a period of 48 hours.

The Hazardous Wastes (Management and Handling) Rules, 1989[24]
Hazardous Waste Management Rules 1989 are notified to ensure safe handling , generation, processing, treatment, package, storage, transportation, use reprocessing, collection, conversion, and offering for sale, destruction and disposal of Hazardous Waste. These Rules came into effect in the year 1989 and have been amended later in the years 2000, 2003 and with final notification of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 in supersession of former notification.

Hazardous Wastes: "Hazardous waste" according to Section 3 (14) of The Hazardous Wastes (Management and Handling) Rules, 1989, means any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include -
(a) Wastes listed in column (3) of Schedule-1;
(b) Wastes having constituents listed in Schedule-2 if their concentration is equal to or more than the limit indicated in the said Schedule; and
(c) wastes listed in Lists 'A' and 'B' of Schedule-3 (Part-A) applicable only in case(s) of import or export of hazardous wastes in accordance with rules 12, 13 and 14 if they possess any of the hazardous characteristics listed in Part-B of Schedule 3".

Hazardous waste management: The collection, reception, treatment, storage, transportation and disposal of Hazardous waste shall be followed separately in accordance with rules specified under The Hazardous Wastes (Management and Handling) Rules, 1989. According to Section (15) of the Act "hazardous wastes site" means a place for collection, reception, treatment, storage and disposal of hazardous wastes which has been duly approved by the competent authority.

Municipal Solid Waste (Management & Handling) Rules, 2000[25]
The Ministry of Environment & Forests, Government of India notified Municipal Solid Wastes (Management & Handling) Rules, 2000 under Environment (Protection) Act, 1986 to regulate management and handling of the municipal solid wastes. The salient features of rules are:

i. Implementation of provisions of the MSW Rules.
ii. Collection of waste by organizing Door-to-Door collection system or community bins
iii. Segregation and storage waste by adopting three bin system
iv. Transportation of waste in covered vehicles.

v. Establishment of processing facilities
vi. Construction of Sanitary landfill facilities.

The Plastic Waste (Management and Handling) Rules, 2011

The Plastic Waste (Management and Handling) Rules, 2011 replaces the earlier Recycled Plastics Manufacture and Usage Rules, 1999 (amended in 2003). These Rules have been brought out following detailed discussions and consultations with a wide spectrum of stakeholders including civil society, industry bodies, relevant Central Government Ministries and State Governments.[26]

Plastic Waste: Plastic means material which contains as an essential ingredient a high polymer and which at some stage in its processing into finished products can be shaped by flow. Plastic waste means any plastic product such as carry bags, pouches or 7 [multilayered plastic pouch or sachet etc.], which have been discarded after use or after their intended life is over.[27]

Plastic waste management: Waste management according to Section 3(p) of the Plastic Waste (Management and Handling) Rules means the scientific reduction, re-use, recovery, recycling, composting or disposal of plastic waste.

E-Waste (Management and Handling) Rules, 2011

E-Waste: E-Waste means waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded.[28] E-waste management was enclosed under the Hazardous Waste (Management and Handling) rules until 2010. Due to huge concerns and the adverse impact of the E-waste in the surrounding environment and human health, India pressed the necessity of the strategic initiative to control the E-waste menace and its hazardous characteristic. The Ministry of Environment and Forests enforced the first E-waste (Management and Handling) Rules in 2011 under the Environmental Protection Act in order to regulate management and handling E-waste Pollution.[29]

16. JUDICIAL DECISION RELATED TO SOLID WASTE MANAGEMENT IN INDIA:

1. Municipal Council, Ratlam vs. Vardhichand.[30]
2. B.L Wadhera vs. Union of India.[31]
3. Almitra Patel and Anr..vs. Union of India and Ors.[32]

The Supreme Court relied on Municipal Council, Ratlam v. Vardhichand, (1980) 4 SCC 162 and B.L. Wadhera v. Union of India, (1996) 2 SCC 594 where it was held that clean environment is fundamental right of citizens under Article 21 and the local bodies as well as the State should ensure that public health is preserved by taking all possible actions and held that *"…handling of solid municipal waste is a perennial challenge and would require constant efforts and monitoring with a view to making the municipal authorities concerned accountable, taking note of dereliction, if any, issuing suitable directions consistent with the said Rules and direction incidental to the purpose underlying the Rules such as upgradation of technology wherever possible. All these matters can, in our opinion, be best left to be handled by the National Green Tribunal established under the National Green Tribunal Act, 2010."*[33]

The Tribunal Stated that "Moreover, without fixing quantified liability necessary for restoration, mere passing of orders has not shown any tangible results in the last eight years (for solid waste management) and five years (for liquid waste management), even after expiry of statutory/laid down timelines. Continuing damage is required to be prevented in future and past damage is to be restored."

17. CRITICAL ANALYSIS AND DISCUSSION:

Waste collection, storage, transfer and disposal practice in India is a mixture of everything in the same place without separating them. This creates problems for the recyclers/waste pickers**.** The practice of waste recycling is less effective in Indian, many of the people especially the literate people feels that it is the lowest job to collect and separated the waste, rather than it is the job of the poor, waste picker or garbage collector to do the same. Another habit or attitudes is out of sight and out of mind. This habit creates tones of waste into the environment. Waste recycling is an informal or unregister job done by the poor to maintain their livelihood and sustain the environment from further degradation, in which their life was put at risk of health problem or even death. Without no legal status social or health insurance the jobs of the recyclers was look down by many. Recycling is without any doubt one of the cheapest and quickest methods to reduce greenhouse gas emissions, according to a research made by Tellus Institute (2008)[34]. However recycling still requires substantial amounts of energy and causes a lot of emissions, including in the use-phase of the recycled product. So, recycling should be measures according to the needs and necessary for waste prevention within the environmental limits. Solid waste pollution is the primary concern of our life today. Mere passing the laws relating to solid waste management does not enough without full participation from all sectors in order to get the effectives outcomes.

18. RESULTS AND FINDINGS:

It is clear from the research paper study that protection of environment is to protecting our life free from pollution which is our basic needs and fundamental rights. Solid waste pollution control primary goals is to achieve sustainable environment free from waste pollution by minimize or reduce, reuse and recycle the solid waste. Recycling of waste is the cheapest and fastest ways of waste reduction. Recycling not only benefits the environments but also the waste pickers/recyclers especially those who earn their income, and maintain their livelihood from the collection of recycle wastes. Needs should comes with proper care and protection, so does the life and safety of the waste pickers/recycler. The existing laws relating to Solid waste management, treatment, management, handling, disposal and other scientific technique should be implemented and enforce according to the changing needs of the society for better environment pollution control.

19. RECOMMENDATION:

1. The government or any other local authority should provide separate dustbin for those goods or waste materials which can be recycle and separated from those who are not fit for recycle.
2. Each and every person ought to be responsible for their own wastes generated to manage and dispose it in a proper manner.
3. The government or authority should provide safety measure for the waste picker especially relating to their health and safety while collecting waste.

20. CONCLUSION:

Waste is an unavoidable product as long as there is the existence of human being and human consumption. Technology and economic development plays a significance role in producing non biodegradable product which is environmental unfriendly. So recycling of waste product help to reduce the tones of waste disposal into the environment and also reduce the over exploitation of natural resources and energy.

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Towards a Greener Future: Innovations and Strategies in Solid Waste Management

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Abstract: *Solid waste management is a very sensitive aspect of environmental sustainability including public health in it. With urbanization and industrialization on the rise, the volume of solid waste generated globally has reached unprecedented levels, presenting significant challenges for communities and policymakers alike. This paper explores innovative approaches and strategic interventions aimed at revolutionizing solid waste management practices. In an era marked by escalating waste generation and environmental concerns, the need for sustainable waste management solutions has become paramount. This study examines a range of innovative technologies, policies, and community-based initiatives that are reshaping the landscape of solid waste management. From advanced waste-to-energy conversion techniques to decentralized recycling programs and smart waste collection systems, these innovations hold promise for mitigating environmental pollution, conserving resources, and promoting circular economy principles. Through case studies and analysis, it elucidates the effectiveness, challenges, and potential implications of these strategies in achieving sustainable waste management goals. Case studies from different regions highlight successful initiatives and best practices in waste management, illustrating the importance of community engagement, policy support, and technological innovation. By synthesizing existing knowledge and identifying gaps in research, this paper aims to inform future efforts to develop more sustainable and resilient solid waste management systems.*

Keywords : *Green Future, Innovations, Strategies, Solid Waste Management.*

1. INTRODUCTION:

Solid waste management encompasses the entire process of gathering, handling, and getting rid of solid waste. Wastes are gathered from various sources and disposed of during the waste management process. Waste is collected, transported, treated, analyzed, and disposed of during this procedure. To ensure that stringent rules and regulations are obeyed, it must be watched over. In any civilization, solid waste management is a necessary service. Let's begin with a discussion of the material being managed—solid waste—before introducing the procedure.

The term "solid waste" describes the variety of waste products that are thrown away as undesired and pointless and result from both human and animal activity. Solid waste can be managed in a number of ways and is produced by commercial, industrial, and residential activity within a given area. Landfills are therefore usually categorized as municipal, industrial, construction and demolition, or sanitary waste sites.
Materials such as plastic, paper, glass, metal, and organic garbage can be used to classify waste. Hazard potential, such as that of radioactive, flammable, infectious, poisonous, or non-toxic wastes, can also be used to categorize materials. Categories may also pertain to the origin of the waste, whether industrial, domestic, commercial, institutional, or construction and demolition.

Solid-waste characteristics :

Physical and chemical composition of solid wastes vary depending on sources and types of solid wastes. • The nature of the deposited waste in a landfill will affect gas and leachate production and composition by virtue of relative proportions of degradable and non-degradable components, the moisture content and the specific nature of the bio-degradable element. • The waste composition will effect both the bulk gases and the trace components.

Determination of Characteristics in the Field: • Solid wastes are complex, multiphase mixtures. • Because of the heterogeneous nature of solid wastes, determination of composition is not easy. Statistical procedures are difficult and usually procedures based on random sampling techniques are used to determine composition. • To obtain a sample for analysis the waste is reduced to about 100 kg by coning and quartering.

Physical Characteristics

Information and data on the physical characteristics of solid wastes are important for the selection and operation of equipment and for the analysis and design of disposal facilities. The major physical characteristics measured in waste are: (1) density (2) size distribution of components and (3) moisture content. Other characteristics which may be used in making decision about solid waste management are: (1) colour (2) voids (3) shape of components (4) optical property (5) magnetic properties and (6) electric properties

Chemical Characteristics

Knowledge of the classification of chemical compounds and their characteristics is essential for the proper understanding of the behaviour of waste, as it moves through the waste management system. The products of decomposition and heating values are two examples of chemical characteristics. If solid wastes are to be used as fuel, or are used for any other purpose, we must know their chemical characteristics, including the following: • Lipids • Carbohydrates • Proteins • Natural fibres • Synthetic organic material (Plastics) • Non-combustibles • Heating value • Ultimate analysis • Proximate analysis

2. TYPES OF SOLID WASTE MANAGEMENT:

Solid waste management includes a range of techniques and strategies for managing, processing, and getting rid of diverse kinds of solid waste. Typical forms of solid waste management include the following:
Source Reduction: Also referred to as waste minimization, this strategy aims to cut down on waste

production at its source. To reduce waste production, it entails actions like product development, packaging optimization, and encouraging the usage of reusable things.

Reuse: Reusing materials or objects rather than throwing them away as waste is a good waste management tactic. It entails giving things a makeover, repair, or new use in order to increase their longevity and decrease the demand for new resources.

Recycling: In order to create new products, recycling entails gathering and processing resources including paper, glass, plastics, metals, and electronics.

Composting is the process by which organic waste products, such as leftover food, yard debris, and agricultural residues, break down biologically to produce nutrient-rich compost. In addition to lowering methane emissions and producing a useful soil additive for gardening and agriculture, composting helps remove organic waste from landfills.

Waste-to-Energy: Waste-to-energy methods use pyrolysis, gasification, and incineration to turn solid waste into fuel, heat, or power. These technologies lessen the amount of waste that needs to be disposed of while also recovering energy from waste.

The act of disposing of solid waste in landfills that are engineered to contain and separate garbage from its surroundings is known as landfilling. Frequently, non-recyclable and non-compostable materials end up in landfills.

3. NEED OF THE STUDY:

With the increasing population and urbanization, there is a significant rise in solid waste generation, leading to environmental pollution, degradation, and health hazards .Many materials in solid waste can be valuable resources if properly managed and recycled. As natural resources become scarcer, there is a growing need to recover and reuse materials from waste streams. Governments worldwide are implementing stricter regulations regarding waste management, including recycling and waste reduction targets. Understanding innovative approaches can help meet these requirements effectively. Poor waste management practices can lead to health issues, especially in developing countries. Proper waste management strategies are crucial for maintaining public health and safety. Solid waste management contributes to greenhouse gas emissions. Innovative waste management strategies, such as waste-to-energy technologies, can help reduce these emissions. Implementing innovative waste management practices can create new economic opportunities, such as recycling industries and waste-to-energy projects, leading to job creation and economic growth.

In conclusion, studying innovation and strategies in solid waste management is essential to address these challenges and move towards a greener, more sustainable future.

4. PROBLEM STATEMENT :

"How can innovative technologies and strategic approaches be leveraged to achieve a greener future through improved solid waste management practices?

This question opens up avenues for exploring various aspects of waste management, including technological innovations, policy frameworks, community engagement strategies, and their collective impact on sustainability and environmental health.

5. LITERATURE REVIEW:

Agarwal, Jaya : Municipal Solid Waste Management in special reference to Dehradun Uttarakhand A Socio Legal study

Municipal solid waste management is now required due to an increase in the population living in urban areas (MSWM). It is legally required of municipal corporations and urban local authorities to manage solid waste more efficiently and with less quantity. The rising output of MSW and challenges in properly treating it are causing serious problems for the local municipality of Dehradun. Over the ages, Dehradun has been the focal point of all major development projects. As a result of the influx of residents from nearby districts and the brisk expansion of its commercial sector during this time, the municipal and local government bodies have faced tremendous challenges in managing the waste generated by residential and commercial buildings. Residents' open burning or dumping of rubbish in public areas such as fallow land, open ground, and sewers leads to unsanitary circumstances for locals and harm to human health. Since Dehradun's solid waste management is currently neither managed nor handled by the municipality, it is imperative that significant changes be made in order to make the area aesthetically pleasing, hygienic, and enjoyable. The purpose of this study is to identify potential areas for improvement by concentrating on the generation, processing, mass transit, and disposal of garbage in Dehradun. Proposing a single, universal definition of MSW that is applicable to all nations becomes an extremely challenging task. The population of Dehradun has grown by more than 32% since it became the capital of the Uttarakhand province in 2001 (1.28 million in 2001 -1.69 million in 2011). Dehradun saw a remarkable increase in the number of industrial units from 247 to 3044 between 2001 and 2011. As a result, 291.8 MT of municipal garbage are produced every day in the Dehradun metropolitan region.

Rana, Rishi : Municipal Solid Waste Characterization and Analysis in Tricity

Unscientific garbage disposal has been linked to a number of environmental issues, including soil, water, and air pollution. To reduce the impact of solid waste on the environment and human health, this needs to be addressed right away. Economic development has a direct impact on garbage generation. The majority of local administrations in developing nations struggle to run their affairs effectively and efficiently. Numerous factors, including geographic location, time of year, way of life, dietary habits, population growth, and social standing, have an impact on the formation of solid waste and its composition. Consequently, before choosing and putting into practice waste management techniques for a specific location, it is now crucial to take into account all of these factors and determine the composition and quantity of garbage. An option for treating waste that works well in one location might not work as well in another. Thus, in choosing a treatment plan for a given area, it's important to consider a number of variables, including population growth rate, waste composition variations, and waste creation patterns. Newline, Aiming to investigate the current waste management practices in the Tricity of Chandigarh, Mohali, and Panchkula, as well as the environmental consequences of leachate generated from open dumping sites, this study takes into account current environmental and public health issues. It also explores the life cycle assessment methodology to determine the impact of municipal solid waste management under various scenarios.

Dalia Perkumiene˙, Ahmet Atalay , Larbi Safaa &Jurgita Grigiene˙(2023)- Suggested and concluded in their study that The reduction, collection and disposal of waste is very important for a sustainable environment and sustainable tourism and recreation activities. In particular, the increase in the number of events and mass participation highlight the need for sustainable waste management and the environmentally friendly execution of this process. Therefore, when organizing environmentally friendly recreational activities, sustainable waste management should be understood and correctly applied by both managers and participants. Sustainable waste management has become a vital part in the way of tourism and recreation sectors. The drastic rise of tourism has brought to a significant rise in generated waste, which also has different negative impacts on the environment, public health and tourism experiences. Sustainable waste management strategies and planning's, which include in ti reducing the waste generation, improving waste collection and disposal methods, and promoting recycling and composting, can help to mitigate these negative impacts.

6. OBJECTIVE OF THE STUDY:

1. To create an awareness on Solid Waste Management.
2. To study the impact of Solid Waste Management on economy.
3. To understand the regulatory and policy initiatives impacting Solid Waste Management.
4. To encourage cooperation between public and private sector organisations.
5. To generate awareness among the local people about solid waste.

7. RESEARCH METHOD / METHODOLOGY:

SOURCES OF DATA COLLECTION:

Our research is based on purely secondary research.

SECONDARY DATA: It majorly consist of the information collected from various sources like books, websites, journals etc.

SCOPE FOR FURTHER RESEARCH:

The scope for further research in innovation and strategies in solid waste management for a greener future is broad and encompasses various areas. Here are some potential areas for further research:

Explore emerging technologies such as advanced recycling processes, waste-to-energy technologies, and smart waste management systems to improve efficiency and sustainability in waste management. Investigate the potential of implementing circular economy principles in solid waste management to promote resource recovery, reduce waste generation, and minimize environmental impact. Conduct studies to understand public attitudes, perceptions, and behaviour's towards waste management to develop more effective communication strategies and incentive programs for waste reduction and recycling. Analyse the effectiveness of existing waste management policies and regulations and propose recommendations for enhancing policy frameworks to promote sustainable waste management practices. Focus on developing innovative and context-specific waste management solutions for developing countries facing unique challenges such as limited infrastructure and financial resources. Conduct life cycle assessments of different waste management practices to compare their environmental, economic, and social impacts and identify opportunities for improvement. Explore strategies for engaging communities and stakeholders in sustainable waste management practices, including education, awareness campaigns, and participatory decision-making processes. Investigate the role of solid waste management in mitigating climate change through the reduction of greenhouse gas emissions from waste treatment and disposal. Study methods for minimizing waste generation at the source through product design, packaging innovation, and consumer behaviour change. Explore opportunities for collaboration between different sectors, such as industry, academia, government, and NGOs, to promote innovation and knowledge sharing in waste management.

Overall, there is a vast scope for further research in innovation and strategies in solid waste management, with potential for significant contributions to achieving a greener and more sustainable future.

8. DISCUSSION AND ANALYSIS:

CASE STUDIES:

Case Study 1 Help us Green

Help Us Green is preserving River Ganga from becoming religious sewer.(by flower cycling the waste from temples and mosques)

Into patented lifestyle products, providing livelihood to 1200 rural families.

Tonnes waste lowers and 97 kgs toxic chemicals prevented from getting into the river daily.

The waste is handcrafted by rural women, self help groups into patented organic fertilizer and incense sticks.

Value of Organization (Current Validation of a boot strapped start up is 40 Million USD)

Value of Society

1. 1060 metric tonnes temple waste flower cycled till date
2. 110 metric tonnes chemical pesticide offset.
3. Direct Livelihoods-Income increases by minimum of 6 times
4. Indirect Livelihoods-365, each family has 5 members on average
5. Increasing standard of living for women workers and making them economically independent predictable and regular incomes.
6. The project has attracted interest across the country thus highlighting the issue of temple flower disposal.

Case Study 2 Graviky Labs

1. Carbon capturing startups in the world and only such start up in India
2. Create paint and ink from the pollution itself.
   *Built a contraption that gets connected to the exhaust on the tall pipe of a vehicle
   *Collects the raw carbon (the soot)
   *A purification process successfully converts this air pollution into printing ink
3. The same procedure can be done for chimneys or boats to collect effluence and then convert that into ink.

KAALINK-is patent pending retrofit technology used to capture air pollution particulate, which is hten processed into making AIR-INK

Valur for Organization: Organization worth 8 crore INR starting in 2016 seed, 120 US dollar

Value for Society: 20500 litres of Air Ink produced, 700 tons of carbon offset

Case Study 3 Impossible Burger

1. Discovering healthy, sustainable new ingredients from nature
   *Invent new ways to make the meat we crave directly from plants
   *They use 95% less land,74% less water and creates 87% less greenhouse gas emissions
2. Burger: has all natural ingredients such as wheat, coconut oil, potatoes
3. Magic ingredient -Heme
Heme is a basic building block of life on Earth including plants, but its uniquely abundant in meat
They discovered that heme us what makes meat smell, sizzle and taste gloriously meaty.
Consider it the magic ingredient that makes their burger a carnivorous dream.
4. Plant is in Oakland-
*Capacity to produce/million pounds of plant based meat per month
*Enough to serve about 1 million quarter pound Impossible Burger per week
Value for Society:
Feeding generations to come
The way the world produces meat today is taking and enormous toll on our planet
According to livestock researchers
*animal agriculture uses 30% of all land
* over 25% of all freshwater on Earth and creates as much greenhouse gas emissions as all of the world car, trucks, trains, ships and airplanes combined

Impossible Burger: are made entirely from plants without the destructive impact of livestock, so that the present and future generations will be able to enjoy a good fashioned burger.

9. RESULTS & FINDINGS:

IMPLEMENTATION OF STRATEGIES ON SOLID WASTE MANAGEMENT:

Implementing sustainable solid waste management requires a combination of strategies that address waste generation, collection, treatment, disposal, and resource recovery while considering environmental, social, and economic factors. The following are some crucial tactics for managing solid waste in a sustainable manner:

1. **Encourage waste minimization** and source reduction techniques in order to cut down on the quantity of trash produced. This entails encouraging consumers to make ecologically responsible purchase decisions, promoting reusable items, and incorporating durable and recyclable product design.
2**. Recycling and Resource Recovery**: To recover valuable resources from solid waste, such as metals, plastics, paper, and organic materials, establish extensive recycling systems. Convenient recycling infrastructure should be provided, and people should be made aware of the value of recycling and appropriate garbage sorting.
3. **Composting and Organic Waste Management**: Encourage the composting of organic waste to keep it out of the trash and to provide nutrient-rich compost that can be added to soil for landscaping and agriculture. To assist composting projects, implement distinct schemes for collecting organic waste from homes, companies, and institutions.
4. Waste-to-Energy (WtE) and Energy Recovery: Learn about waste-to-energy technologies that use thermal treatment techniques like incineration to extract energy from non-recyclable refuse. To reduce emissions and pollutants, make sure waste-to-energy facilities abide with stringent environmental standards.
5**. Policy and Regulatory Frameworks**: To support sustainable solid waste management practices, create and implement thorough waste management policies, rules, and standards at the municipal, state, and federal levels. Verify adherence to environmental regulations, waste diversion goals, and pollution control strategies.
6. **Investment in Technology and Infrastructure:** To promote sustainable waste management practices, invest in cutting-edge waste management infrastructure, such as collection systems, recycling centers, composting facilities, and waste-to-energy facilities. To increase resource recovery, environmental performance, and the efficiency of waste processing, embrace cutting-edge research and technologies.
7. **Community-Based Approaches:** Through public awareness campaigns, community education projects, and participatory approaches, involve local communities in solid waste management initiatives. To develop and execute sustainable waste management solutions that are suited to local needs, encourage cooperation between governmental organizations, corporations, non-governmental organizations, and community groups.
8. **Integrated Waste Management Systems:** To maximize resource recovery and reduce environmental effect, develop integrated waste management systems that encompass various waste management choices, such as recycling, composting, landfilling, and energy recovery. Establish a hierarchy of waste management choices, giving reuse, reduction, and prevention of waste precedence over disposal.
9. **Green Procurement and Sustainable Consumption**: Promote ecologically friendly product and packaging choices that have the least negative effects on the environment throughout the course of their lifetimes among enterprises, government agencies, and other institutions.

10. GOVERNMENT'S INITIATIVES

Policy and Regulation	Level of Implementation
Institutional Framework	Central Level • State Level • Other Organizations/Associations
Legal Framework	• 74th Constitutional Amendment Act, 1992 • Management and Handling Rules • Environment (Protection) Act, 1986 • National Environment Tribunal Act, 1995 • National Environment Appellate Authority Act, 1997 • Water (Prevention & Control of Pollution) Act, 1974 • Water (Prevention & Control of Pollution) Cess Act, 1977
Environmental Norms	• Existing Environmental Standards • Recently Notified Environmental Standards
Policy Initiatives	• National Urban Sanitation Policy, 2008 • National Environment Policy, 2006 • Policy Statement for Abatement of Pollution, 1992 • National Conservation Strategy and Policy Statement on Environment and Development, 1992 • Law Commission Recommendation • Ecomark Scheme, 1991
Key Government Programmes	JNNURM Total Sanitation Campaign MNRE's Waste-to-Energy Programme • Integrated Low Cost Sanitation Scheme • National Biogas and Manure Management Programme

Technology and Practices	• Landfills • Waste Incineration • Sanitation
Technology and Practices (Key Initiatives)	• Kolkata: SWM Improvement Project • Kanchrapara: SWM through Citizens' Participation • Kollam: MSW Management Project • Chennai: MSW Project • Navi Mumbai: MSW Management Project • Gurgaon: Ultra Modern Waste Management Plant • Namakkal: Zero Garbage Status • Suryapet: Dustbin Free and Zero Garbage Town • Visakhapatnam: SWM Though Citizens Participation • Thiruvananthapuram: Decentralised SWM • CIDCO: SWM System at Areas Adjoining Navi Mumbai
Rural Waste Management	• Tamil Nadu: Zero Waste Mgt. at Vellore District • Maharashtra: Slwm at Dhamner Village • Gujarat: Greywater Mgt. at Fathepura Village • Maharashtra: Greywater Mgt. at Wadgaon Village • Nashik: Wastepaper to Pepwood • Kerala: Post-NGP Initiatives at Kattapana Village
Industrial Solid Waste Mgt.	Andhra Pradesh: 3.66-MW Power Generation Project • Uttar Pradesh: 6-MW Biomass Cogeneration Power Plant • Other WTE Projects • Kolkata: Waste Minimisation of Small-Scale Industrial Units • Himachal Pradesh: Waste Treatment Plant
Liquid Waste Management	• Municipal Liquid Waste • Other Noteworthy Water Reuse and Recycling Projects • Industrial Liquid Waste

11. LIMITATIONS:

Waste Generation Rates: As cities become more populated and urbanized, more waste is produced, placing a pressure on the infrastructure currently in place for waste management.

Absence of Infrastructure: A lot of areas lack the necessary facilities for the collection, transportation, treatment, and disposal of garbage. This results in water body contamination, open burning, and unlawful dumping.

Improper Disposal Practices: Improper disposal techniques increase greenhouse gas emissions, contamination of the environment, and health risks. Examples include burning garbage, open dumping, and landfilling without the use of adequate liners.

Restricted Financial Resources: The construction and operation of waste management infrastructure is sometimes impeded by municipalities' restricted funds, which makes it difficult to apply efficient waste management techniques.

Public Education and knowledge: Inadequate public education and knowledge about appropriate waste management techniques results in inappropriate disposal practices, which exacerbates waste management initiatives.

Recycling and Resource Recovery: Infrastructure, technology, and public involvement investments are necessary to establish effective recycling and resource recovery programs. Because of insufficient recycling facilities and logistical difficulties, recycling rates are still low in many places.

Hazardous Waste Management: Because of legal restrictions, specific treatment needs, and possible health and environmental hazards, managing and properly disposing of hazardous waste presents a number of difficulties.

Waste Composition and Diversity: Handling a variety of waste streams, such as hazardous, plastic, electronic, and organic waste, calls for specialized infrastructure and solutions, which makes waste management systems more difficult.

Impacts of Climate Change: By raising the frequency and intensity of extreme weather events, which can harm infrastructure and interfere with waste management operations, climate change can make waste management problems worse.

Frameworks for Policies and Regulations: The implementation of sustainable waste management methods can be hampered by inconsistent or insufficient waste management policies and regulations, which can result in inefficiencies and environmental impact.
Despite these limitations, addressing the challenges in innovation and strategies in solid waste management is crucial for advancing towards a greener future. By acknowledging these limitations and working to overcome them, researchers can contribute to more effective and sustainable waste management practices.

12. CONCLUSION:

In conclusion, achieving a greener future through innovative strategies in solid waste management is not only desirable but also imperative for the sustainability of our planet. The integration of technologies such as waste-to-energy processes, advanced recycling techniques, and smart waste management systems can significantly reduce the environmental impact of waste disposal. Additionally, the implementation of effective policies and regulations, coupled with community engagement and awareness programs, plays a crucial role in promoting sustainable waste management practices. By adopting a holistic approach that combines technological innovation with strategic planning and community involvement, we can pave the way towards a greener future. It is essential for governments, industries, and communities to work together to address the challenges of solid waste management and transition towards more sustainable practices. Only through collective effort and a commitment to innovation and sustainability can we ensure a cleaner, healthier environment for future generations.

13. RECOMMENDATION & SUGGESSTIONS:

Here are some recommendations and suggestions for innovations and strategies in solid waste management for a greener future:

Implementing Advanced Recycling Technologies: Invest in advanced recycling technologies such as pyrolysis, gasification, and chemical recycling to process waste that cannot be recycled through traditional methods.

Promoting Circular Economy Principles: Encourage the adoption of circular economy principles, such as designing products for durability, reuse, and recyclability, to minimize waste generation.

Enhancing Organic Waste Management: Promote composting and anaerobic digestion of organic waste to produce valuable compost and biogas, which can be used as fertilizers and renewable energy sources, respectively.

Deploying Smart Waste Management Systems: Utilize smart waste management systems that leverage IoT (Internet of Things) technology to optimize waste collection routes, reduce collection frequency, and improve operational efficiency.

Encouraging Source Segregation: Implement policies and programs to encourage source segregation of waste at the household and commercial levels, facilitating easier recycling and composting.

Strengthening Extended Producer Responsibility (EPR): Enforce EPR policies that require manufacturers to take responsibility for the end-of-life disposal of their products, encouraging them to design products with recycling and reuse in mind.

Educational and Awareness Campaigns: Conduct educational campaigns to raise awareness about the importance of waste reduction, recycling, and proper waste management practices among the public.

Supporting Informal Waste Pickers: Recognize and support the role of informal waste pickers in waste management by integrating them into formal waste collection and recycling systems.

Investing in Infrastructure: Invest in infrastructure for waste segregation, recycling facilities, and waste-to-energy plants to process waste efficiently and reduce landfill dependency.

Policy and Regulatory Frameworks: Develop and enforce comprehensive policy and regulatory frameworks that promote sustainable waste management practices and incentivize innovation in the sector.

By implementing these recommendations and suggestions, communities can move closer to achieving a greener future through more efficient and sustainable solid waste management practices.

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Participation of Working Women for Environmental Sustainability Measures: An example of Chandrapur Area, Western Coalfields Ltd

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Abstract: *Human activities since the last century have significantly altered the Earth's ecosystems, leading to profound environmental changes. Widespread human interference has caused environmental pollution, land degradation, global warming/climate change, water scarcity, and loss of biodiversity. These issues directly compromise the quality and sustainability of natural ecosystems, posing threats to their resilience and functionality. Human activities have led to the loss of habitats and mass extinction of species, raising serious concerns about biodiversity conservation. Scientific studies and data indicate that if current trends persist, environmental conditions will worsen, posing significant challenges to human civilization in the future. Coal India Limited, being a major player in the coal industry, has a responsibility to address the environmental impacts associated with coal mining and usage. This includes implementing policies and practices aimed at mitigating pollution, reducing carbon emissions, conserving water resources, and preserving biodiversity in mining areas. The research delves into the specific policies adopted by Coal India Limited and Western Coalfields Ltd, analyzing their effectiveness in promoting environmental sustainability. It also highlights the crucial role played by women employees in driving these sustainability initiatives forward. Women in the workforce often bring unique perspectives, skills, and dedication to environmental causes, contributing significantly to the overall sustainability efforts of the coal sector. Through detailed analysis and case studies, this research aims to showcase the tangible actions taken by Coal India Limited and the invaluable contributions of working women towards achieving environmental sustainability goals within the coal mining industry. It emphasizes the importance of collaborative efforts, sound policies, and dedicated individuals in mitigating the environmental impacts associated with coal energy production.*

Key Words: *Environmental Sustainability, Working women, Coal India Ltd, Western Coalfields Ltd.*

1. INTRODUCTION:

The relationship of man and the environment can be referred to as give and take, but the so-called developing mankind didn't understand this. Ruthlessly extraction from the environment has put and is putting the environment into danger. So, we can say modifying the environment to fit the needs of society has caused severe effects and put the environment in hazards.

The main four major environmental hazards are:

1. Pollution
2. Global warming
3. Deforestation and
4. Soil erosion

Mankind forgot that it owes to the environment and it is also supposed to give back to the environment something. But, it did almost nothing. And thus today we are forced to talk about the environment and to take sustainability measures at least for our own welfare. Environmental sustainability measures refer to actions, practices, policies or strategies implemented to ensure human activities and development, conducted in a way that minimizes negative impact on the environment, preserves natural resources, and to maintain ecological balance for present and future generations.

So, the sustainability measures are designed to promote sustainable development, which aims to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Some key aspects and components of environmental sustainability measures include:

1. Resource Conservation: Efficient use of natural resources such as water, energy, land, and minerals to minimize waste and reduce environmental degradation.
2. Waste Management: Implementing methods to reduce, reuse, recycle, and properly dispose of waste materials to minimize pollution and landfill usage.
3. Renewable Energy Adoption: Promoting the use of renewable energy sources like solar, wind, hydroelectric, and biomass to reduce reliance on fossil fuels and lower greenhouse gas emissions.
4. Biodiversity Conservation: Protecting and preserving ecosystems, habitats, and wildlife species to maintain biodiversity and ecological balance.
5. Pollution Prevention: Implementing measures to prevent or reduce pollution from various sources such as air, water, and soil pollution through pollution control technologies and best practices.
6. Climate Change Mitigation: Taking actions to reduce greenhouse gas emissions, adapt to climate change impacts, and promote climate-resilient practices.
7. Sustainable Agriculture: Encouraging sustainable farming practices that promote soil health, conserve water, minimize chemical inputs, and support biodiversity.
8. Green Infrastructure: Designing and developing infrastructure (e.g., buildings, transportation systems, urban spaces) that is environmentally friendly, energy-efficient, and resilient to climate impacts.
9. Education and Awareness: Raising public awareness, promoting environmental education, and fostering a culture of sustainability to encourage responsible environmental stewardship.
10. Policy and Regulation: Enacting and enforcing environmental laws, regulations, and standards at local, national, and international levels to promote sustainable development and hold individuals and organizations accountable for their environmental impacts.

Overall, environmental sustainability measures aim to balance economic, social, and environmental considerations to create a more resilient and harmonious relationship between human activities and the natural environment.

This article is focused on how Coal production is the contributing factor for degradation of the environment. Coal production contributes significantly to environmental degradation through various stages of its extraction, processing, transportation, and combustion. Overall, the environmental impacts of coal production underscore the importance of transitioning to cleaner and more sustainable energy sources to mitigate climate change, protect ecosystems, safeguard public health, and promote environmental sustainability.

2. RATIONALE OF SELECTION OF THIS TOPIC: The degeneration of the environment over time is primarily attributed to human activities and their cumulative impacts. This article is focused on how coal production is the contributing factor for degeneration of the environment. In my awarded research work "A sociological study of problems and prospects of working women of Western courses Limited", there were questions related to the health of working women in coal mines areas like Western coalfield Limited. The findings related to respondents health problems were as follows:

1. 48.67% of the respondents were facing digestive problems.
2. 38% were facing respiratory problems.
3. 4.33% were facing heart problems.
4. 2% percent were facing allergy problems, and
5. 7% were facing any other problems.

All findings indicated more insight are needed in this related topic.

3. OBJECTIVES OF THE RESEARCH:

- How coal production is affecting the environment?
- What are the policies of Coal India Limited regarding environment sustainability?
- What functional measures are in practice for environmental sustainability?
- Where Coal India Limited failed in the implication of the policies for environment sustainability?
- Participation of working women for environmental sustainability measures.

4. RESEARCH METHODOLOGY:

Research methodology adopted in this research were:
1. Document analysis and
2. Observation method

SOURCE OF DATA COLLECTION:
- Primary sources of data were collected by the researcher, by doing field visits.
- Secondary data collection was collected from documents, journals, and reports.

5. LITERATURE REVIEW:

1. Environment analysis of coal India, Gourvi Gupta, Sep 2021: The findings of this research were: Mining hazards are one of the gravest collateral damage in coal mining, these fatalities need to be reduced as much as possible. Sulphur Dioxide emitted from coal mines can cause acid rain, Coal India Limited needs to lower its sulphur emissions. If, in any case, the pollutants exceed the limit subscribed, the authorities should take a serious action immediately, or be heavily penalized. There is a shortage of industrial cleaner mechanical grooming techniques.

2. Effects of coal mining and climate-environment factors on the evolution of a typical Eurasian grassland, Lijing Fang a, Ruizhong Gao a, & others, 2024. This study investigated the spatiotemporal evolution of a typical Eurasian grassland, which is in the southern part of the Mongolian Plateau and has extensive coal mines, and the influencing climate-environment factors. In this regard, the evolution was measured using fractional vegetation cover (FVC). The results indicated that coal mining significantly reduced the FVC in the vicinity of the minefield and such impacts would expand and intensify over time as climate changes.

3. Coal Mining and Local Environment: A Study in Talcher Coalfield of India, Niharranjan Mishra and Nabanita Das, 2017. As coal production increases, these mining-affected areas experience accelerated environmental decline. Despite claims by mining authorities regarding pollution control measures, air, water, and noise pollution persist. Elevated levels of SPM (Suspended Particulate Matter) and RSPM (Respirable Suspended Particulate Matter) beyond permissible limits contribute to respiratory ailments, reducing the average lifespan of those affected. Groundwater quality in areas like Talcher-Anugul has deteriorated significantly, rendering it unfit for drinking. Mining drainage water shows increased suspended sediments and COD (Chemical Oxygen Demand) levels, potentially harming aquatic life. Noise pollution not only incurs higher household repair costs but also causes hearing and mental health issues. Based on data, observations, interactions, and photographic evidence, urgent action is needed to mitigate environmental degradation by reducing pollution across various fronts.

6. FINDINGS:

Facts and findings about how coal production is affecting the environment:

Coal production is attributed to deforestation, water pollution, land degeneration, green gas emission, air pollution, waste generation, resource depletion, climate change, health impacts, etc.

Facts and findings related to the policies of CIL regarding environment sustainability:

India is the world's second largest producer of coal. The mission of coal in the limit is to produce and market the plant quantity of coal and coal products efficiently economically in an eco-friendly manner with due regards to safety conservation and quantity.

Major steps being taken by all subsidies of Coal India Limited are:

1. Utilization of mine water
2. Eco parks
3. Extraction and use of sand from over burden
4. First Mile connectivity
5. Renewal energy
6. Bio reclamation and tree plantation
7. Capital expenditure investment

About the Chandpur area of Western coalfields Limited:

Currently three OC (Opencast) and two UG (Underground) mines are operational:
Operational Mines are:

1. Hindustan Lalpeth OC
2. Bhatadi OC
3. Durgapur OC
4. Nandgaon UG
5. Durgapur Rayatwari Colliery UG

Closed/Discontinued Mines are:

1. Padmapur OC
2. Chanda Rayatwari Colliery UG
3. Mahakali Colliery UG
4. Hindustan Lalpeth Colliery UG
5. Mana Incline UG

There are three ISO 18001 Certified mines:

1. Bhatadi Opencast
2. Durgapur Opencast and
3. Padmapur Opencast

Steps to reduce environmental impact during transportation packaging and dispatch of coal:

i. Bhatadi OC (Pipe Conveyor) and Durgapur OC (Rope Conveyor) – road transportation of coal is negligible resulting in reduced air pollution due to road transport.
ii. From other mines, coal transport to Thermal power plants is through railway siding.
iii. The amount of coal (less than 10%) is through road-sale (consumers other than thermal power plants).

Steps to reduce environmental impact during coal dispatch:

i. Mobile water tankers – Departmental (28 Kl capacity) and HOE tanker (12 KL) operate on haul roads in the mine. Mobile tankers of 10-12 KL capacity are operated on coal transport roads (till CHP or railway siding) on hiring basis.
ii. Fixed water sprinklers are also installed along coal transport routes for dust suppression.
iii. CHP and belt conveyors are equipped with mist spray nozzles.
iv. Recently 10 mist fogger canons with 100 m throw capacity have been deployed at coal stock area/CHPs and railway sidings in Chandrapur Area for dust suppression.
v. At HLC Railway Siding a wind barrier wall (metallic curtain) of 680 m length and 20 feet height) has been constructed.

The statutory and regulatory measures related to environmental compliances being taken:

1. As per statute, ambient air/water/ noise monitoring is carried out at four locations around every mine – once in every 15 days.
2. Groundwater monitoring (water level and water quality)in the buffer area (10 km radius of the mine) is carried out at 54 locations in Chandrapur.
3. Dust suppression measures by way of sprinklers, mobile tankers, metallic curtain are implemented.
4. Effluent Treatment Plants are provided wherever HEMM washing is involved.
5. Every mine has provision of sedimentation tanks to ensure that the discharged water meets the prescribed norms.
6. One Continuous Ambient Air Quality Monitoring System has been installed at Durgapur OC, two others are under procurement for Bhatadi OC and HLOC as part of compliance with directions of the State Pollution Control Board.

Steps are being taken for dust emissions and propagation:

I. During mine operations – wet drilling is employed and controlled blasting delay detonators are practiced.
II. Mobile water tankers are deployed for spraying of water on haul roads in the mine and on a coal transportation road.
III. Fixed water sprinklers are provided along permanent coal transportation routes
IV. Metallic curtain/Wind barrier wall provided at Railway Siding.
V. 10 nos mist fogger canons with 100 m throw range have been deployed at CHPs/Railway Siding

Steps are being taken for reduction of CHG emissions:

i. Plantation is carried out on OB Dumps, Backfilled area and vacant land available in the mines. In the last 5 years plantation has been done in an area of 46.80 hectares in Chandrapur Area (119000 nos. saplings. This plantation acts as a carbon sink and helps in reducing GHGs.
ii. Electric vehicles are being deployed wherever possible as a substitute for Diesel operated vehicles. 07 EVs have been commissioned by Chandrapur Area in FY 2023-24.
iii. Solar plants are operational at 05 locations with installed capacity of 375 KWP.

The dust suppression measures being taken to mitigate generation and propagation of dust:

I. During mine operations – wet drilling is employed and controlled blasting delay detonators are practiced.
II. Mobile water tankers are deployed for spraying of water on haul roads in the mine and on a coal transportation road.
III. Fixed water sprinklers are provided along permanent coal transportation routes
IV. Metallic curtain/Wind barrier wall provided at Railway Siding.
V. 10 nos mist fogger canons with 100 m throw range have been deployed at CHPs/Railway Siding.

Installation of Solar power on roof tops for green generation. What capacity is installed and what is planned ahead:

1. Installed Solar plant capacity is 375KWP (at 5 locations).
2. Proposed – 5 MW plant at Durgapur Opencast.

Steps are being taken for waste management:

I. Hazardous Waste (ETP Sludge, Oil contaminated waste) are disposed of through authorized hazardous waste handling agencies – M/s MEPL, Butibori. The waste is transported by the agency to its TSDF facility at Butibori.
II. Overburden from mines – Either dumped as external OB or backfilled in mine voids.
III. Colony waste **-** Colony waste is handled by Chandrapur Municipal Corporation (for colonies located in Chandrapur City) and respective gram panchayats. WCL pays tax to these local bodies.

Total number of trees planned on OB (Overburden) dumps and avenue plantation in the last 5yrs:

1. In the last 5 years plantation has been done in an area of 46.80 hectares in Chandrapur Area (119000 nos. saplings)
2. Bhatadi OC – 74000 nos. (14500 nos on OB Dump, 59500 along mine periphery)
3. Durgapur OC – 20000 nos. (Backfilled OB Dump)
4. HLOC – 25000 nos. (Plain land/Avenue)

Compensatory a forestation done during the last 5 yrs against the forest land acquired:

Compensatory Afforestation amount paid for land of 73.96 Ha (against diversion of 36.98 Ha forest land in HLOC in 2020-21) and for an area of 243.16 Ha (2021-22) for Durgapur OC (diversion of 121.58 Ha forest land).

How many hectares of land reclaimed through plantation, how many mines were closed in the last 5yrs and in that area what steps were taken for environment sustainability:

Land reclaimed through plantation in the last 5 years – 8 hectares in Durgapur OC. In other mines, plantation was done on external Overburden dumps. Mines closed in last 5 years – Mana Incline Underground mine (July 2022), Mahakali Underground mine (September 2021), Padmapur Opencast (March 2022)

Number of Eco parks in the Chandrapur Area:

01 – Neem Vatika at Chanda Rayatwari Colliery Underground Mine, Chandrapur

Measures taken for Eco Restoration in the last 5 years:

i. Backfilling of mined void at Durgapur Opencast and HLOC
ii. Plantation carried out over 8 ha backfilled land at Durgapur Opencast , 5 Ha over Overburden dump and 23.8 Ha over plain land at Bhatadi Opencast and 10 Ha at HL Opencast Mine)
iii. 01 Eco-park (Neem Vatika) created over 3.44 Ha land at the closed mine of CRC Underground.

Total Mine water discharge for the last 5 years and utilization:

Mines	De-watering (m^3/day)	As per CGWA Application in Process (m^3/Day	Total (m^3/Year)	Total Utilization (m^3/day)	% Mine Water Utilization
Durgapur OCM	13455	13455	4911075	11515	85.58 %
Bhatadi OCM	14820	14820	5212200	1323	8.92 %
Padmapur OCM	Nil	11322	4132530	Nil	100 %
Hindustan Lalpeth OCM	1400	4494	1640310	604	43.14 %
Mahakali Colliery	4500	4500	1642500	3885	86.33 %
Durgapur Rayatwari Colliery	17600	17600	6424000	16850	95.74 %
Manna Incline	1700	1701	620865	1632	96.00 %
Nandgaon Incline	5440	5440	1985600	3480	63.97 %

The number of villages and villagers benefiting from discharged mine water:

1. Villages Chandsurla, Chek Tirwanja, Tirwanja Mokasa from Bhatadi Opencast
2. Nandgaon Pode village from Nandgaon Underground
3. Ramala Talav Village from Mahakali Underground Mine

There is no plant like Gundegaon which turns mine water to drinking water.

Some small scale RO Plants have been created for which the source of water is mine water (RO Plant at DRC-3, AGM Office.)

There is provision of mine water supply for irrigation from the Chandrapur Area.

Mine water discharge after sedimentation is utilized for irrigation at Bhatadi Opencast Mine (Chandsurla & Chek Tirwanja villages) and at Nandgaon Underground (Nandgaon village)

Facts and findings related to working women manpower engagement in the environmental department, in Chandrapur Area for environmental sustainability measures.

In Environment Department - 02 Women (01 clerk and 01 General mazdoor) out of 5 Working Women are engaged in Environment related jobs –

1. HEMM Washing at ETP – 05 nos. (04 at Durgapur OC and 01 at Bhatadi OC)
2. Water Supply/Filter Plant – 07 nos. (03 at Lalpeth SubArea, 02 at Bhatadi OC, 02 at Durgapur OC)
3. Civil Overseer – 02 (01 at Rayatwari Sub-Area and 01 at Durgapur OC)
4. Contractual Works - 02 Women engaged in maintenance of Neem Vatika Eco-park,
5. 03-04 labourers are engaged as and when required for lifting of solid waste into Hazardous waste trucks)

Executive executive MS Tussi Mandal has worked as Head of your department of environment department in Vani area.

Facts and Findings related to Chandrapur City:

Chandrapur was the hottest in the world and stood at third position boiling at 47.8 degree Celsius on 29th may 2019 as per the EI Dorado report which monitors temperatures across the world.

Chandrapur in Maharashtra with air quality index at 824 is the most polluted city in India as reported by Indian Express on 7th November 2016.

Locals blame cold power plants in Maharashtra for death and sickness. Air pollution from the thermal power plant in Chandrapur killed 1300 people in the area in 2020. Reported by post graduate research scholar Varsha Tor Gal Kar on 18th May 2022.

As India pushes to expand fold mining to meet domestic needs environmentalists fear the water crisis will only be an incoming year. Parched villages in Indian Coal Mines hubs hunt for scarcity of water was reported by Mrinali Dhembla on 21st July 2021.

7. CONCLUSION:

No doubt Coal India Limited is trying to imply all the major environment sustainability measures. There is a plant to purify the mine's water to drinking water at Gondegaon WCL Maharashtra. Mine's water is being supplied for irrigation from Saoner to Goregaon in WCL.

But, the environmental reports related to Chandrapur city are quite alarming. Environmental sustainability measures are crucial for safeguarding the health of Chandrapur city inhabitants, ensuring their well-being, at the same time fostering economic prosperity, and fulfilling moral and ethical responsibilities.

8. RECOMMENDATIONS:

We are committed to continuously improving the female-male ratio at all levels. At the end of FY 2022, we had a total of 19,618 female employees, representing 7.9% of total employees.
This research reflects Coal India Limited must put more efforts in compliance of the environmental sustainability measures and in all this endeavor, working women participation should be increased. The Coal India Limited must be more focused to:

1. Preserving natural resources
2. Protecting ecosystem health
3. Mitigating climate change

4. Improving Public Health
5. Ensuring water security
6. Promoting economic stability
7. Supporting social equity
8. Conserving energy
9. Protecting cultural heritage and
10. Meeting Global commitments

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