SOURCES OF PLANET ENERGY, ENVIRONMENTAL & DISASTER SCIENCE CLIMATE JUSTICE AND EQUITY

All India Seminar on SPEEDS-2024

held

29th & 30th June, 2024

Editors

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PREFACE

Climate change and related environmental issues are posing immense hazards to all lives on planet earth endangering human life as well, thus becoming a human rights issue. All human beings should have the right to live a life of safety, security and dignity. However, it is quite apparent that climate crisis is causing loss of lives, livelihoods, while putting many at risk, creating food and water shortages, leading to displacement and conflict.

A potent climate crisis impedes the right to good health as well. Rising temperatures, increased frequency of extreme weather conditions, high levels of air and water pollution contribute to significant health impacts, this includes extreme heat stress, disease outbreaks, malnutrition, and trauma from having lived through disasters. The impacts are more severe for vulnerable populations who have limited means to adapt to climate change.

The Concept of Climate Justice and Equity has been widely used to refer to the idea that most of the developed and wealthy nations have achieved their wealthy status by blatantly exploiting the natural environmental resources. This logic extends to rich business houses and large scale industries also whose chemical emissions have created a level of climate crisis which has resulted in Green House Effect and depletion of Ozone layer. The large-scale deforestation and increasing pollution have created a deep set structural inequality among the people of this world which affects the marginalized sections of the society most. The adverse impact of this structural inequality falls heavily on the people who have the least resources to adapt and cope with abrupt changes. They are at an increased risk of the adverse impacts of climate change, including threats to their health, food security, and access to water energy, and sanitation, and livelihoods, particularly in developing countries.

Concept of Climate Justice therefore suggests that the countries, industries, businesses, and people that have become wealthy from emitting large amounts of greenhouse gases have a greater responsibility to shoulder the burden of that effect of climate change, particularly the most vulnerable countries and communities, who often are the ones that have contributed the least to the crisis.

Climate justice means putting equity and human rights at the core of decision-making and action on climate change. The relevance of this topic is underscored by an increase in human mortality rates arising from floods, droughts, and storms which has gone significantly higher in the decade 2010-20 and is putting Indigenous People and their traditional knowledge at maximum risk.

Climate justice is also an important aspect of a just transition toward a sustainable future.

Currently, it can be maintained that those who have least contributed to the climate crisis are being disproportionately affected by it. Climate justice suggests that the responsibilities in addressing climate change should be divided according to who is contributing most to the problem, while addressing systemic, socioeconomic, and intergenerational inequalities.

A two day All India Seminar on "Sources of Planet Energy, Environmental & Disaster Science: Climate Justice and Equity"(SPEEDS-2024) was held on 29th & 30th June, 2024 at School of Management Sciences Lucknow. This seminar was sponsored by The Institution of Engineers (India) U.P. State Centre, Lucknow, in association with Dr. A.P.J. Abdul Kalam Technical University Uttar Pradesh, Lucknow and Council of Science & Technology, U.P Department of Science and Technology, Govt. of U.P.

The seminar aimed to explore the burning issue of Climate Justice and Equity in the 21st century and potential threats with possible remedial action.

To facilitate in-depth discussions, technical sessions were organized, featuring contributions from intellectual leaders in the fields of science, technology, academia, and industry. These sessions focused on aligned issues and solutions related to the following themes:

1. **Ensure access to affordable, reliable, sustainable and modern energy for all. (6),**
2. Take urgent action to combat climate change and its Impacts. (1)
3. Life Below Water (2)
4. Life on Land (2)
5. Others (6)

In response to the call for papers, we received a total of 50 submissions spanning various themes, with 35 of them being accepted and 20 ultimately presented. We urged all presenters and keynote speakers to shed light on innovative ideas addressing the challenging issues surrounding global warming and climate damage.

This book comprises a curated selection of **17** research papers, encompassing five Themes

1. **Ensure access to affordable, reliable, sustainable and modern energy for all. (6),**
2. Take urgent action to combat climate change and its Impacts. (1)
3. Life Below Water (2)
4. Life on Land (2)
5. Others (6)

I extend my heartfelt gratitude to the editorial board, the authors of the research papers, and all stakeholders who provided unwavering support and guidance throughout the seminar. A special acknowledgment is reserved for Mr. Sharad Singh, CEO of SMS Lucknow, whose motivation and mentorship played a pivotal role in steering the entire team.

In the end, words fail to express my reverence for the almighty, without whose divine intervention, this seminar programme would not have culminated in its final form.

Prof. (Dr.) Bharat Raj Singh,
Editor-in-Chief & Seminar Co-Chair
Director General (Technical), SMS, Lucknow

ACKNOWLEDGMENT

The success of an event is directly tied to the collaborative efforts of its team, coupled with meticulous planning and the execution of innovative ideas. The outstanding success of this seminar is a testament to the hard work of the team that brought together distinguished individuals from both research backgrounds and industry to the platform of SPEEDS.

We take great pride in acknowledging that the dedication of each and every individual involved in SPEED 2023-24, contributed significantly to its success. We are deeply grateful to **The Institution of Engineers (India) U.P. State Center and CST, U.P., Department of Science & Technology** as well as **Dr. A.P.J Abdul Kalam Technical University,** for their continuous support and sponsorship of this seminar.

Our sincere appreciation goes to all the dignitaries and presenters who generously shared their time and insights on various topics and sub-topics of the seminar titled: **"Sources of Planet Energy, Environmental and Disaster Science: Climate Justice and Equity"** (SPEEDS 2023-24) held on **29th -30th June**, 2024.

We extend special thanks to Prof. Sanjay Singh, Hon'ble Vice Chancellor, Dr. Shakuntala Mishra National Rehabilitation University, for gracing the event as the Chief Guest during the inaugural session. We extend our gratitude to **Dr. C.M. Nautiyal, former Consultant Indian National Science Academy** for being a Guest of Honour and **Er. Satya Prakash, Chairman, The Institution of Engineers (India) UP State Lucknow** who was a keynote speaker, as well as to **Prof Jagbir Singh Director College of Architecture, Amity University**, Lucknow for gracing the valedictory session as Chief Guest.

Our heartfelt thanks also go to Dr. Usha Bajpayi, Former Professor from Centre of Excellence Renewable Energy-University of Lucknow who served as the Guest of Honour for the valedictory session, making a valuable contribution to the seminar. We express our deepest regards to **Shri Sushil Kumar Gupta** Finance Officer, Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow, Keynote speaker Dr. Alok Kumar, Ex-Dean & Director Faculty of Management Studies, GNS University, Rohtas. and Dr. Niraj Gupta, Prof. & Dean, SRM University, Lucknow.

We are equally grateful to Dr. Venkatesh Dutta, Assistant Professor at SES, BBAU, Lucknow, and Dr. Suresh Chandra Bajpai, Director of Futuris Energy Pvt. Ltd., for

their insightful contributions during the seminar. Special mention is due to our patrons, Dr. M.P. Singh, Executive Secretary (SMS Society), Mr. Sharad Singh, Secretary & CEO (SMS Lucknow), Prof. (Dr.) Manoj Mehrotra, Director of SMS, Lucknow, and Prof. (Dr.) Dharmendra Singh, Associate Director and Seminar Coordinator, for their unwavering support and guidance.

We extend our deepest gratitude to Prof. (Dr.) P.K. Singh, Seminar- Convener, Dr. Hemant Kumar Singh, Seminar-Organizing Secretary, Dr. Dharmendra Singh- Seminar Coordinator, Dr. Jagdish Singh, Director Admin & Admission, Mr. Surendra Srivastava, Chief General Manager General Manager (Corporate Relations) at SMS, Lucknow, for their exceptional support and cooperation.

Our sincere thanks to the Advisory Committee Members, Executive Committee Members, and all Faculty Members associated with us directly or indirectly. Special mention goes to Mrs. Sujata Sinha, Dr. Shrinkhla Srivastava, and Mr. Amit Kumar Srivastava (DTP) for their cooperation and assistance since the inception of this seminar.

We express our deepest regard to our leading sponsors, the Institution of Engineers and Ultra Tech Cement, without whom this program would not have achieved such success. Last but not least, our appreciation goes to all the Delegates, Participants, Paper Presenters, and Media personnel for their invaluable support, which played a crucial role in elevating this seminar to its heights.

Prof. (Dr.) Bharat Raj Singh,
Editor-in- Chief & Seminar Co-Chair,
Director General (Tech.),
SMS, Lucknow

Recommendation of SPEEDS-2024
All India Seminars on Sources of Planet Energy, Environmental & Disaster Science: Climate Justice and Equity

Introduction

This report presents information and materials from the All India Seminar on Sources of Planet Energy, Environmental and Disaster Science (SPEEDS): Climate Justice and Equity held on June 29-30, 2024. The event was hosted by the School of Management Sciences (SMS) in Lucknow, Uttar Pradesh, in collaboration with The Institute of Engineers, India U.P. State Centre, Council of Science & Technology, U.P. Department of Science &Technology, Government of U.P., India and Dr. A.P.J. Abdul Kalam Technical University, and the

The executive committee identified global subject experts, obtained their approval to support the conference, and formed an advisory board of 17 members and an organizing committee of 13 members. The conference aimed to bring together leading academicians, researchers, technocrats, practitioners, and students to exchange and share their experiences and research on all aspects of Climate Change, Justice, and Equity. It provided a premier interdisciplinary platform to present and discuss recent innovations, trends, concerns, and practical challenges in the fields of Planet Energy, Environmental and Disaster Science.

Executive Summary

The seminar, held over two days, gathered over 100 research scholars, faculty members, students, and key officials nationally and internationally. Discussions focused on recent advances in Environmental Sciences and Climate Changes with an emphasis on sustainability. The event concluded with presentations of real-time cases describing noteworthy initiatives relevant to the conference theme.

Seminar Goals

The primary purpose of the seminar was to discuss issues associated with the environment and climate change. The objectives included:

- **Environmental and Disaster Science:** Examining the intricate relationships between natural systems and human activities, impacts of pollution, deforestation, biodiversity loss, and the need for conservation and sustainable practices. Discussing disaster science, preparedness, risk assessment, and resilience building.

- **Climate Justice and Equity:** Addressing how climate change disproportionately affects marginalized communities and the importance of incorporating justice and equity into climate policies.
- **Bridging Disciplines:** Emphasizing interdisciplinary collaboration to develop comprehensive strategies for addressing climate change challenges.

Day 1 Highlights

1.1 Inaugural Session:

- **Sources of Planet Energy:** Sessions explored renewable energy options such as solar, wind, hydro, and geothermal. Speakers highlighted advancements in these technologies and their potential to meet global energy demands sustainably. The importance of transitioning from fossil fuels to cleaner energy sources was underscored to mitigate climate change's adverse effects.
- **Welcome Address:** Dr. Ashish Bhatnagar, Director at SMS, Lucknow, welcomed attendees and emphasized the importance of interdisciplinary research and collaboration.
- **Opening Remarks:**Er. Satya Prakash, Chairman of the Institution of Engineers (India), U.P. State Centre, discussed the preservation of nature, birds, water, climate, and soil.
- **Theme Introduction:** Prof. (Dr.) Pramod Kumar Singh, Seminar Convener, detailed the conference theme and spoke on the crucial relationship between humans and nature, stressing the need for sustainable practices.
- **Guest of Honour:** Dr. C. M. Nautiyal, Former Consultant (Science Communication) at the Indian National Science Academy, discussed weather and climate changes, the increase in heat waves, and the importance of renewable energy resources.
- **Chief Guest:** Prof. Sanjay Singh, Vice-Chancellor of Dr. Shakuntala Mishra National Rehabilitation University, talked about climate change, its comprehensive understanding, and the example of Denmark's tax on livestock due to Greenhouse Gas emissions from cow dung.

1.2 Plenary Session:

Plenary Session has beenintroduced by **Dr. Alok Kumar**, **Ex-Dean and Director, Faculty of Management Studies, GNS University, Rohtas**. He said that SPEED is a platform for discussion of energy resources, environment and disaster science. He also speaks on "Seeing Blue with REDD+". He said that blue is symbol of calmness, stability. REDD+ shows the role of conservation and sustainable management. He also suggested reducing carbon footprints and also introduced us to the challenges to environment due to uncontrolled deforestation. As per him one third of original tropical forests have gone, one third is degraded and we are having only one third with us. He had spoken about possible solutions.

Dr. Balraj Singh, Associate Professor, Department of Electronics and Communication Engineering, BBAU, Lucknow, Guest Speaker introduced us with evolution of semiconductor industry, transistor and photovoltaic cell.

Dr. Pooja Srivastava, Department of Physics, Amity University, Lucknow, was the guest speakers who introduced us with Graphene its two dimensional structure, she also introduce us with designing of 2D structure of Graphene for hydrogen shortage application. She also talked about green hydrogen cycle.

1.3 Technical Session:

- **Session Chair:** Dr. Alok Kumar, Ex-Dean and Director, Faculty of Management Studies, GNS University, Rohtas.
- **Notable Presentations:**
  - Dr. Rishit Bhatnagar discussed "Environmental Entrepreneurship" and introduced the term Climatech (Climate + Technology).
  - NishchayChaurasia presented on "Harnessing Green Chemistry for Environmental Sustainability."
  - Mr. Gokul T discussed the design and characterization of biochar-LDH nano-composites for wastewater treatment.

Day 2 Highlights

2.1 Plenary Session:

- **Impact of Climate Change on Supply Chain:** Dr. Neeraj Gupta, Principal Solutions Consultant, discussed sustainability in supply chains.

- **Scarcity of Water:** Dr. Vinay Pathak, Assistant Professor at Indian Institute of Information Technology, Sonipat, emphasized the critical significance of water.
- **Wind Energy Potential in India:** Prof. (Dr.) Bharat Raj Singh, Director General, SMS, Lucknow, discussed India's Solar &wind energy potential and its prospects for climate change mitigation.
- **Environmental Entrepreneurship:** Prof. (Dr.) Ashish Bhatnagar, Director, SMS, Lucknow, addressed the topic of environmental entrepreneurship.

2.2 Technical Sessions

- **Session Chair:** Dr. Alok Kumar and Dr. Dharmendra Singh.
- **Notable Presentations:**
- Mr. PuneetVerma addressed the environmental impact of mechanical industries.
- Dr. Amarjeet Singh discussed control strategies for renewable energy and smart grids.
- Mr. Abhishek Pratap Singh assessed environmental pollution from construction activities.
- Dr. Ashok Sen Gupta analyzed the environmental sustainability of animal farming.
- Mr. Shivam Singh examined the environmental impact of lithium-ion battery disposal.
- Ms. Mamta Sharma reviewed research on the impact of climate change on employee productivity.
- Ms. Srishti Sharma and Ms. Anshika Singh explored the role of low-frequency vibrations in enhancing plant growth.
- Dr. Ved Kumar discussed biodiesel production in India.

2.3 Valedictory Session

The conference concluded with a valedictory session. Prof. (Dr.) Ashish Bhatnagar delivered the welcome speech, followed by a valedictory address from Prof. (Dr.) Bharat Raj Singh. Prof. (Dr.) Pramod Kumar Singh provided concluding remarks, and a special address was given by Guest of Honour Dr. Usha Bajpai. Feedback on the conference was provided by Mr. Sushil Kumar Gupta, Finance Officer at AKTU, and the session ended with a vote of thanks by Prof. (Dr.) Hemant Kumar Singh.

2.4 Key Takeaways and Recommendations:

- Urgent need for a global shift towards renewable energy.
- Integration of environmental conservation with disaster preparedness.
- Critical role of Climate Justice and Equity in shaping sustainable futures.
- Value of community engagement, education, and policy advocacy.
- Contributions of mechanical engineers in achieving sustainable development goals.
- Importance of reducing carbon emissions and addressing Greenhouse Gas effects.
- Recommendations for three-layer plantation along expressways to sequester carbon dioxide.

All India Seminars on
"Sources of Planet Energy, Environmental & Disaster Science: Climate Justice and Equity"
(SPEEDS-2024)
held
29th & 30th June, 2024

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Proceedings All India Seminar on Sources of Planet Energy, Environmental & Disaster Science (SPEEDS-2024): Climate Justice and Equity.

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Waste Steel WireAggregatesin Paver Block: A Green Approach

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ABSTRACT

Nowadays, the paving blocks in the market are costly. This study introduces a new type of paving block that is more affordable than conventional paving blocks. The new paving blocks are made from waste materials such as steel bearing balls, wires, lath scrap, and quarry dust, which makes them more environmentally friendly.In this study, the compressive strength eco-friendly paver block is compared to the conventional paving block.For manufacturing of paver block, bearing balls and wires have been used as coarse aggregate, while quarry dust has been used as fine aggregate. This paper presents a parametric experimental study on the production of paving blocks using waste steel wire aggregates in the form of steel wires cut to a length of 20-22 cm and rounded bearings of 6.35 mm.To investigate the increase in compressive strength, various percentages of waste steel wire aggregates are added to the concrete of paving blocks. The results of the tests revealed that integrating various percentages of wasted steel wire aggregates with paving blocks can increase impact strength by up to 50% when compared to standard paving blocks.

Keywords: *Waste Steel Aggregates, Compressive Strength, Concrete Interlocking Paving Blocks, Round Bearings.*

1. INTRODUCTION

Concrete block paving has been widely used nowadays because of its diverse advantages. It is forms in rectangular shape accordance to bricks shape and now there are many various shapes of paving blocks. These blocks are a type of concrete with good in quality and durability due to the manufacturing and the right method of mixture[1]. The concrete paving blocks also something interesting and versatile because of its great resilience, its strength in accommodate traffic flow, interesting aesthetic, and function, cost effective and do not need to be maintenance if the correct way installations from first phase [2,3].The material that use for paving blocks has been widely changed where there are many of paving blocks are added or replaced with the used materials or wastes materials to reduce environmental

pollutions besides can improve its strength and also their mechanical properties [4,5,6]. From the literature study, there are many researchers use waste materials as the aggregate and cement replacement to create paving blocks.

Numerous research have been conducted in the recent literature to study the usage of waste materials as partial replacements in paving blocks The thorough literature study establishes a solid foundation for current research on the performance of paver block when partially replaced with materials such as cement, sand, or coarse aggregate [7,8,9,10]. The materials used are waste steel, rounded bearings, lath scrape, cut size bars, etc. which these materials are available in cheaper price or free of charge [11,12,13]. The primary goal of this research is to look at the performance and properties of paver blocks constructed from various waste components and compared the results with conventional paver block.

2. MATERIAL & METHODOLOGY

The scope of these study is to test the strength of eco-friendly paving block that use waste materials (wires and bearings) as an additive in coarse aggregate with coarse gravel and materials (dust) as fine aggregates in concrete mixture and will be compared to control paving blocks.

2.1 Materials

We will be producingconcrete paver block using waste steel wire aggregate in this paper. The materials used in this study are follows:

2.1.1 Cement: For concrete work ordinary Portland cement is used which this type of binder has two important properties, which is good in adhesion and cohesion with these features, cement will act as a binder to bind the aggregate to form a strong concrete mix.

2.1.2 Water: Water used for mixing concrete and curing must be free of hazardous materials.In general, the minimal water/cement ratio employed for hydration is 0.3 to 0.8. Excess water in the concrete mixture can make the bonding between the concrete less effective and cause holes to emerge in the concrete mixture.In this study, **c**oncrete mixture ratio is 1:2:4 (cement: sand: stone fragments) with a water/cement ratio 0.60

2.1.3 Aggregates: The two kinds of fine aggregate used, which is sand and quarry dust. Sand is used for control paving blocks while quarry dust is used for eco-friendly paving block. Fine aggregate that used are passing the sieve analysis test at size 2.36mm. For coarse aggregate, control paving blocks used coarse gravel while eco-friendly paving block use 75% of gravel stone and 25% of waste material

(wires, steel ball bearings, lath scrape, crushed can pieces).The coarse gravel used are passing 20mm in size of sieve analysis test.

2.1.4 Steel Wire: The waste materials used are steel wirers, round bearings, lath scrape (Karadi) which is a byproduct of cutting and filing job. Bearings balls are the waste break or dispose bearings. They are completely garbage and are used for land filling, dumping, or melting, which requires a great amount of energy and emits hazardous gases or increases the carbon footprint. Using this waste materials in construction is a win-win solution. It helps to reduce pollution and conserve resources, while also producing high-quality products. Figure 1 shows the steel wire which is used in the present study.The used materials are cut to the needed sizes. steel wires cut size of length 20cm – 22cm rounded bearings of size 6.35 mm.

Figure 1: Steel Wire Waste

2.2 Methodology

First step from the procedure are making 12 moulds with size 240 mm x 120 mm x 80 mm (Figure 2). Then, fine and coarse aggregate will be test by sieve analysis test to get the size needed. After that, the concrete work will be done and proceed with the tests. First test are slump test where the result should not exceed or less then 75mm (±25mm), to achieve the real slump and workability. Then it will be cube test and curing process to proceed with density test where the mass (kg) of paving blocks will be divided by the volume (m^3) and compressive strength test where the compressive result will get when load (kN) at the failure divided by the area of the surface paving block (m^2) when achieve 7 and 14 days.

Figure 2: Paving Block Specimen

There are 12 paving blocks produced where 6 of it are control paving blocks and the balance is Eco-Friendly Paving Block. The test will be done when the paving block reaches the 7 and 14 days of their mature age and the result of Eco-Friendly Paving Block will be compared to the control paving blocks based on the test performed.

2.2.1 Design and classification of paver block

Normally, Paving blocks are rectangular-shaped and it is almost like a brick. But now, there is a lot paving blocks variation**.** According to the study in this paper, the classification for paving blocks is based on SNI 03-0691-1996 (zigzag type sizes 240 mm x 120 mm x 80 mm) and Table-1 show the classification of the paving blocks based on their compressive strength.

Table-1: Classification of Paver Blocks

	Classification	**Compressive strength (MPa)**	
A	Road, Petrol Pump	45	35
B	Parking	30	17
C	Walkway	20	15
D	Play Area Or Garden	10	7.5

3. RESULTS & DISCUSSION

Compressive strength test measuredthe maximum amount of compressive load a material can bear before fracturing the test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compression-testing machine by a gradually applied load.The zigzag shaped tile with area 32760 (240x120x80mm) which is tested under a compressive testing machine of 10 kn-300kn as shown in Figure 3.

Figure 3: Compressive Test of Paver Block (ZigZag)

To work on control paving block the ratio of materials used cement: sand: coarse gravel is case1 cement 625gm: sand 2667gm: coarse gravel 1775gm (1:4:2.6) (as per standard IS:15658:2006) and for eco-friendly tiles the ratio of materials used case 2 cement 625gm: sand 2667gm: waste 150gm: coarse gravel 1775gm (1:4.2:0.2:2.9) whose strength goes upto 29.59N/mm^2, then under case 3 cement 625gm: sand 2667gm: waste 300gm: coarse gravel 1775gm (1:4.2:0.4:2.8) strength goes up to 32.67N/mm^2 then under case 4 cement 625gm: sand 2667gm: waste 750gm: coarse gravel 1775gm (1:4.2:1.1:2.8) strength goes up to 34.54N/mm^2 and case 5 cement 625gm: sand 2667gm: waste 875gm: coarse gravel 1775gm (1:4:1.4:2.8) strength goes up to 43.57N/mm^2 which is representing (cement: sand: waste material: coarse aggregate) Volume of 0.032m^3 concrete mixtures are made for 32 moulds based on the ratio. Table 3 shows the quantity of material that used for both types of paving blocks.

Table-2: Quantity of Material

Paving blocks	Cement	Fine aggregate	Eco friendly material	Couse aggregate
Case.1 Standard (1:4:2.6)	13.3%	52.63%	0%	34.9%
Case 2 (1:4.2:0.2:2.9)	11.9%	51.1%	2.8%	34%
Case 3 (1:4.2:0.4:2.8)	11.6%	49.6%	5.5%	33%
Case 4 (1:4.2:1.1:2.8)	10.7%	45.8%	12.8%	30.5%
Case 5 (1:4.2:1.4:2.8)	10.5%	44.8%	14.7%	29.8%

Based on the result and analysis the table 3 is showing the compression of strength with standard tile and the eco-friendly tile and increased strength percentage.

Table-3: Compressive strength results

Paving block	Composition	Standard Strength	Waste strength
Case1	1:4:2.6	19.25 N/mm^2	-
Case2	1:4.2:0.2:2.9	19.25 N/mm^2	29.59 N/mm^2
Case3	1:4.2:0.4:2.8	19.25 N/mm^2	32.67 N/mm^2
Case4	1:4.2:1.1:2.8	19.25 N/mm^2	34.54 N/mm2
Case5	1:4.2:1.4:2.8	19.25 N/mm^2	43.57 N/mm^2

The comparison of compressive strength of paver block using waste material with traditional block is shown in Figure 4.

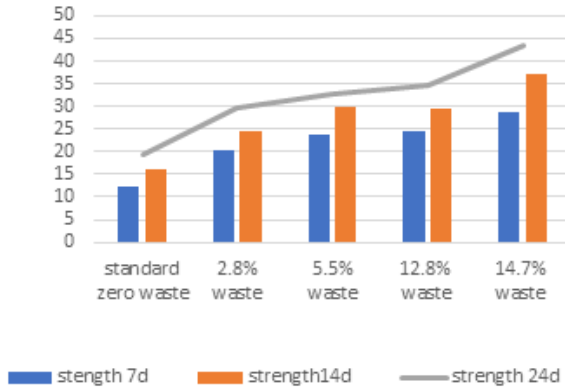

Figure 4: Effect of eco-friendly paver block on Compressive strength (N/mm^2)

Steel aggregates can improve the mechanical property such as elastic modulus, stresses, and optimum compressive strength can be achieved with use of waste aggregate % 2.8, 5.5, 12.8, 14.7, can raise compressive strength up to 53%, 69.7%, 79.4%, 126%, respectively, of ordinary paver block zigzag type these waste products are added in various percentages in concrete prepared with standard design ratio. It is used to reduce the cost of paving block manufacturing and it is used in different proportion with other material such as coarse aggregate, fine aggregate, cement. Waste such as cans of soft drink, lath machinery scrape, wires, steel bars, which are available from variety of sources, wires and bars are cut longitudinally in the desired size according to the moulds which is zigzag shape and cleaned using water, then being dried then being scratch by the iron brush so that the bond between steel bars and concrete became stronger.

Cost analysis:The normal standard M40 tile cost of production is Rs.16.24in this experiment we are using waste to increase strength and to reduce cost so the tile of 5^{th}sample shown in table3 with 875gm of waste achieve strength of 43n/mm2 which cost around Rs.12.74. So we are saving aroundRs.3.5 per pcs of eco-friendly tiles.

4. CONCLUSION

The main conclusions drawn from the studies so far using waste material for the manufacturing of paver block may be summarised as follows:

1. The workability of standard paving blocks are better than eco-friendly paving block using steel wire aggregate.
2. For density, eco-friendly paving block resultbetter than standard paving block.
3. This also can protect our environment from the waste material that can ruin the ecosystem.4. Eco-Friendly Paving Block also cheaper because the used of waste material in the mixture the advantage is for the manufacturers and for the consumers that it will be cost effective and for the manufacturers there will be good profit margin.
5. Compressive strength of paver blocks zigzag shape using steel aggregates is much greater than that of paver block without steel aggregate.

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Environment Friendly EV Charger with Isolated HBC

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ABSTRACT

A power quality improved bridgeless power factor corrected converter (BPFCC) based battery charger is designed, modeled and its performance has been analyzed in this paper. Bridgeless operation of power factor corrected converter ensures high efficiency and low conduction losses. The use of isolated half bridge converter (HBC) improves dynamic response in all operating condition. To maintain the battery current, current controller along with voltage controller are being used in synchronization. The proposed conFigureuration draws a sinusoidal input current and almost unity PF which is in line with standard set by international regulatory. The observed performance of verifies the design and satisfactory charging operation at all operating conditions.

Keywords: BPFCC, HBC, Electric Vehicle.

1. INTRODUCTION

In the context of extreme climatic conditions, it is now important to introduce alternative ways to meet India's economic growth, urbanization, commutation as well as country'senergy security in the transportation fields [1-2]. Electric vehicle plays a viable means to address the aforementioned issues at compatible price, support infrastructure, incentives from Government, high efficiency and are pollution free. However, charging of these batterypowered EVs are of main concern for the rapid adoption of EVs in the market. These EV chargers used ac-dc converters for the conversion of voltage. The conventional charger suffers from poor power quality in terms of high harmonic generation and low power factor. To address these problems, various solutions in terms of power factor corrected converters have extensively reported in literature for adherence of the standards [3]. Various ac-dc converters have been used to improve the power quality of these on board and off boardchargers [4-7].

The effect of electric vehicles on the distribution system has been analyzed and is presented in [8]. The current system cannot sustain without the introduction of

modern consumption management systems. A portable EV charger operated in bulk as well as float charge mode to enhance battery life is presented [9].

In continuation to these advancements, various bridgeless con Figureurations have been proposed for EV chargers. These bridgeless conFigureurations not only improve the conduction losses in comparison to bridge based PFCC but also eliminate the need of diode bridge. Single stageEV based charger using isolated bridgeless (BL) Cuk-SEPIC converter with intrinsic power factor correction is presented. The main advantage is low component count with improved efficiency [10-12]. Moreover, use of electric vehicles reduces the carbon content emitted by vehicle which in turn, aided in environment friendly and sustainability [13-16]. A new such BPFCC integrated with HBC is proposed here which not only mitigates power quality problem but also offers improved dynamic response for EVs. Significant features of the conFigureuration such as simple control due to operation of BPFCC in DCM, less number of conducting components in one switching cycle (due to bridgeless), improved efficiency.

2. SYSTEM CONFIGUREURATION, OPERATING PRINCIPLE & DESIGN OF BPFCC BASED EV CHARGER

The system conFigureuration, operating principle and design calculation of BPFCC based EV charger is presented in following subsections:

2.1 System ConFigureuration of BPFCC Based EV Charger

The proposed BPFCC based EV charger consists of a BPFCC integrated with isolated HBC as shown in Figure.1. The BPFCC is a diode bridge rectifier-less conFigureuration in which two converters are connected to conduct in upper and lower half of the ac voltage alternately. The BPFCC consists of switches S_{b1} and S_{b2}, capacitors C_{b1} and C_{b2}, high frequency diodes D_{b1}, D_{b2}, D_{b3} and D_{b4}. The dc voltage of theBPFCC is controlled by the voltage controller by the means of PWM pulses and given to both the S_{b1} and S_{b2} alternately in synchronization with ac voltage. The BPFCC output is connectedto the isolated HBC for regulating the dc voltage. The battery is controlled by means of cascaded controller-1and 2 for controlling the battery charging.

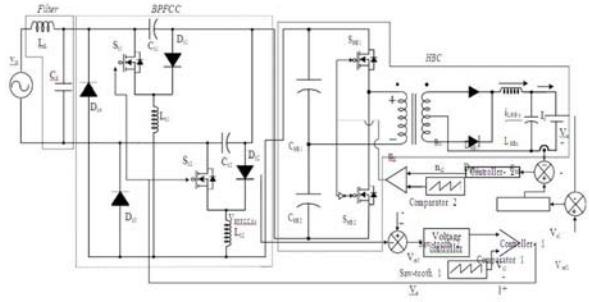

Figure 1: BPFCC integrated with HBC based EV charger

2.2 Operating Principle of BPFCC Based EV Charger

For analyzing the operation of BPFCC, one switching cycle is considered and explained. Due to symmetrical operating characteristic the upper BPFCC operation is explained (Figure.2). The BPFCC is designed in DCM; therefore three different modes (Inductor Charging, Inductor discharging and zero energy) takes place in one switching cycle.

1) Mode I (Charging; switch ON)

When switch S_{b1} turned on (D_B*T), and inductor L_{b1} energizes. To complete the current path diode D_{b4} turns on.

2) Mode II (Discharging; switch OFF)

As switch S_{b1} turned off *(D_B*T)*, Inductor L_{b1} starts discharging and its current becomes zero. To complete the current path diode D_{b3} turns on.

3) Mode III (Discharging; switch OFF)

None of the switch and diodes are on in this mode. The inductor current remains zero until thestart of the next switching cycle.

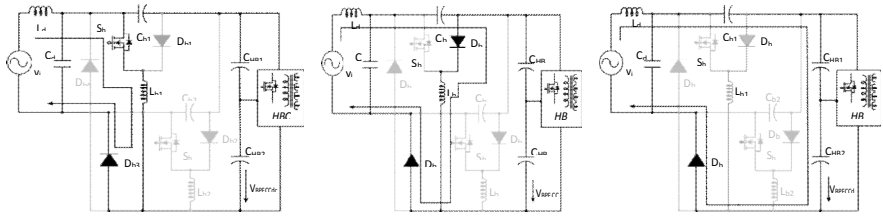

Figure 2: Operating modes of BPFCC

and diode D_{HB2} turned off to freewheel the inductor current. The same sequence repeats forthe lower switch.

2.3 Design of BPFCC Based EV Charger

Each component of *BPFCC* based EV Charger is designed after analyzing the behavior in the one switching cycle. The design equation for the configuration is summarized in Table-1.

Table-1: Calculated values of various component used in EV Charger

Component	Design Equation	Calculated Value	Selected Value
Duty Cycle	$D_B = \frac{V_{BPFCCdc}}{V_{} + V_{}}$	0.602	0.3
Inductor	$L_{b1} = \frac{D_B V_{}}{f_o * 2I_{in}}$	0.29mH	0.05mH
Capacitor	$C_{b1} = \frac{I_{in} D_B}{\Delta V_{Cb1} t_b}$	1.52µF	1.33µF
Filters	$C_m = \frac{I_R \tan\theta}{\omega V_p}$, $L = \frac{1}{4*\pi^2 * f_c^2 * C_d}$	124nF,0.57mF	110nF, 0.66mH
Output Capacitor	$C_{HB1} = C_{HB2} = \frac{I_{BPFCCdc}}{\omega \Delta V_{BPFCCdc}}$	1.76mF	1.5mF
Inductor of HBC	$L_{HBo} = \frac{V_o(0.5-D_H)}{\Delta i_{LHBo} * f_H}$	0.192mH	0.17mH

3. ANALYSIS OF BPFCC BASED EV CHARGER

The designed values of BPFCC based EV charger is considered while modeling of such system. To analyze the functioning, the system has been simulated and observed performance has been shown discussed in detail. The input voltage/ current, BPFCC output voltage (at 300V), current as well as battery voltage represents steady state operation (Figure.3a). The output voltage of BPFCC and battery is maintained constant shows the performance of controller. The inductor current of BPFCC shows the bridgeless functioning. The input current (Figure. 3(b)) is sinusoidally varying and the harmonic content of the current is 3.5%. It can be depicted and clear that the voltage and current are inline marinating the PF unity.

The input voltage is varied and the performance is shown in Figure.4-5. In all the operating conditions, the observed performance is satisfactory in terms of sinusoidal input current (low harmonic content and sin shape) as well as maintained dc output voltage and this ensures excellent power quality indices even at under voltage and overvoltage conditions.

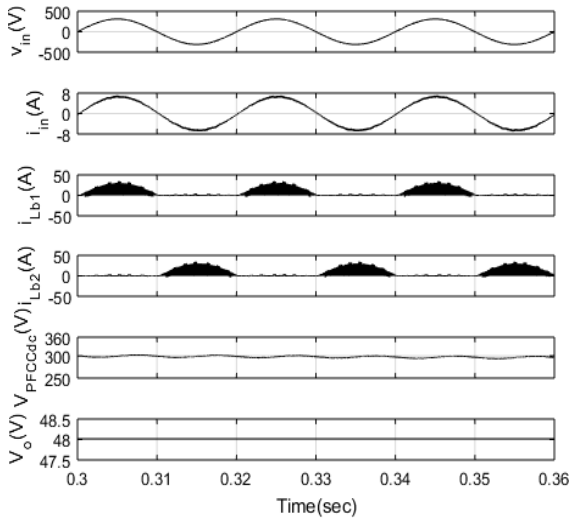

Figure 3(a): Performance of BPFCC with HBC at variable voltage (220V)

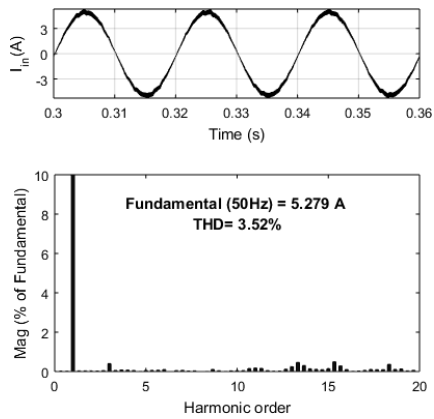

Figure 3(b): Input current and the THD of the waveform

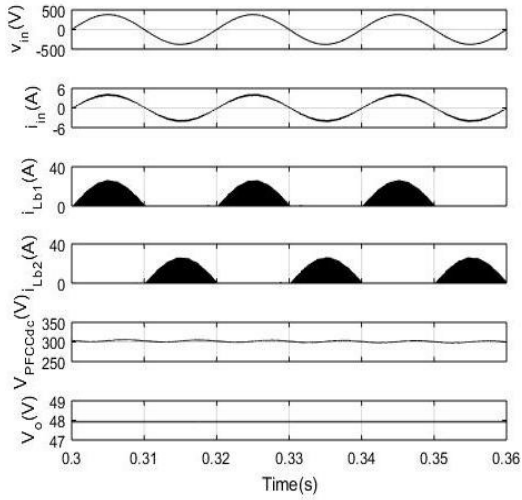

Figure. 4 (a): Performance of BPFCC with HBC at variable voltage (270V)

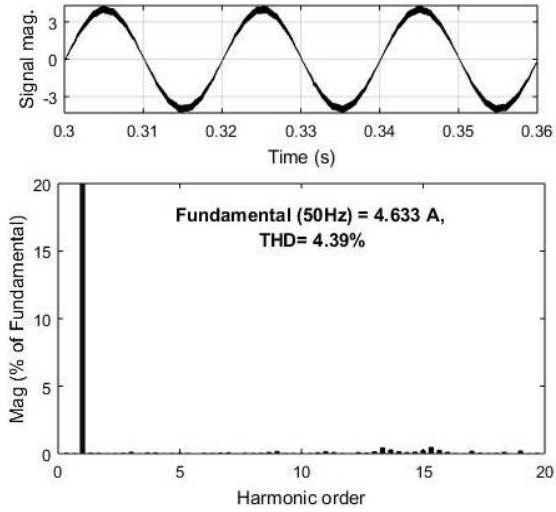

Figure.4(b) Input current and the THD of the waveform (270V)

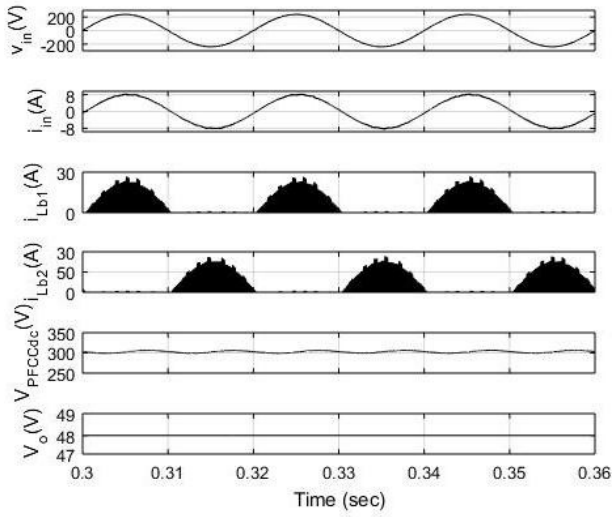

Figure. 5 (a): Performance of BPFCC with HBC at variable voltage (170V)

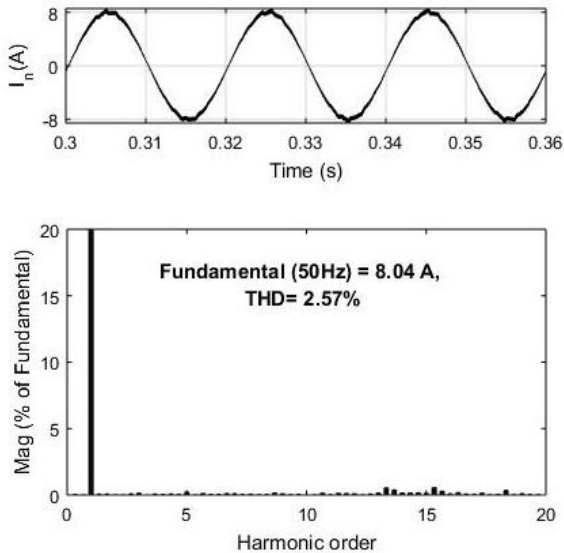

Figure.5(b) : Input current and the THD of the waveform (170V)

4. CONCLUSION

An EV charger (BPFCC integrated with HBC) has been designed and simulated to assess its performance. It is evident from the performance of the proposed BPFCC based charger has exceptionally good power quality with PF close to unity under varying voltage. Simple control technique, rectifier less conFigureuration, DCM design of BPFCC, improved power quality are salient features which make this a promising candidate for off board charger for EVs and less carbon emission in comparison to conventional vehicles.

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MWCNTs' Effects on the Performance & Emission Analysis of VCR Diesel Engines Fuelled by Blends of Diesel and Neem Biodiesel

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ABSTRACT

The present research shows how a diesel engine's emission characteristics were affected by the mixture of functional multi-walled carbon nanotubes (MWCNTs) to diesel-biodiesel fuel. The blends of B0, B10, and B20 biodiesel were combined with the MWCNT nanoparticles. Using ultrasonication, the MWCNT nanoparticles were distributed into B0, B10, and B20 at concentrations of 0 and 25 ppm. Engine testing was done with the engine running at 1500 rpm and 16 CR continuously. We looked into the characteristics of performance and emissions, such as BTE and CO emission. The outcomes demonstrated that, in comparison to B0, adding MWCNTs to B25 reduced emissions and enhance performance. The findings of this study may open the door to the development of diesel engines that use mixes of biodiesel with nano additives. In order to replace crude oil in engines, the majority of countries nowadays are searching for alternative fuels. Examples of these include renewable energy sources like solar power, biodiesel, wind energy, edible and non-edible oils, natural gas, alcohol, and hydrogen fuel. Different ratios of biodiesel and different amounts of CNT nanoparticles were combined to create test fuel samples. To achieve practicality in the real world, dispersion was achieved without the requirement for a nanoparticle stabilizer. Using ultrasonication, the diesel and biodiesel were combined and sheared at a high speed to distribute the nanoparticles evenly throughout the mixtures.

Kewords: CNT nano-particles; neem biodiesel; BTE; brake-specific fuel consumption; unburnt hydrocarbon.

1. INTRODUCTION

The need to find petroleum diesel substitutes stems from a number of factors, including rising energy prices, environmental issues brought on by the use of fossil fuels, and a lack of predictability in the world's energy production and supply [1]. From this angle, a lot of focus has been placed on producing biodiesel as an alternative to diesel. Furthermore, the advantages that biodiesel fuel oil offers the

environment because it is made from plants and vegetables have made it more appealing [2].The need to find alternative fuel sources has arisen due to the rapid depletion of natural resources derived from the earth's crust. One of these substitutes for petroleum-based diesel is now biodiesel. Vegetable oil resources that are not edible are used to produce this product [3–8]. The seeds of plants such as Pongamia, Karenja, Jatropha, etc. can be used to make biodiesel. Using biodiesel doesn't require any engine modifications. You can only alter the proportions of biodiesel used to power the engine. Biodiesel contributes to cleaner air and lower exhaust emissions. Climate neutrality is another definition of biodiesel. Benefits of biodiesel include: improved engine performance, reduced engine wear, less emissions, lower fuel and oil usage, greater cetane rating, etc.

1.1 Biodiesel

Making biodiesel often involves the use of vegetable oil. Oils derived from vegetables are sustainable. Should petroleum-based fuel become scarce, fuel derived from vegetable oils might be utilized. Vegetable oil qualities are similar to diesel fuel properties in comparison.

There are various oils and fats used to make biodiesel. The components of it are the fatty acid esters found in triglycerides. Since plants and animals serve as the feedstock for biodiesel, it is a renewable fuel (Valente et al. 2011). Biodiesel is commonly prepared using the process of transesterification.

1.2 Development of Biodiesel In India

India has worked on a few initiatives converting oil into biodiesel for use in the automotive industry. In light of the existing shortcomings in traditional biodiesel production technologies, such as feedstock availability, production, and eco-friendliness, numerous researchers have proposed novel concepts and technology. (2011) Missra and Murthy.

India is the third-biggest energy consumer in the world. The nation's population, modernization, and economic growth are all happening at quicker rates than before, which is driving up energy consumption. India consumed 1372 TWh of electricity in 2018–19. India uses 44% coal, 24% biomass and waste, 23% petroleum and other liquid fuels, and 9% renewable energy sources like solar, wind, nuclear, and biofuels to meet its energy needs.

In terms of petroleum and crude oil consumption, India is ranked fourth. India imports around 80% of its crude oil needs, which is a significant drain on foreign cash. According to MOCI (2018), the value of the crude oil imports was USD 76148.85 million. Furthermore, the economy and energy security are heavily impacted by this. It is anticipated that the annual demand for diesel will rise by 5.8%. Given that they resemble diesel under these conditions, biofuels are regarded

as an alternative vehicle fuel. From an economic perspective, using biofuel for a variety of purposes will be a smart move for India (USEIA 2016).

In view of the tightening environmental rules and rising costs of petroleum products, renewable energy sources are becoming more and more necessary. Fuel referred to as biofuel is produced via anaerobic digestion and further biological processes. More possibility exists for non-edible vegetable oils to be used as diesel engine fuel substitutes. They decompose naturally and are sustainable. Because of their high cetane number, they are the optimum fuel for engines with compression ignition. Their high fire point feature gives them additional benefits, such as improved safety when handling, storing, and transportation. Several tactics have been used to successfully use biofuel as a diesel engine fuel. One of the more effective methods is to heat the oil beforehand.

1.23 Impact of a Biodiesel Additive on the Characteristics of Engine Emissions

Diesel engines are well known for their exceptionally low emissions of hydrocarbons and carbon monoxide. However, their attractive but odorous exhaust, which has high PM and NOx emissions, has also caused a lot of people to reject them. Improvements in engine design and combustion conditions have resulted in a significant reduction in both NOx and PM emissions from current diesel engines; nonetheless, these reductions were not sufficient to fulfill the new limits. However, if engine improvement is paired with diesel fuel reformulation and/or fuel additive use, emissions can be further and more successfully decreased.

Comparing biodiesel epoxy fuels to Jatropha biofuel, Basha and Anand's (2011) experimental investigation revealed a substantial reduction in NOx and exhaust emissions.

2. MATERIALS AND METHODS

Several neem leaves were utilized in the experiment to create neem biofuel. First, an acid-catalyzed method and subsequently a base-catalyzed method were employed for esterification. Sulfuric acid served as the base catalyst and sodium hydroxide as the acid catalyst for the aspiration. A 40-minute cycle of 20 seconds "ON" and 20 seconds "OFF" was employed with a 120 W probe sonicator to get the best nanoparticle dispersion in the mixes.

The transesterification procedure yielded biodiesel. To obtain the nano-sized CNT with particle sizes smaller than 100 nm, Tech4Nano was utilized. A single crystal phase, a density of 5.606 gm/cc, an average particle size of 30 nm, a 99% purification rate, and a black hue are some of the features of nanoparticles. The particles were continually mixed in an ultrasonicator with varying volumes of diesel and biodiesel until a clear mixture was produced.

Table-1 : Peformance of CNT

SAMPLES	CNT(CR14)	CNT(CR16)
B0	25(PPM)	25(PPM)
B10	25(PPM)	25(PPM)
B20	25(PPM)	25(PPM)

3. FINDINGS/ RESULTS/ DISCUSSION

An I-cylinder, 4-stroke, water-cooled VCR engine was powered by neem biodiesel, which was created in the current work using a 2-stage transesterification technique using diesel and CNT nanoparticles as additives.

3.1 Performance Evaluation

a). BTE:

BTE = BP/(mass of Fluid*CV)

Table-2: BTe of Distinctive Mixture on Distrinctive Loads

	25 PPM(CR 14)			25 PPM(CR 16)		
	3 KG	**6 KG**	**9KG**	**3 KG**	**6 KG**	**9 KG**
B0	25.515	26.721	27.578	26.64	28.414	28.978
B10	24.186	24.2678	25.327	24.786	26.318	27.788
B20	23.232	24.019	24.592	24.544	25.629	26.436

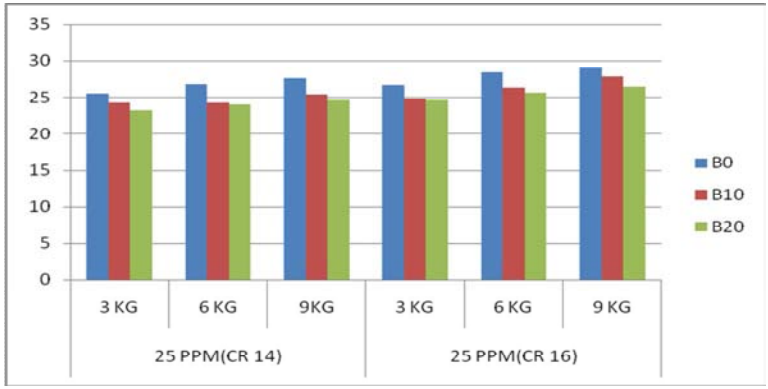

Figure1: BTE of various formulations

The result indicates that under different load conditions, a rise in the compression ratio enhanced the BTE.

3.2 Emission Evaluation

a.Carbon Monooxide Emission[mg/nm^3]: Despite being a tiny trace gas, CO has an impact on the climate that goes beyond its immediate impacts. CH_4, tropospheric ozone, CO_2 concentrations are all impacted. Coal monoxide comes from both natural and anthropogenic causes, like many other poisons.

Table-3: CO Emission of Various Blends

	25 PPM(14 CR)			**25 PPM(**16 CR)		
	3 KG	**6 KG**	**9 KG**	**3 KG**	**6 KG**	**9KG**
B0	.465	.431	.393	.345	.339	.324
B10	.385	.365	.346	.285	.273	.263
B20	.347	.328	.308	.248	.241	.233

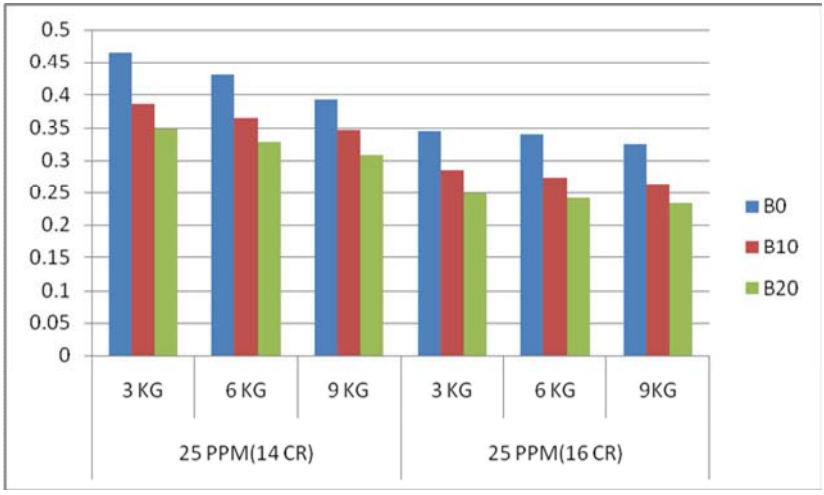

Figure 2: CO Emissions of Various Formulations

The outcome shows that an increase in the compression ratio decreased the emission under various load circumstances.

4. CONCLUSIONS

The experiment will be used to determine the results.

1. It is discovered that blends have a higher BTE at 16 CR with 25ppm of CNT than BTE at 14CR with 25ppm of CNT. The highest BTE for B10 with 25 ppm of CNT is 27.788% for a 12 kg load at 16CR.

2. Converted CO Blends having a high surface to volume ratio of nanoparticles may have lower emissions; for example, blend B20 with 25 ppm of the nanoadditive CNT had the lowest emissions at 12.kg of load, at .233% for 16CR.

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Harnessing Green Chemistry for Environmental Sustainability A Comprehensive Analysis

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ABSTRACT

In an era of mounting environmental concerns, green chemistry is pivotal for promoting sustainability across industries. It significantly mitigates environmental degradation and advances global sustainability goals. By prioritizing sustainability and pollution control, green chemistry provides a holistic framework for reimagining chemical processes and products to minimize their adverse environmental impacts while enhancing efficacy and safety. Emphasizing renewable feedstocks, waste reduction, and energy efficiency, it embodies proactive environmental stewardship. Green chemistry supports sustainable production of polymers, chemicals, and medications by promoting benign solvents and minimizing hazardous by products. Understanding green chemistry is crucial for addressing pressing environmental issues and transitioning to a circular economy, which conserves resources through material reuse and recycling. Collaborative adoption of green chemistry principles can expedite the shift towards a more sustainable future.

Kewords: Green Chemistry, Sustainable Chemistry, Waste Reduction, Energy Efficiency, Green Catalysts, Eco-Friendly.

1. INTRODUCTION

"Green Chemistry: Principles and Practice" is like a visionary guidebook, showing us how to transform the way we think about chemical processes. It's all about finding smarter, more eco-friendly ways to work, like reducing waste and using less energy. It's not just a book; it's a roadmap to a cleaner, greener future for everyone[1]. "Innovations and Green Chemistry" is like a beacon of hope, illuminating the path to a more sustainable future. It's about people coming together to find creative solutions that protect our environment while making things better for everyone. It's a celebration of human ingenuity and teamwork, showing us that a greener world is within our reach [2]. "Designing for a Green Chemistry Future" is like an artist's palette, blending creativity with sustainability to paint a brighter tomorrow. It's about caring for our planet, using smart designs to protect the environment. It's a call to action, inspiring us to create a greener, more beautiful world for generations

to come[3 "Green Chemistry: Present and Future" is like a conversation between friends, reflecting on where we are and where we're going in sustainability. It's about people working together, sharing ideas to protect our planet. It's a hopeful look ahead, inspiring us to create a greener, brighter future for all[4]. "Origins, Current Status, and Future Challenges of Green Chemistry" is like a storybook, narrating the journey of sustainability through time. It's about learning from the past, navigating the present, and dreaming of a better future. It's a story of hope, inspiring us to overcome challenges and create a greener, more sustainable world together [5].

"Nanocatalysis and Prospects of Green Chemistry" is like a story of tiny heroes, showing us how small things can make a big difference. It's about using the power of nanotechnology to protect our planet. It's a tale of innovation, showing us how tiny particles can lead us to a greener, more sustainable future [6]."Green Chemistry, a Pharmaceutical Perspective" is like a doctor with a heart for the planet, prescribing eco-friendly solutions for a healthier world. It's about caring for both people and the environment, finding better ways to make medicines without harming the planet. It's a story of compassion, showing us how science can heal not just individuals, but our world too[7]. "Origins and Development of Green Chemistry" is like a storybook, recounting the tale of sustainability's journey through time. It's about learning from the past to create a brighter, greener future for all[8]. "Fundamentals of Green Chemistry: Efficiency in Reaction Design" is like a guidebook, showing us how to make chemistry more efficient and eco-friendly. It's about using resources wisely, like a friend teaching us to be kind to the planet [9]. "Application of the Principles of Green Chemistry in Analytical Chemistry" is like a thoughtful scientist, finding ways to analyze without harming the planet. It's about using less and caring more, showing us how to be gentle with our Earth[10]

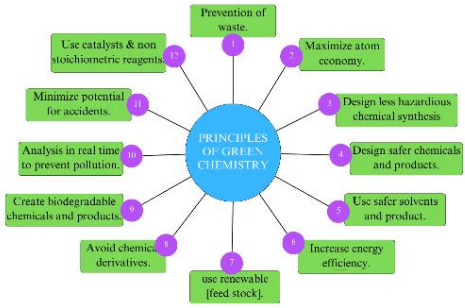

Figure 1: Principles of green chemistry.

2. LITERATURE REVIEW

"Green Chemistry and Green Engineering: A Framework for Sustainable Technology Development" is like a team of eco-minded inventors, combining chemistry and engineering to create technologies that care for our planet. It's about working together to build a greener, more innovative future [11]. "Green Chemistry is Good Process Chemistry" is like a master chef's recipe for success, blending sustainability with smart design. It's about cooking up chemical processes that are kind to the planet, making everything work together smoothly for a better, more efficient outcome[12]."Green Chemistry: A Design Framework for Sustainability" warmly guides readers through a structured approach to integrate sustainable principles into chemical design, nurturing environmentally conscious practices and contributing to a more sustainable future [13]."Environmental Green Chemistry as Defined by Photocatalysis" explores the application of photocatalysis in green chemistry with care, highlighting its role in sustainable environmental remediation and pollutant degradation for a cleaner ecosystem [14]."The Importance of Green Chemistry in Process Research and Development" emphasizes the significance of sustainable practices in optimizing chemical processes, minimizing environmental impact, and fostering innovation for a greener future with heart [15].

"Promoting Sustainability Through Green Chemistry" passionately advocates for eco-friendly practices in chemical processes, underscoring the role of green chemistry in mitigating environmental impact and advancing sustainability goals [16]."Green Chemistry: The Emergence of a Transformative Framework" celebrates the rise of a comprehensive approach to chemical practices, emphasizing sustainability and innovation to address environmental challenges and shape a greener future [17]. "The Evolution of Green Chemistry and Its Multidimensional Impacts: A Review" warmly examines the historical progression and diverse effects of green chemistry, offering insights into its transformative role in sustainability and environmental stewardship [18].Introduction: Green Chemistry" sets the stage for exploring sustainable chemical practices, emphasizing the importance of minimizing environmental impact and promoting innovation for a greener future [19]. Introduction to Green Chemistry" offers an initial insight into sustainable chemical practices, highlighting the importance of minimizing environmental harm and fostering innovation for a more eco-friendly future [20].

Green Chemistry Metrics with Special Reference to Green Analytical Chemistry" dives into the realm of quantifying sustainability in analytical processes, highlighting the importance of eco-conscious methods for analysis with a caring eye on the environment [21]. In "Green Chemistry: Challenges and Opportunities," James H. Clark delves into the obstacles and promise of sustainable chemical

practices, urging for creative solutions and teamwork to tackle environmental issues with impact and care [22]. Metrics of Green Chemistry and Sustainability: Past, Present, and Future" takes a journey through the measurement of sustainability in chemical processes, tracing its growth and envisioning future paths toward eco-conscious practices[23]. Green Chemistry, Biofuels, and Biorefinery" ventures into a realm where sustainable chemistry meets biofuel production and biorefinery processes, aiming to harness renewable resources efficiently and eco-consciously [24]."Green Chemistry by Nano-catalysis" is like using tiny magic helpers to make chemicals without hurting the planet. It's about using small things to solve big problems, like cleaning up pollution and making things better for everyone [25].

Catalysis is a hero of green chemistry, making chemical reactions more efficient and cleaner. It's like having a secret weapon to fight waste and pollution, helping us take better care of our planet [26]."Green Chemistry" cares about how we make things, using smart ways to create products that are good for the Earth. It's like teaching chemistry to be kinder, making sure we leave a better world for future generations [27]."Green Chemistry" is like a wise gardener, tending to our resources carefully. It's about using less and caring more, like recycling and saving energy, to make our world greener and more sustainable [28]."Green Chemistry in the Synthesis of Pharmaceuticals" is like a doctor with a heart for the planet, finding better ways to make medicines without harming the environment. It's about caring for both people and the Earth, making sure we're healthy inside and out [29]. "Solid Acids for Green Chemistry" is like using a different kind of magic to clean up our messes. It's about finding new ways to make chemicals without making more waste, helping us protect our planet and use less energy [30].

3. METHODOLOGY

This research paper delves into the synergistic realm of green chemistry and green engineering, envisioning a comprehensive framework for sustainable technology development. Through an extensive literature review, we explore the fundamental principles and frameworks that underpin these fields, drawing insights from a wide range of existing studies and real-world applications. Utilizing compelling case studies and examples, we showcase the practical implications of green chemistry and engineering, highlighting successful implementations, persistent challenges faced, and invaluable lessons learned.

Our methodological approach is multifaceted, combining qualitative and quantitative methods to collect and analyze data on various aspects of green chemistry and engineering. This includes conducting surveys, interviews, and rigorous data analysis to delve into processes, materials, energy usage,

environmental impact, and economic feasibility. The results and discussions section synthesizes our findings, emphasizing the critical role of integrating green chemistry principles with smart engineering design to create processes that are not only efficient but also environmentally benign.

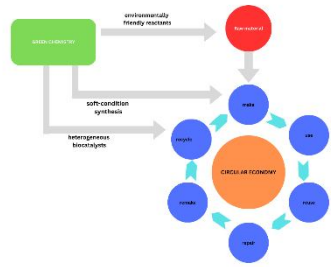

Figure 2: Circular economy.

In conclusion, we offer actionable recommendations for promoting and implementing green chemistry practices across industries, academia, and policy realms. By recognizing the transformative potential of green chemistry and engineering, we can collectively advance sustainability goals and contribute meaningfully to a greener, more resilient future for generations to come.

4. RESULT

The paper explores the development of green synthesis methods, focusing on novel approaches for producing chemicals, materials, or pharmaceuticals with reduced environmental impact. These methods may involve the use of renewable feedstocks, biocatalysts, or environmentally benign solvents.

Furthermore, the research delves into the optimization of reaction conditions to minimize energy consumption, waste generation, and the use of hazardous reagents or catalysts. Techniques such as microwave or ultrasound-assisted synthesis are implemented, along with the design of efficient catalytic systems.

Another aspect of the study involves the synthesis of green materials for various scientific applications, such as biodegradable polymers, sustainable nanomaterials, or eco-friendly coatings. Characterization studies are conducted to demonstrate the performance and properties of these materials compared to conventional counterparts.

Moreover, the research includes environmental impact assessments that compare traditional chemical processes with green alternatives. Life cycle analysis

(LCA) is used to quantify factors such as energy consumption, greenhouse gas emissions, toxicity, and resource depletion.

In terms of biomedical applications, the paper discusses the development of green chemistry approaches for drug discovery, formulation, or delivery systems. This includes the synthesis of pharmaceuticals using greener routes and the design of biocompatible materials for medical devices.

Additionally, the study explores the application of green analytical techniques for environmental monitoring, quality control, or forensic analysis. This involves the use of miniaturized and automated systems, green solvents, or biosensors to achieve sensitive and selective detection with minimal environmental impact.

Furthermore, the paper discusses the scalability and industrial implementation of green chemistry processes. Pilot-scale studies, economic evaluations, and case studies are presented to demonstrate the feasibility and benefits of adopting green technologies in industrial settings.

The research also addresses regulatory compliance and safety considerations associated with green chemistry applications. This includes toxicity testing, risk assessments, and adherence to regulatory frameworks governing chemical manufacturing, handling, and disposal.

Finally, the paper highlights education and outreach efforts aimed at promoting awareness and adoption of green chemistry principles within the scientific community. Workshops, training programs, and educational resources are developed to support green chemistry initiatives.

5. CONCLUSION

In wrapping up, the blend of green chemistry and green engineering emerges as a beacon of hope for sustainable technological progress. Our exploration has delved into the core principles, frameworks, and real-world impacts of these disciplines, revealing their power to reshape industries and lessen our environmental footprint. Through captivating case studies, rigorous methodology, and insightful analysis, we've emphasized the vital fusion of green chemistry ideals with intelligent engineering design, fostering processes that are both efficient and eco-friendly.

The discoveries unearthed here echo a pressing call for widespread adoption of green chemistry across diverse sectors. By championing eco-friendly methods, reducing waste, and optimizing resource use, we can tangibly shrink our ecological impact and nurture a planet that thrives. Moreover, the actionable recommendations we've presented offer practical pathways for businesses, academics, and policymakers to embrace and enact green chemistry principles with impact and purpose.

Looking ahead, our collective focus on sustainability, innovation, and collaboration is paramount. As we steer towards a future marked by greener solutions, we must continue championing the transformative potential of green chemistry and engineering. Together, we can sculpt a world where technology and environmental responsibility intertwine, illuminating a brighter, healthier tomorrow for everyone.

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Voice Controlled Robotic Vehicle

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ABSTRACT

This project Voice Controlled Robotic Vehicle helps to control robot through voice commands received via android application. The integration of control unit with Bluetooth device is done to capture and read the voice commands. The robotic vehicle then operates as per the command received via android application. For this Arduino is integrated in the system which makes it is possible to operate the vehicle via android application. The controlling device may be any android based Smartphone/tab etc. having an android OS. The android controlling system provides a good interactive GUI that makes it easy for the user to control the vehicle. The transmitter uses an android application required for transmitting the data. The receiver end reads these commands and interprets them into controlling the robotic vehicle. The android device sends commands to move the vehicle in forward, backward, right and left directions. After receiving the commands, the Arduino then operates the motorsI order to move the vehicle in four directions. The communication between android device and receiver is sent as serial communication data. The Arduino program is designed to move the motor through a motor driver IC as per the commands sentby android device.

Kewords: Robotic Vehicle.

1. INTRODUCTION

Voice-controlled robotic vehicles represent a significant advancement in human-machine interaction, offering intuitive and hands-free control over robotic platforms. This project aims to develop a voice-controlled robotic vehicle using modern technology, specifically focusing on implementing voice recognition capabilities to maneuver the vehicle. The system operates with the use of an android device which transmits voice commands to an 8051 microcontroller to achieve this functionality.

2. OBJECTIVE

The objective of this project is to design and implement a motor vehicle that can be controlled via voice commands sent from a smartphone. The goal is to provide a hands-free control mechanism, making it easier to interact with the vehicle and demonstrating the feasibility and accessibility of integrating voice control with robotics using affordable and readily available components.

3. WORKING PRINCIPLE

The android smart phone's microphone is used to recognise human voices. Using the Android operating system and Artificial Intelligence software, this voice is processed and transformed into English words. Speech recognition is a multidisciplinary subfield of computational linguistics that explores approaches and technology that allow computers to recognise and convert spoken language into text. Automatic speech recognition (ASR), computer voice recognition, and speech to text are some of the other names for it (STT). It blends languages, computer science, and electrical engineering expertise and study. Speech recognition has a long history in terms of technology, with multiple waves of key advancements. Advances in deep learning and big data have recently improved the field. The improvements are proven not only by the increasing number of academic articles published in the subject, but also by the widespread industry acceptance of a range of deep learning approaches in the design and deployment of voice recognition systems around the world.

3.1 Voice Recognition

The system utilizes a microphone to capture voice commands from the user. These commands are then processed by a voice recognition module, which converts spoken words into digital signals.

3.2 Command Interpretation

The digital signals are analyzed by the system to identify specific commands related tocontrolling the robotic vehicle, such as "forward," "backward," "turn left," "turn right," etc.

3.3 Control Signal Generation

Once the commands are recognized and interpreted, the system generates corresponding control signals for the robotic vehicle's motors or actuators. These signals dictate the vehicle's movement based on the user's voice commands.

4. BLOCK DIAGRAM

The block diagram consists of Bluetooth Module, Battery, Motor Driver, Arduino UNO, Motors.

4.1 Bluetooth Module

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data. Specification: ▪Model: HC-05 ▪Input voltage: dc5V ▪Communication method ▪Serial Communication ▪ Master and Slave mode can be switched.

4.2 Motor

A DC motor is an electrical motor that uses direct current (DC) to produce mechanical force. The most common types rely on magnetic forces produced by currents in the coils. Nearly all types of DC motors have some internalmechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

4.3 Battery

Battery, in electricity and electrochemistry, any of a class of devices that convert chemical energy directlyinto electrical energy. Although the term battery, in strict usage, designates an assembly of two or more galvanic cells capable of such energy conversion, it is commonly applied to a single cell of this kind. Every battery (or cell) has a cathode,or positive plate, and an anode, or negative plate.

4.4 Arduino

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2010. The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields)and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmablewith the Arduino IDE (Integrated Development Environment) [7], via a type B USB cable. It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a rectangular 9-volt battery.

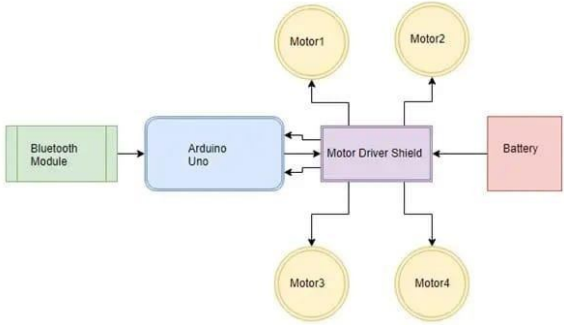

Figure 1: block diagram of Bluetooth Module, Battery, Motor Driver, Arduino UNO, Motors.

4.5 Motor Driver

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC). The l293d candrive small and quiet big motors as well, check the Voltage Specification.

5. CIRCUIT DIGARAM

Figure shows the circuit diagram of Voice Controlled Robotic Vehicle. It shows the overall connection of all the components with each other and how they are performing their functions individually.

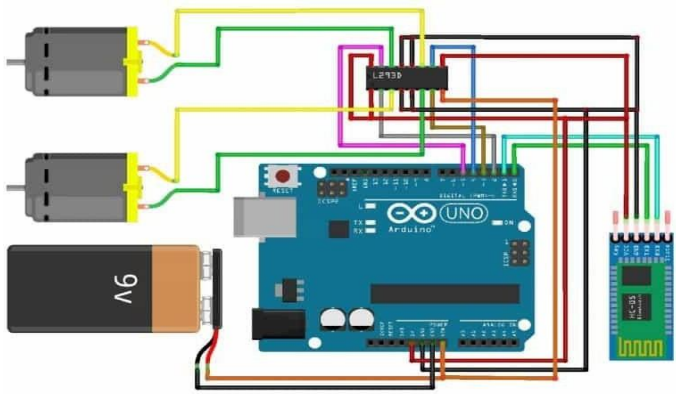

Figure 2: circuit diagram of Voice Controlled Robotic Vehicle

6. CONCLUSIONS

The proposed system shows how the android smartphone can be used as remote controller for robot and various embedded technologies with the help of the Bluetooth technology. At the same time, this program uses blue-tooth connection to communicate with robot. The proposed system also shows that how a robot can be used for travelling purpose. The operating system of smartphone is Android, and it can develop effective remote control program and by using WiFi wireless network, the communication between smartphone and robot can be realized, which makes it simple and convenient to control robot.dedicated to the same.

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India's Potential of Wind Energy and Prospects for Climate Change Mitigation - A Review

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ABSTRACT

India, like many other nations, faces the challenge of meeting the escalating energy demands posed by its burgeoning population. The predominant reliance on coal-fired thermal power plants for energy generation exacerbates environmental concerns due to their substantial emissions of pollutants. However, amidst this scenario, wind power emerges as a promising solution, offering environmentally sustainable and renewable energy resources. As one of the leading producers of wind power globally, India stands at the forefront of harnessing this green energy potential.

This article explores the current landscape of wind energy in India, focusing on its status, potential, and regulatory frameworks. With a considerable untapped capacity for wind power generation, India holds significant promise in advancing its renewable energy agenda. The article provides an in-depth analysis of the potential for wind power generation across various states in India, highlighting regional disparities and opportunities.

Among these states, Tamil Nadu emerges as a frontrunner in wind power production, exemplifying the efficacy of wind energy initiatives. The article sheds light on the factors contributing to Tamil Nadu's prominence in wind energy generation, ranging from geographical advantages to policy incentives. By examining the regulatory landscape governing wind energy in India, including incentives, tariffs, and permitting processes, this article offers insights into the facilitative measures and challenges associated with scaling up wind power projects.

This article underscores the imperative of accelerating the adoption of wind energy in India to meet escalating energy demands while mitigating environmental impact. It advocates for sustained efforts in policy formulation, technological innovation, and investment to unlock the full potential of wind power, thereby advancing India's transition towards a greener and more sustainable energy future.

Keywords: *India, wind energy, renewable energy, environmental sustainability, energy generation, regulatory framework, Tamil Nadu, potential, policy incentives.*

1. INTRODUCTION

India, with its rapidly growing population and industrialization, faces significant energy challenges. The country's energy demand is projected to increase substantially, necessitating a shift from traditional fossil fuel-based energy sources to more sustainable alternatives. Currently, coal-fired thermal power plants dominate India's energy landscape, contributing to severe environmental pollution and greenhouse gas emissions. In this context, renewable energy sources, particularly wind energy, present a viable solution to India's energy and environmental crises.

Wind energy, being one of the cleanest and most abundant renewable energy sources, has the potential to significantly reduce carbon emissions and dependence on fossil fuels. India, endowed with a vast coastline and favorable wind conditions, is well-positioned to harness this potential. This paper aims to explore India's wind energy landscape, examining its current status, potential, and regulatory framework, and discussing its role in climate change mitigation.

2. LITERATURE REVIEW

The transition to renewable energy has been widely studied, with wind energy emerging as a critical component in achieving sustainable energy goals. According to the Global Wind Energy Council (GWEC, 2021), India ranks fourth globally in installed wind power capacity, demonstrating its commitment to renewable energy. However, despite significant progress, the full potential of wind energy in India remains underexploited.

Research by Kumar and Prasad (2020) highlights the uneven distribution of wind energy resources across India, with states like Tamil Nadu, Gujarat, and Maharashtra leading in wind power generation. These states benefit from favorable wind conditions and proactive policy measures. Another study by Joshi and Gupta (2019) underscores the importance of regulatory frameworks and government incentives in promoting wind energy development. They argue that while India has made strides in policy formulation, challenges such as land acquisition, grid integration, and financial constraints persist.

Furthermore, the International Renewable Energy Agency (IRENA, 2019) emphasizes the role of technological advancements and innovation in enhancing wind energy efficiency and reducing costs. They point out that investment in research and development (R&D) is crucial for overcoming technical barriers and improving the overall feasibility of wind power projects.

3. DETAILS OF WIND POTENTIAL IN INDIA

India's wind energy potential is vast, with estimates suggesting a technical potential of over 300 GW, primarily concentrated in seven states: Tamil Nadu, Gujarat, Maharashtra, Karnataka, Rajasthan, Andhra Pradesh, and Madhya Pradesh. Tamil Nadu, Figure 1 in particular, stands out with its robust wind energy infrastructure and favorable wind conditions.

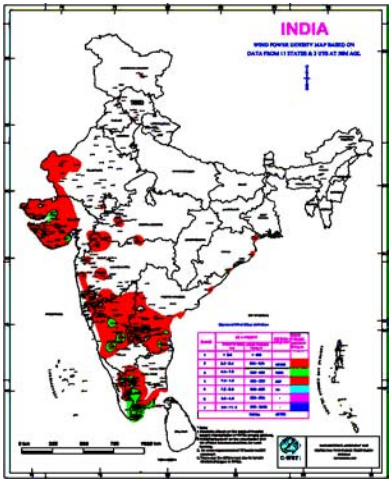

Figure 1: Wind Potential at India

3.1 Tamil Nadu

Tamil Nadu leads the country in wind power generation, with an installed capacity of over 9,000 MW. The state's success can be attributed to its advantageous geographical location, consistent wind speeds, and supportive government policies. Initiatives such as the Wind Energy Policy 2016 have provided a conducive environment for wind power development, offering incentives like tax breaks, subsidies, and streamlined permitting processes.

3.2 Gujarat

Gujarat follows closely, with an installed capacity of approximately 7,500 MW. The state has made significant investments in wind power infrastructure, driven by strong policy support and private sector participation. Gujarat's wind energy potential is further bolstered by its extensive coastline and favorable wind conditions.

3.3 Maharashtra

Maharashtra, with an installed capacity of around 5,000 MW, has also made substantial progress in wind power development. The state's wind energy policies have focused on attracting private investment and promoting technological innovation.

3.4 Other States

Other states, including Karnataka, Rajasthan, Andhra Pradesh, and Madhya Pradesh, also contribute to India's wind power capacity, albeit to a lesser extent. These states possess significant wind energy potential, which remains largely untapped due to various challenges, including regulatory hurdles, infrastructure limitations, and financial constraints.

4. DETAILED ANALYSIS OF WIND ENERGY IN INDIA: STATUS, POTENTIAL, AND REGULATORY FRAMEWORKS

4.1 *Current Landscape of Wind Energy in India*

India has made significant strides in the development of wind energy over the past few decades. As of 2023, the country ranks fourth globally in terms of installed wind power capacity, with a total capacity of approximately 40 GW (Global Wind Energy Council, 2021). This progress underscores India's commitment to transitioning to renewable energy sources to meet its growing energy demands and mitigate environmental impacts.

4.2 Wind Energy Potential

India's wind energy potential is vast, estimated at over 300 GW at 100 meters above ground level (Ministry of New and Renewable Energy [MNRE], 2020). This potential is spread across several states, each with varying capacities based on geographical and meteorological factors.

4.3 State-wise Wind Energy Potential

1. **Tamil Nadu**:
    - **Installed Capacity**: Over 9,000 MW
    - **Potential Capacity**: Approximately 33,800 MW
    - **Average Wind Speed**: 5.5 - 6.5 m/s
    - **Key Areas**: Coimbatore, Tirunelveli, Kanyakumari
2. **Gujarat**:
    - **Installed Capacity**: Around 7,500 MW
    - **Potential Capacity**: Approximately 84,000 MW
    - **Average Wind Speed**: 6.0 - 7.5 m/s
    - **Key Areas**: Kutch, Saurashtra, Gulf of Khambhat

3. **Maharashtra**:
    - **Installed Capacity**: About 5,000 MW
    - **Potential Capacity**: Approximately 45,000 MW
    - **Average Wind Speed**: 5.5 - 6.5 m/s
    - **Key Areas**: Satara, Sangli, Ahmednagar
4. **Karnataka**:
    - **Installed Capacity**: Around 4,800 MW
    - **Potential Capacity**: Approximately 55,000 MW
    - **Average Wind Speed**: 5.0 - 6.0 m/s
    - **Key Areas**: Chitradurga, Davanagere, Gadag
5. **Rajasthan**:
    - **Installed Capacity**: Around 4,300 MW
    - **Potential Capacity**: Approximately 18,770 MW
    - **Average Wind Speed**: 5.5 - 6.5 m/s
    - **Key Areas**: Jaisalmer, Barmer, Jodhpur
6. **Andhra Pradesh**:
    - **Installed Capacity**: About 4,200 MW
    - **Potential Capacity**: Approximately 44,000 MW
    - **Average Wind Speed**: 5.0 - 6.0 m/s
    - **Key Areas**: Anantapur, Kurnool, Kadapa
7. **Madhya Pradesh**:
    - **Installed Capacity**: Around 2,600 MW
    - **Potential Capacity**: Approximately 10,484 MW
    - **Average Wind Speed**: 4.5 - 5.5 m/s
    - **Key Areas**: Dewas, Ratlam, Ujjain

4.4 Regional Disparities and Opportunities

While states like Tamil Nadu, Gujarat, and Maharashtra have harnessed significant portions of their wind energy potential, others lag behind due to various challenges. These include:

- **Land Acquisition Issues**: Securing land for wind farms (Figure 2) can be contentious and bureaucratic.
- **Grid Connectivity**: Inadequate infrastructure for transmitting wind-generated electricity to the grid.
- **Financial Barriers**: High initial capital costs and difficulty in securing financing for projects.

- **Regulatory Hurdles**: Complex permitting processes and inconsistent policies across states.

Figure 2: Wind Farm

4.5 Regulatory Frameworks

India's wind energy sector is governed by a combination of national policies and state-specific regulations. Key regulatory frameworks include:

1. **National Wind Energy Mission**:
   - Launched to provide a roadmap for achieving wind energy targets.
   - Aims to install 60 GW of wind power capacity by 2022 and 140 GW by 2030.
   - Focuses on policy support, financial incentives, and technological advancements.
2. **Incentives and Subsidies**:
   - **Generation-based Incentives (GBI)**: Offered to wind power producers to encourage production.
   - **Accelerated Depreciation (AD)**: Allows investors to claim a higher depreciation rate, reducing taxable income.
   - **Feed-in Tariffs (FiTs)**: Set tariff rates to ensure stable revenue for wind power producers.
3. **Policy Measures**:
   - **Renewable Purchase Obligations (RPOs)**: Mandates for electricity distribution companies to purchase a certain percentage of power from renewable sources.
   - **Renewable Energy Certificates (RECs)**: Tradeable certificates representing the environmental attributes of renewable energy generation.
4. **Permitting Processes**:
   - Streamlining the approval process for wind power projects.

- Implementing single-window clearance systems to reduce bureaucratic delays.

Therefore, the current landscape of wind energy in India reflects both significant achievements and untapped potential. With substantial wind resources and a conducive regulatory environment, India is well-positioned to expand its wind power capacity. Addressing the regional disparities and overcoming the challenges will be crucial in realizing the full potential of wind energy and advancing India's renewable energy agenda.

5. CLIMATE MITIGATION

Wind energy plays a crucial role in climate change mitigation by reducing greenhouse gas emissions and decreasing reliance on fossil fuels. The environmental benefits of wind power include:

1. **Reduction in Carbon Emissions**: Wind power generates electricity without burning fossil fuels, leading to significant reductions in carbon dioxide (CO2) emissions. According to the Ministry of New and Renewable Energy (MNRE, 2020), India's wind power capacity has already helped avoid over 42 million tonnes of CO2 emissions annually.
2. **Air Quality Improvement**: By displacing coal-fired power plants, wind energy contributes to improved air quality, reducing pollutants such as sulfur dioxide (SO2), nitrogen oxides (NOx), and particulate matter (PM). This, in turn, has positive health implications for the population.
3. **Energy Security**: Wind energy enhances energy security by diversifying the energy mix and reducing dependence on imported fossil fuels. This is particularly important for India, which imports a significant portion of its energy needs.
4. **Economic Benefits**: The wind energy sector generates employment opportunities and stimulates economic growth through investments in infrastructure, manufacturing, and maintenance.

6. CONCLUSION

India's potential for wind energy is immense, offering a sustainable solution to the country's growing energy demands and environmental challenges. States like Tamil Nadu, Gujarat, and Maharashtra have demonstrated the feasibility and benefits of wind power, setting examples for other regions to follow. To fully realize this potential, it is imperative to address existing challenges through sustained efforts in policy formulation, technological innovation, and investment.

Accelerating the adoption of wind energy requires a collaborative approach involving government agencies, private sector players, and research institutions. By unlocking the full potential of wind power, India can make significant strides towards a greener and more sustainable energy future, contributing to global climate change mitigation efforts.

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The Role of Low-Frequency Vibrations 50-120 Hz in Enhancing Plant Growth and Health: A Review

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ABSTRACT

In recent years, the use of sound to enhance plant growth and health has gained significant attention.This studydelves into the effects of low-frequency vibrations, specifically in the 50 to 120 Hz range, on plant life. Theobjective is to understand how these sound frequencies influence various physiological and biochemical processes in plants, potentially leading to improved growth rates, increased disease resistance, and overallvitality. Our research involved exposing different plant species to controlled sound frequencies within the 50-120 Hz range over a specified period. We closely monitored key growth parameters, including stem height, leafarea, chlorophyll content, and root development. Additionally, we assessed the plants; responses to commonstress factors such as drought and pathogen attack. Preliminary findings suggest that specific frequencies withinthis range can stimulate growth by promoting cellular activities and enhancing nutrient absorption. For example,frequencies around 60 Hz significantly increased root elongation and biomass accumulation, while frequenciesnear 100 Hz improved chlorophyll synthesis, resulting in healthier and more robust foliage. Furthermore, thestudy explores the underlying mechanisms of these effects, hypothesizing that low-frequency vibrations mayenhance the expression of certain genes associated with growth and stress resistance. The potential practicalapplications of these findings could revolutionize agricultural practices by offering a non-invasive, cost-effective method to boost crop yields and resilience. This review contributes to a deeper understanding of plantacoustics and opens new avenues for sustainable agriculture and horticulture, where sound frequencies can beleveraged to optimize plant health and productivity. Further studies are needed to elucidate the exact molecularpathways involved and to refine the application techniques for maximum benefit across diverse plant species.

Keywords: Plant Acoustics, Low-Frequency Vibrations, Plant Growth Enhancement, 50-120 Hz Sound Frequencies, Plant Disease Resistance, Stress Response in Plants, Sustainable Agriculture, Crop Yield Optimization, Non-Invasive Agricultural Techniques, Sound Frequency Applications in Agriculture.

1. INTRODUCTION

Vibrating solids, gases, or liquids, such as water, may create sound waves. Vibrating objects emit waves into the medium. When the sound source excites the medium, sound waves form, and the vibrations travel far at sound speed. Sound waves pass transversely and longitudinally through solids, air, and water. Longitudinal waves oscillate parallel to propagation, whereas transversal waves do not Timbre, strength (dB), and frequency differentiate sound waves at the same frequency. Together, these traits create various sounds. Density and elasticity directly influence the acoustic propagation velocity [1–20]. Nature's three frequency ranges create audible sounds: There are four frequency bands: low (20–200 Hz), medium (200–1 kHz), medium high (1–5 kHz), and high (5–20 kHz). Below 20 Hz and above 20 kHz are infrasound and ultrasound frequencies. Hearing measures sound pressure in decibels (dB) [21–37]. Exocytosis and endocytosis can be changed by mechanical stimuli using the cytoskeleton, integrins, phospholipases, tyrosine kinase, and cAMP [38]. These days, in response to external stressors, cells alter a variety of processes, including gene expression, signal transduction, dimensional growth, cell division, and membrane ion channel activation. [39–40] Membrane proteins known as mechano-sensitive ion channels (MS) may open and shut in response to mechanical forces produced by sound, osmotic pressure, and gravity. When the ionic channels are open, ions such as Ca2+ and K+ may flow across the membrane in response to mechanical forces. It produces an ionic current, which, in mechatronics, may transform into an electrical or chemical signal. The lipid double layer can either directly transmit the produced membrane tension into the channel or combine indirectly with other cellular elements [41]. Waves reached steady-state development after 26 days, as opposed to 30 days for control groups. Given that the majority of natural sounds have a frequency of 2.2 kHz, the research shows that listening to them enhances algal biomass creation. Writers may discover it in nature. This might serve as the foundation for using sound waves in closed cultivation systems, such as bioreactors, to improve algal cultures. This tests both biomass productivity and lipid yields, showing that sound waves help cells make valuable biotechnological products and microalgae grow [42–43].

In 2013, researchers developed an approach known as "Microbial Bebop." This approach starts with the observation of natural patterns and takes inspiration from certain bebop jazz ideas to create music utilizing environmental data. [44] The technique highlights links between various data types in complicated biological data sets using rhythm, pitch, duration, and harmony. With this data collection from the environmental monitoring station L4 in the Western English Channel, the authors produced four compositions. We extracted every composition from the same dataset, emphasizing the connections between environmental variables and the microbial community's structure while taking various facets of their ecological interactions into account. Certain algorithms produced the pieces "Blues for Elle," "Bloom," "Far and Wide," and "Fifty Degrees North, Four Degrees West." This kind of method is applicable to many other complicated biological data sets. In recent years, researchers have looked at how "Blues for Elle" and "Far and Wide" affect the microalga Haematococcus pluvialis' ability to develop and produce [45].

In order to perform the experiment, we subjected the microalga culture to 60 dB of loud sound for 8 and 22 days. Compared to the control group that did not listen to music, the growth rate increased by 58%, according to the data. The writers can use the coding found in the musical synthesis of ecological data to start the reproduction and synthesis of important cellular parts in ecosystems that are biotechnologically relevant. These studies confirm that algae respond to sound by accelerating their rate of development and cellular production, regardless of the frequency or strength of the sound [42, 43, 45]. [44] As with other species, algae should also have their time exposed to sound taken into account. In addition, we aquatic creatures need to consider the watery medium in which sound travels. While Chlorella pyrenoidosa microalgae [42] benefit from enhanced photosynthetic pigment production at frequencies of 10 and 15 kHz, these frequencies often reduce C. vulgaris biomass[46].

However, the same microalgae exposed to 5, 10, 15, and 20 kHz frequencies produce more triacylglycerols, suggesting that further research is necessary to produce biodiesel. Exposure to 41 kHz at 90 dB has shown to simultaneously enhance growth and increase lipidic production in Pyrochlore Oklahomans. [43] The pieces "Blues for Elle" and "Far and Wide" were found to correlate to 0.28 kHz and 0.24 kHz at 60 dB, respectively, in the study using the microalga Haematococcus pluvial is [45]. Even though algae only make up a tiny percentage of sound applications, they definitely need further research. Various species offer varying frequencies and intensities that enhance algal growth and production, yet the current research on these species fails to fully illustrate the potential combinations.

2. THE USE OF SOUND IN OTHER LIVING THINGS

Several studies report the effectiveness of sound stimuli in promoting the growth of organisms, with the impact varying based on the frequency and intensity of the sound waves. Recently, research has investigated the effect of audible sound on the germination and growth of green beans. In one study, green beans were exposed to frequencies ranging from 1 to 2.5 kHz at variable intensities (80, 90, and 100 dB) for 72 hours[27]. The study found that exposure to a frequency of 2 kHz and an intensity of 90 dB significantly decreased germination time and increased bud growth.

In another study, green beans were grown in open-air chambers under controlled environmental conditions. The beans were exposed to five different types of acoustic patterns (soprano, classical, nature, rock, and Koranic recitation) at a sound pressure level of 60 dB, along with a control group that was not exposed to sound. The results indicated that different acoustic patterns favored the growth of various parts of the beans, such as stem length, number of leaves, and root length. Specifically, the soprano pattern significantly increased stem length, while the Koranic recitation enhanced leaf production [50]. Recently, the impact of audible sound on the germination and growth of green beans has been investigated. In one study, green beans were exposed to frequencies ranging from 1 to 2.5 kHz at variable intensities (80, 90, and 100 dB) for 72 hours [27]. The findings revealed a reduction in germination time and a significant increase in bud growth at a frequency of 2 kHz and an intensity of 90 dB. In another study, green beans were cultivated in open-air chambers under controlled environmental conditions. The plants were exposed to five different types of acoustic patterns (soprano, classical, nature, rock, and Koranic recitation) at a sound pressure level of 60 dB, with a control group not exposed to sound. The results indicated that different acoustic patterns promoted the growth of various parts of the beans, such as stem length, number of leaves, and root length. Specifically, the soprano pattern significantly enhanced stem length, while the Koranic recitation increased leaf production. Solanum Lycopersicon has been studied [50]. Tomato plants were exposed to three different consecutive frequency values: 0.6kHz in the first week,1.24kHz in the second week and 1.6kHz in the third week of growth, with a volum of 90dB. The total phenol content, lycopene content and ascorbic acid of tomato plants exposed to sound waves at different frequencies increased by 70%, 20%, and14%, respectively. According t other results of all the parameters measured in tomato fruits (lycopene,vitamin C, total sugars, total acids,and total phenol levels),1.6kHz was the best frequency value of sound waves. Someother studies related to the application of sound on the growth and productivity of plants, sonic vibrations Sonic vibration refers to the oscillatory motion of particles within a medium, induced by sound waves, that occurs at sonic frequencies, typically within the range of human hearing (approximately 20 Hz to 20 kHz). Sonic vibrations can

be utilized in various applications, including medical, industrial, and biological fields have been shown to influence the growth and metabolic activity of various organisms. This study examines the impact of low-frequency (100 Hz at 92 dB), high-frequency (10 kHz at 89 dB), and broadband (320 kbps at 80/90 dB) sonic stimuli on the growth and metabolic pathways of plant cells grown in a controlled liquid medium. Compared to a silent control with a 90 dB background, the application of sonic stimuli resulted in a 12% increase in the growth rate of the plant cells, albeit with a 14% reduction in biomass production. These findings indicate that different sound frequencies can distinctly affect the intra- and extracellular metabolite profiles, highlighting the complexity of the plant response to sonic vibrations.

The impact of sound wavesA sound wave is a type of mechanical wave that propagates through a medium (such as air, water, or solid materials) as a result of the vibration of particles on bacterial growth was also examined. In the study, three different sound frequencies within the audible range were applied to the E. Coli strain. It was observed that the bacteria exhibited better growth at frequencies below 1 kHz, whereas frequencies above 1 kHz resulted in significantly reduced growth.[60]

As evidenced by the results presented thus far, the effects of sound applications on organisms are quite diverse. Research indicates that plants exposed to medium and low frequency bands and intensities exhibit increased growth rates, enhanced photosynthetic activity, and greater pest resistance [14,47,52]. Similar changes are observed at the cellular level in yeasts and bacteria, although in some instances, an increase in growth rate is accompanied by a reduction in biomass content[62].

In general, these and other studies indicate a shift in interest in plant acoustics from questioning "if" plants can sense sound to understanding "how" they do so. Plants have been exposed to various types of sounds, ranging from Vedic chants[63] and Mozart[64] to artificial single buzzes[65,66] and insect recordings[17,18]. The results consistently show that plants respond to pathogen-related sounds by producing secondary defense molecules, exhibit improved growth with higher yields and related parameters, germinate earlier, and more. Understanding "why" this occurs is the new significant challenge in the basic research of plant acoustics, a field often overshadowed by its biotechnological applications in agriculture. Sonic vibrations, specifically those in the audible range, have shown potential in various agricultural applications. These applications can positively influence plant growth, pest control, seed germination, and overall crop yield. Here's an overview of how sonic vibrations are used in agriculture:

- Enhanced Plant Growth and Development,
- Pest Control,
- Disease Control,
- Improving Soil Health,
- Post-Harvest Applications.

3. MECHANISMS OF ACTION

- **Mechanical Stimulation:** Sonic vibrations cause mechanical stimulation, which can enhance various physiological processes in plants, such as nutrient uptake, enzyme activity, and cellular metabolism.
- **Stress Response:** Low levels of sound-induced stress can activate plant defense mechanisms, making plants more resilient to environmental stressors and pathogens.
- **Hormonal Changes:** Sound waves can influence the production and regulation of plant hormones, such as auxins, gibberellins, and cytokinins, promoting growth and development.

4. FINAL THOUGHTS

In order to comprehend the molecular and physiological reactions to the combination of sounds and various algae strains that have been examined thus far, it will be interesting to go deeper into the subject of acoustics in the future and integrate investigations of frequencies and intensities.Clearly, sound—even wavelengths that are inaudible to humans—affects living things, such as algae and plants. The ecological significance of sound perception and reaction will be further explored after the first research, and it's possible that noise pollution will eventually need to be taken into consideration alongside light and air pollution as well as many other types of human intervention in the natural world.

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Analyze the Relationship between the Frequency and Energy of Photon

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ABSTRACT

The concept of the "photon" as a quantum of light was indeed introduced by the American physical chemist Gilbert N. Lewis in 1926. His proposal was a significant step in the development of quantum theory and the understanding of light. Here is a more polished version of the quote and a brief context around it. In 1926, G. N. Lewis introduced the concept of the "atom of light," which he named the "photon." He stated:"I therefore take the liberty of proposing for this hypothetical new atom, which is not light but plays an essential part in every process of radiation, the name photon." Gilbert N. Lewis, 1926.Lewis's introduction of the term "photon" provided a concrete nomenclature for the quantum of electromagnetic radiation, which had been described by earlier physicists such as Max Planck and Albert Einstein. This concept has since become a fundamental element of quantum mechanics and modern physics.

In 1905, Albert Einstein expanded on Planck's hypothesis and proposed the concept of the photon, a particle-like quantum of light. In his paper on the photoelectric effect, Einstein suggested that light consists of discrete packets of energy, which he called quanta (later known as photons). He used Planck's formula ($E = hf$) to explain how light could eject electrons from a material, a phenomenon that could not be explained by classical wave theory of light. Einstein's work provided strong evidence for the quantization of light and led to the acceptance of the photon concept. He was awarded the Nobel Prize in Physics in 1921 for his explanation of the photoelectric effect.

In classical mechanics, the creation of electromagnetic radiation is fundamentally tied to the motion of charged particles. Here's a more detailed explanation. Thus, electromagnetic radiation is the result of the acceleration of charged particles, leading to the propagation of oscillating electric and magnetic fields through space. These fields travel at the speed of light and manifest as photons in the quantum mechanical framework.

The statement you've provided is partially accurate but requires some clarification and expansion to fully capture the historical and scientific context of Planck's radiation formula and its significance. While Planck's radiation formula was indeed a new scientific interpretation, it represented a profound shift from classical electromagnetic theory to quantum mechanics. It was not merely an extension of classical theory but a fundamental transformation that addressed phenomena that classical physics could not explain, such as the blackbody radiation spectrum and the photoelectric effect.

The concept of "matter waves" or "de Broglie waves" is a fundamental aspect of quantum mechanics that illustrates the wave-particle duality of matter. This idea was proposed by Louis de Broglie in 1923 as part of his doctoral thesis. De Broglie hypothesized that particles, such as electrons, exhibit both particle-like and wave-like properties. This was a revolutionary idea, as it extended the wave-particle duality observed in light to all matter.

The concept of discrete energy levels is a cornerstone of quantum mechanics and atomic physics. It explains the stability of atoms, the emission and absorption spectra, and the fundamental nature of chemical interactions. Understanding these principles is crucial for advancing technology in fields like spectroscopy, quantum computing, and materials science.

Keywords: Energy, Frequency, Photon, Electrons.

1. INTRODUCTION

1.1 Emission of Radiation from Hot Bodies (Blackbody Radiation)

Classical physics predicted that the energy emitted by a blackbody at high frequencies would be infinite, a problem known as the "ultraviolet catastrophe." This issue was resolved by Max Planck in 1900. Planck proposed that electromagnetic energy could only be emitted or absorbed in discrete quantities, or "quanta," laying the foundation for quantum theory.

1.2 Photoelectric Effect

Maxwell's wave theory couldn't explain why light of certain frequencies could eject electrons from a metal surface regardless of the light's intensity. In 1905, Albert Einstein proposed that light itself is quantized into particles called photons. He suggested that the energy of each photon is proportional to its frequency ($E = h\nu$, where h is Planck's constant). This explanation not only accounted for the photoelectric effect but also earned Einstein the Nobel Prize in Physics in 1921.

1.3. Heat Capacity of Solids

Classical physics predicted that the heat capacity of solids should be constant at all temperatures, which was inconsistent with experimental observations. In 1907, Einstein applied quantum theory to this problem, proposing that the vibrations of atoms in a solid could only have discrete energy levels. This approach was further refined by Peter Debye in 1912, resulting in the Debye model, which accurately described the temperature dependence of heat capacity.

1.4. Line Spectra of Atoms (Hydrogen Spectrum)

The classical wave theory couldn't explain the discrete line spectra emitted by atoms, especially the hydrogen atom. In 1913, Niels Bohr introduced his model of the atom, which incorporated quantized orbits for electrons. This model explained the hydrogen spectrum by suggesting that electrons could only occupy certain allowed orbits, emitting or absorbing energy when they jumped between these orbits.

2. PLANCK EQUATION

You are referring to Planck's relation, which indeed describes the energy of a photon based on its frequency. However, the description can be refined for clarity and accuracy. Here's an improved version:

Planck's relation, given by the equatio $E = hf$ describes the energy (E) of a photon in terms of its frequency (f). In this equation, (h) is Planck's constant, which has a value of $(6.625\times10-34Js)$. This equation implies that the energy of a photon is directly proportional to its frequency. Consequently, photons with lower frequencies, such as radio waves, have lower energies, whereas photons with higher frequencies, such as X-rays, possess higher energies.

Max Planck's law, formulated in 1900, describes the spectral density of electromagnetic radiation emitted by a black body in thermal equilibrium at a given temperature. This law was initially derived using empirically determined constants, and Planck later demonstrated that it represents the unique stable energy distribution for radiation in thermodynamic equilibrium.

Planck's law, as an energy distribution, is part of a family of equilibrium distributions that include:

Bose-Einstein distribution: Describes the distribution of bosons (particles with integer spin) in thermal equilibrium. It applies to particles that do not obey the Pauli exclusion principle, allowing multiple particles to occupy the same quantum state.

Fermi-Dirac distribution: Describes the distribution of fermions (particles with half-integer spin) in thermal equilibrium. It is governed by the Pauli exclusion

principle, which states that no two fermions can occupy the same quantum state simultaneously.

Maxwell-Boltzmann distribution: Describes the distribution of particles in a classical ideal gas. It applies to particles that do not follow quantum mechanical constraints and is a good approximation for the behavior of gases at high temperatures and low densities where quantum effects are negligible.

These distributions are fundamental in statistical mechanics and help explain the behavior of different types of particles in thermal equilibrium.

Planck's constant (denoted as(h)) is indeed a fundamental physical constant in quantum mechanics. It relates the energy ((E)) of a photon to its frequency (f)) through the equation:

$$[E=hf]$$

This relationship is crucial in understanding the behavior of particles and waves at the quantum level. The value of Planck's constant is approximately (6.625×10−34Js) joule-seconds (Js).

In metrology, Planck's constant has a significant role as it is used to define the kilogram in the International System of Units (SI). Since 2019, the kilogram is defined by fixing the numerical value of the Planck constant to exactly (6.625×10−34Js) Js, thereby linking mass to a fundamental physical constant.

This redefinition represents a shift from the previous definition based on a physical object (the International Prototype of the Kilogram) to one based on an invariant of nature, providing greater stability and precision in measurements.

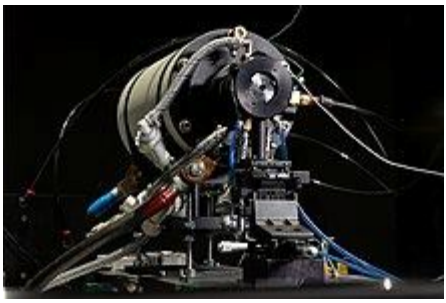

Figure 1: A black body radiator used in CARLO laboratory in Poland. It is an approximation of a model described by Plancks law utilized as a spectral irradiance standard

That's correct! A black body is a theoretical object that perfectly absorbs all wavelengths of electromagnetic radiation and re-emits energy perfectly according to its temperature. This concept is fundamental in the study of thermal radiation and quantum mechanics.

The radiation emitted by a black body is characterized by the Planck radiation law, which describes the spectral density of the radiation. A black body in thermal equilibrium emits radiation in a predictable manner known as black-body radiation, which has a specific spectrum that depends solely on the body's temperature. The peak wavelength of this radiation shifts according to Wien's displacement law, and the total emitted energy can be described by the Stefan-Boltzmann law.

In contrast, a white body reflects all incident light uniformly and does not absorb any radiation, making it an ideal reflector.

3. THEORY OF RELATIVITY

That's a good summary of the theory of relativity. Special relativity, introduced by Albert Einstein in 1905, focuses on the relationship between space and time in the absence of gravitational fields. One of its key principles is that the speed of light in a vacuum is constant and independent of the observer's motion or the source of the light. This theory introduced the famous equation\($E = mc^2$), which shows the equivalence of mass and energy.

General relativity, published by Einstein in 1915, extends these concepts to include gravity. It describes gravity not as a force between masses but as a curvature of space-time caused by mass and energy. This curvature affects the path of objects and light, leading to phenomena such as gravitational time dilation, where time passes more slowly in stronger gravitational fields, and the bending of light around massive objects (gravitational lensing).

These theories have been confirmed by many experiments and observations and are fundamental to modern physics, influencing our understanding of the universe from the smallest particles to the largest structures in space.

Absolutely! Newton's Principia is a landmark work in the history of science. It laid down the foundation for classical mechanics and described the laws of motion and universal gravitation. These principles indeed dominated scientific thought for centuries, providing a framework to understand the motion of objects on Earth and in the heavens. It wasn't until Einstein's theory of relativity in the early 20th century that our understanding of space, time, and gravitation underwent a profound transformation. The theory of relativity showed that Newtonian mechanics are accurate approximations under certain conditions but break down at very high speeds or in the presence of extremely strong gravitational fields.

Newton's work on gravitation indeed began to take shape during his time at Woolsthorpe Manor in 1665, where he began considering the concept of universal gravitation. His return to celestial mechanics in 1679 was crucial as he developed his theory further, integrating gravitational forces into the framework of Kepler's

laws of planetary motion. This work culminated in his monumental work, "Philosophiæ Naturalis Principia Mathematica," published in 1687, where he laid out his laws of motion and the law of universal gravitation. This publication revolutionized our understanding of physics and astronomy.

The theory you are referring to is Albert Einstein's theory of relativity. This revolutionary theory, developed in the early 20th century, consists of two main parts: Special Relativity and General Relativity.

Special Relativity (1905):

Introduced by Einstein in his paper "On the Electrodynamics of Moving Bodies."

Unified space and time into a single four-dimensional continuum known as spacetime.

Introduced key concepts such as the relativity of simultaneity, time dilation, and length contraction.

Established that the speed of light is constant in all inertial frames of reference.

General Relativity (1915):

Extended the principles of Special Relativity to include gravity.

Described gravity not as a force but as a curvature of spacetime caused by mass and energy.

Predicted phenomena such as gravitational time dilation, the bending of light by gravity, and the expansion of the universe.

Impact on Physics:

Transformed theoretical physics and astronomy, providing a more accurate description of the universe at both large and small scales.

Led to the development of the Standard Model of particle physics, improving the understanding of elementary particles and their interactions.

Ushered in the nuclear age, with implications for both energy production and weapons technology.

4. PHOTOELECTRIC EFFECT

That's a great summary of the photoelectric effect! The photoelectric effect was pivotal in the development of quantum mechanics. Here are some additional points that might be of interest:

4.1 Einstein's Contribution

Albert Einstein explained the photoelectric effect in 1905, proposing that light consists of quanta, or photons, each with energy proportional to its frequency. This explanation earned him the Nobel Prize in Physics in 1921.

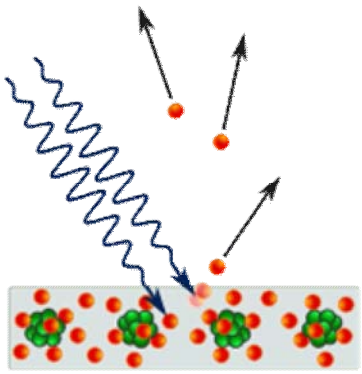

Figure 2: Photoelectric effect: the emission of electrons from a metal plate caused by light quanta photons

4.2 Threshold Frequency

The photoelectric effect demonstrates that electrons are emitted from a material only when the incident light exceeds a certain frequency, known as the threshold frequency. Below this frequency, no electrons are emitted regardless of the light's intensity.

4.3 Applications

The photoelectric effect has numerous applications, including in:

Photomultiplier Tubes: Used in scientific instruments to detect faint light signals.

*Photoelectric Sensors: Common in safety and automation systems.

Solar Cells: Photovoltaic cells that convert light into electrical energy rely on the photoelectric effect.

4. Experimental Observations:

The photoelectric effect supports the quantum theory of light, which contradicts the classical wave theory. Classical theory could not explain why light intensity did not affect the energy of emitted electrons and why there was a threshold frequency.

Would you like to delve into any specific aspect of the photoelectric effect or its applications?

Yes, that's correct. Albert Einstein was awarded the Nobel Prize in Physics in 1921 for his explanation of the photoelectric effect, which was a crucial step in the development of quantum theory. At that time, the concept of the photon and the quantum nature of light were still controversial.

Arthur Compton's experiments in 1923, which demonstrated that X-rays scattered by electrons in a material had energy and momentum consistent with those of particles (photons), provided strong evidence for the quantum nature of light. This phenomenon became known as Compton scattering and was a significant confirmation of the photon concept.

In 1924, Gilbert Lewis coined the term "photon" to describe these light quanta, further solidifying the idea in the scientific community. This period marked a significant shift towards the acceptance of quantum mechanics, fundamentally altering our understanding of light and matter.

Robert A. Millikan was awarded the Nobel Prize in Physics in 1923 for his precise measurement of the elementary electric charge and his work on the photoelectric effect. His oil-drop experiment determined the charge of the electron, which was a significant contribution to the understanding of atomic structure. Additionally, Millikan's experiments confirmed Albert Einstein's theoretical explanation of the photoelectric effect, providing strong evidence for the quantum theory of light.

In quantum perturbation theory of atoms and solids subjected to electromagnetic radiation, the photoelectric effect is analyzed in terms of waves. This wave approach remains valid because photon or wave absorption can only occur between quantized energy levels, where the energy difference corresponds to the energy of the absorbed photon. This duality in understanding the phenomenon highlights the compatibility of wave and particle descriptions in quantum mechanics.

Yes, that's correct! Robert Millikan's experiments on the photoelectric effect were pivotal in the early 20th century. Initially skeptical of Einstein's theory, Millikan meticulously measured the photoelectric effect to disprove Einstein's explanation. However, his results ended up providing strong empirical support for Einstein's theory.

5. LOUIS DE BROGLIE'S

Yes, Louis de Broglie's 1924 thesis indeed marked a pivotal moment in the development of quantum mechanics. By suggesting that particles such as electrons have wave-like properties, de Broglie introduced the concept of matter waves, a foundational element of wave-particle duality. This hypothesis extended the wave-particle duality of light, previously developed by Planck and Einstein, to all matter.

De Broglie's groundbreaking work paved the way for the development of quantum mechanics, particularly wave mechanics, which was later formalized by Erwin Schrödinger. Schrödinger's wave equation described how these matter waves evolve over time, providing a comprehensive mathematical framework for quantum theory.

6. SIR CHANDRASEKHARA VENKATA RAMAN

Sir Chandrasekhara Venkata Raman FRS (7 November 1888 – 21 November 1970) was an Indian physicist renowned for his pioneering work in the field of light scattering. Utilizing a spectrograph he developed, Raman, along with his student K. S. Krishnan, discovered that when light traverses a transparent material, the deflected light changes its wavelength. This phenomenon, initially referred to as "modified scattering," later became known as the Raman effect or Raman scattering. This groundbreaking discovery significantly advanced the understanding of light and its interactions with matter.

That's a great explanation of scattering in physics! Scattering is indeed a fundamental concept that applies to various fields and phenomena. Here's a more detailed breakdown of the different types of scattering and their significance:

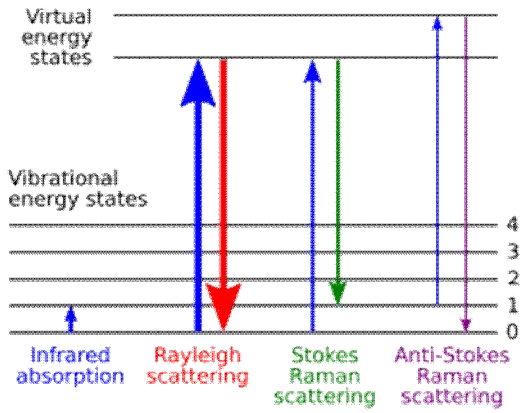

Figure 3: Energy level diagram showing the states involved in Raman signal

Types of Scattering

1.Rayleigh Scattering:

Description: Occurs when particles are much smaller than the wavelength of radiation.

Examples: Explains why the sky is blue (scattering of sunlight by atmospheric molecules).

2. Mie Scattering:

Description: Occurs when the particles are about the same size as the wavelength of radiation.

Examples: Scattering by dust and smoke particles, contributing to the white appearance of clouds.

3. Thomson Scattering:

Description: Elastic scattering of electromagnetic radiation by a free charged particle, typically an electron.

Examples: Occurs in plasmas and can be used to measure electron temperatures and densities.

4. Compton Scattering:

*Description: Involves the inelastic scattering of a photon by a charged particle, usually an electron.

Examples: Demonstrated the particle nature of photons and is used in various spectroscopic techniques.

5. Brillouin Scattering:

Description: Scattering of light caused by sound waves in a material.

Examples: Used to study material properties like density and elastic moduli.

Scattering in Different Mediums

Light Scattering:

Applications: In optical communications, atmospheric science, and medical imaging (e.g., X-rays).

Sound Scattering:

Applications: In sonar technology, acoustics, and medical ultrasonography.

Particle Scattering:

Applications: In particle physics (e.g., scattering experiments in accelerators), materials science, and astronomy.

Diffuse vs. Specular Reflections

Diffuse Reflection:

Description: Radiation is scattered in many directions due to the roughness of the surface or non-uniformities in the medium.

Examples: Matte surfaces, such as paper or unpolished wood.

Specular Reflection:

Description: Radiation reflects in a single direction, following the law of reflection.

Examples: Mirrors, polished metal surfaces.

7.THEORY OF EVERYTHING (TOE)

Yes, the Theory of Everything (TOE) is a highly sought-after goal in physics. It aims to unify all the fundamental forces of nature—gravitational, electromagnetic,

strong nuclear, and weak nuclear forces—into a single theoretical framework. This unification would provide a comprehensive understanding of the universe at both the macroscopic and microscopic levels.

Key Aspects and Challenges:

1. Current Theories:

General Relativity: Explains gravitation and the large-scale structure of the universe.

Quantum Mechanics: Describes the behavior of particles at the smallest scales.

2. Incompatibility:

General relativity and quantum mechanics have been extremely successful in their respective domains, but they are fundamentally incompatible with each other. General relativity is a classical theory that does not incorporate the probabilistic nature of quantum mechanics.

3. Candidate Theories:

String Theory: Proposes that the fundamental constituents of the universe are one-dimensional "strings" rather than point-like particles. String theory has the potential to unify all forces but has yet to produce testable predictions.

Loop Quantum Gravity: Attempts to quantize space-time itself and reconcile general relativity with quantum mechanics, though it faces significant challenges.

4. Experimental Verification:

A major obstacle in finding a TOE is the lack of experimental evidence. Current technologies are often insufficient to probe the extremely high energies or small scales where a TOE might become apparent.

Historical Context:

Isaac Newton: Unified the laws of motion and universal gravitation, providing a framework that stood for centuries.

Albert Einstein: Developed the theory of general relativity, revolutionizing our understanding of gravity.

Quantum Revolution: In the early 20th century, the advent of quantum mechanics brought a new understanding of the micro-world but also highlighted the need for a unified theory.

Finding a TOE remains one of the most ambitious and profound goals in physics, promising to revolutionize our understanding of the universe.

That's a great summary of the two pillars of modern physics: general relativity and quantum mechanics. Let's delve a bit deeper into each of these frameworks and their implications.

General Relativity

Developed by Albert Einstein in 1915, general relativity revolutionized our understanding of gravity. It describes gravity not as a force but as a curvature of spacetime caused by mass and energy.

Applications: Explains phenomena such as the bending of light around massive objects (gravitational lensing), the precise orbits of planets, the expansion of the universe (cosmology), and the prediction of black holes.

Quantum Mechanics

Developed in the early 20th century by scientists like Planck, Bohr, Heisenberg, and Schrödinger, quantum mechanics describes the behavior of particles at the smallest scales.

Key Concepts:

Wave-Particle Duality: Particles exhibit both wave-like and particle-like properties.

Uncertainty Principle: There are fundamental limits to how precisely we can know certain pairs of properties (e.g., position and momentum) simultaneously.

Quantization: Certain properties, like energy, are quantized and can only take on discrete values.

The Standard Model: Formulated in the 1970s, it describes the electromagnetic, weak, and strong nuclear forces, and classifies all known elementary particles.

Fundamental Forces:

Electromagnetic Force: Mediated by photons.

Weak Nuclear Force: Responsible for radioactive decay, mediated by W and Z bosons.

Strong Nuclear Force: Holds protons and neutrons together in the nucleus, mediated by gluons.

Elementary Particles: Includes quarks, leptons (like electrons and neutrinos), and bosons (force carriers).

Challenges and Unification Efforts

Incompatibility: General relativity and quantum mechanics are fundamentally different theories and are mathematically incompatible in their current forms.

Quantum Gravity: Efforts like string theory and loop quantum gravity attempt to unify these frameworks into a single coherent theory.

Theory of Everything (TOE): The ultimate goal is to develop a theory that seamlessly integrates all fundamental forces, including gravity, into one unified framework.

These two theories have profoundly changed our understanding of the universe, each excelling in its domain but highlighting the need for a deeper, unified theory to fully describe the nature of reality.

Steven Weinberg's perspective on the limitations and adequacy of physical theories highlights a critical aspect of scientific methodology. Here are some key points to consider:

1.Approximation and Practicality: While it's true that calculating the precise motion of a projectile in the Earth's atmosphere is practically impossible due to the myriad of factors (e.g., air resistance, wind, temperature variations), Newton's laws of motion and gravitation still provide an adequate framework for understanding and predicting projectile motion within reasonable bounds. These principles are "good enough" because they work well in idealized or controlled conditions and offer reliable predictions in many real-world scenarios.

2. Empirical Success of Principles: Newtonian mechanics and general relativity are considered valid theories because they have consistently yielded accurate predictions in the domains where they apply. Newton's laws work exceptionally well for most macroscopic phenomena involving moderate speeds and weak gravitational fields. General relativity has been confirmed by observations such as the bending of light around massive objects and the perihelion precession of Mercury's orbit.

3. Theory of Everything (TOE): The goal of a TOE is to unify all fundamental forces and particles within a single coherent framework. One significant challenge is reconciling quantum mechanics (which describes the behavior of particles at the smallest scales) with general relativity (which describes the gravitational force). The equations of quantum mechanics often fail under conditions where gravitational forces become extremely strong, such as near black holes or during the Big Bang. This indicates the need for a more comprehensive theory, such as quantum gravity, which remains an open area of research.

4. Incremental Progress: Scientific theories often develop incrementally. Theories are judged based on their ability to explain known phenomena and predict new ones. Even if a theory does not have exact solutions for every possible scenario, its success in simpler cases builds confidence in its broader applicability. This approach has historically led to significant advancements, such as the transition from Newtonian mechanics to Einsteinian relativity.

5. Experimental Verification: A crucial aspect of any scientific theory is its experimental verification. Both Newtonian mechanics and general relativity have been subjected to rigorous testing and have passed numerous experimental tests. The same standard applies to any proposed ToE; it must be able to predict and explain phenomena across a wide range of conditions, and these predictions must be experimentally verifiable.

8. CONCLUSION

Yes, that's correct. A black body in thermal equilibrium emits electromagnetic radiation called black-body radiation. The characteristics of this radiation are determined solely by the temperature of the black body, as described by Planck's law. This law provides the spectral distribution of the emitted radiation.

The spectrum of black-body radiation has a characteristic shape that depends on temperature. As the temperature increases, the peak of the spectrum shifts to higher frequencies (shorter wavelengths), and the total emitted radiation increases. This relationship is described by Wien's displacement law and the Stefan-Boltzmann law.

Impact on Cosmology and Astrophysics:

Predicted and explained extraordinary astronomical phenomena, including neutron stars, black holes, and gravitational waves.

Led to a deeper understanding of the structure and evolution of the universe, influencing modern cosmology and astrophysics.

Einstein's theory of relativity has been experimentally confirmed through numerous observations and experiments, solidifying its status as one of the cornerstones of modern physics.

Einstein's 1905 paper on the photoelectric effect proposed that light could be understood as consisting of discrete packets of energy called quanta (later called photons). According to Einstein, each photon had an energy proportional to its frequency, given by ($E = h f$), where (h) is Planck's constant and (f) is the frequency of the light. This theory explained the observation that light below a certain frequency, regardless of its intensity, would not cause the ejection of electrons from a material's surface, while light above that frequency would.

Millikan's experiments, conducted over a decade from 1914 to 1916, involved precise measurements of the kinetic energy of electrons ejected from a metal surface when exposed to light of different frequencies. Despite his initial goal to refute Einstein, Millikan's data matched Einstein's predictions exactly, confirming the linear relationship between the frequency of incident light and the kinetic energy of ejected electrons.

Millikan's work was crucial in solidifying the quantum theory of light and earned him the Nobel Prize in Physics in 1923, although his Nobel Prize was awarded for his work on the elementary charge of the electron and the photoelectric effect. This work played a significant role in the broader acceptance of quantum mechanics in the scientific community.

De Broglie's hypothesis and subsequent contributions by others fundamentally changed our understanding of the microscopic world, bridging the gap between the physics of energy and matter.

His Nobel Prize in Physics in 1929 recognized the profound impact of his theoretical insights on the field of quantum mechanics.

Scattering is not just limited to light; it encompasses various forms of radiation and particles, making it a versatile and widely applicable concept in physics.

Scattering phenomena have indeed been a subject of scientific inquiry for centuries, tracing back to Isaac Newton's work in the 17th century. William Herschel expanded the concept to include the scattering of "heat rays" in 1800, although their electromagnetic nature was not yet recognized. John Tyndall further connected light scattering with acoustic scattering in the 1870s, highlighting the broader implications of scattering across different types of waves and particles. This evolution in understanding has laid the foundation for diverse fields of research, from optics to acoustics and beyond.

Yes, the development of quantum theory in the early 20th century significantly broadened our understanding of scattering phenomena. Initially observed with cathode rays and X-rays, scientists like Ernest Rutherford's work in 1911 on atomic structure paved the way for applying mathematical frameworks to understand scattering across various particles and waves. This expansion in understanding was crucial for fields ranging from particle physics to materials science and beyond.

In conclusion, Weinberg's argument underscores that the adequacy of a scientific theory is often determined by its empirical success in explaining and predicting phenomena within its applicable domain. The pursuit of a TOE involves extending this success to encompass all physical phenomena, overcoming the challenges posed by the current limits of our understanding.

Indeed, Maxwell's contributions to the understanding of electromagnetic waves were monumental, but his classical theory had limitations that couldn't explain certain phenomena observed in the late 19th and early 20th centuries. Let's look into each of the phenomena you mentioned and the subsequent developments that addressed them:

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Global Threat from Global Warming an Measures to Avoid It

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ABSTRACT

Changing weather is a normal phenomenon but changing temperatures are a matter of concern.

The observed changes in sequential atmosphere since the 1980s are a matter of concern, but at that time no special attention was paid to them. In other words, no one took any necessary steps to stop it.

Due to this reason, the pollution is increasing till today and due to its consequences, all the countries of the world are suffering more or less in some form or the other.

If we talk about global warming, it is basically caused by two reasons. The first is to create nature and the second is to create humans. Natural causes are a kind of normal phenomenon which happens gradually and it is not possible to stop it. Therefore, human made pollutions can be avoided.

In this paper it is being presented that if global warming is not stopped already due to human creation then what terrible consequences can we face for the people of World. Through this paper, suggestions will also be provided on ways to prevent anthropogenic air pollution or Global Warming.

Keywords: weather, temperatures, sequential, pollution, anthropogenic

2. INTRODUCTION

Because we all know that Climate Change and global warming are not one thing, but people have been seen using both these words in the same format many places. If we imagine that our earth is a house. If the temperature of every room of the house or every part of the earth rises then it will be said that this is global warming. Therefore, if the change in temperature of each room in the house is different or the change in temperature of different parts of the world is different, then these phenomena should be understood in the form of Climate Change. Climate change is generally a natural process which is usually seen every 30-35 years. It is being seen that the change in climate is now happening rapidly rather than slowly. This is now happening within 20-25 years. This rapid change in climate is the result of global warming.

2. TERRIBLE CONSEQUENCES OF GLOBAL WARMING

2.1 Rapid increase in earth's temperature

Due to global warming, cause glaciers to melt when the temperature of the earth will rise, there will be unprecedented floods in all the major rivers of the world and India like Ganga, Jamuna, Satlaj, Jhelam, Chinab etc.

Because there are dense settlements on the banks of these rivers, we all will drown in water. Due to more floods the forests will be devastated.

In a few years, when these glaciers melt rapidly, these rivers will become dry. Then the cities situated on the banks of these rivers will suffer from drought.

2.2 *Increase in sea volume*

When the glaciers melt, it is natural that this water will go into the sea and their volume will start increasing. If you go to see the cities not only of India but also of the major countries of the world, they are situated on the shores of the ocean. Due to submergence of these metropolitan cities, the economy will collapse and starvation will spread all over the world. When these big cities start sinking, the people here will run to other cities, but there the situation will be even worse due to floods and then drought.

2.3 Generation of Powerful cyclones

It has been observed that cyclones in the sea arise only from those places where the temperature is 27 °C. But when the temperature in these places increases, even more destructive cyclones will start rising from these places more quickly. This will cause further destruction in the world

2.4 Fishermen's business will end

When the world heats up, there will be an end to the coral in the ocean. A huge number of people living near the sea will reach the brink of starvation because if there are no fish, how will we earn?

2.5 The epidemic will increase further

Increase in global warming means increase in world temperature and also increase in humidity. The simultaneous increase in temperature and humidity means a favorable environment for the birth of viruses and bacteria. As a result, viruses and bacteria will multiply rapidly and the frequency of epidemics and their occurrence will also increase. This will lead to more destruction

2.6 Change in rainfall patterns

Due to change in temperature at different places, there will be change in the rainfall pattern. Where there is heavy rain there will be drought and where there is drought or desert there will be heavy rain. In this way surprising changes will be seen in the weather. The result of this will be that there will be a huge shortage of food grains globally and everyone will start dying due to hunger.

3. SPECIAL POSITIVE AND NEGATIVE EFFECTS

The laws of chemistry say that if the amount of carbon dioxide in the atmosphere increases, crops will be good, which means food production will increase. However, as carbon dioxide increases in the atmosphere leading to global warming, this decision will not be able to save the land from farming, but where will the production go? This means that when there is no land suitable for farming, crops will grow poorly.

4. TECHNICAL SOLUTIONS AND SUGGESTIONS

1. Some scientists believe that they can cause nuclear explosions in all the active volcanoes on Earth. The cloud that forms after this explosion will prevent sunlight from reaching the Earth for a few years and the Earth's temperature will begin to decline rapidly. But practically this is not possible for everyone.
2. The second suggestion is that since we all know that 90% of photosynthesis occurs due to algae located in the oceans. If the amount of algae in the seas is to be increased then iron dust should be sprinkled on them. The result will be that when the amount of algae increases in the oceans, photosynthesis will increase. Due to this, carbon dioxide will be absorbed and settle at the bottom of the sea and thus reducing carbon dioxide will reduce global warming. But if the amount of iron dust goes into the sea, it can have negative consequences for the organisms living in it. Therefore, this type of suggestiveness also does not seem sustainable.
3. Some scientists say that at many places on Earth, huge mirrors whose radius can be 5, 10 or 15 Km can be installed. The advantage of this will be that the heat coming from the sun will be reflected and will go back and will not be absorbed by the earth or by the earth's atmosphere. But installing such a large number of mirrors would be very costly and even more costly would be the maintenance of these mirrors. In this way, this suggestion is also very expensive and is not practically possible.

5. CONCLUSION

The biggest solution to stop the increasing global warming on our earth is to plant trees and plants in maximum quantity. In a country like India, shady trees like Peepal, Banyan etc. should be planted in maximum quantity.

This is a cheap, effective and easy option. As per the Paris Agreement, The current temperature of the world should be stopped at that level or at least efforts should be made to ensure that the world temperature does not increase by more than 1.5 degrees by 2030. This agreement was also signed that all the countries of the world will reduce their production of greenhouse gases by 30% to 35% by 2030. At the current rate of global warming, the global temperature will increase by more than 1.5 degrees between 2030 to 2052. This will be a terrible situation for everyone.

For this, initiatives have been started in our country also. A lot of emphasis is being laid on the production of solar power, wind mill, electric vehicles etc.

If we want to stop the global warming on Earth, we will have to reduce the rate of carbon dioxide emissions from 45% to 0% by 2050, only then we will all be saved.

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Photovolatic Thermal (PVT) Combined with Greenhouse Technology forAquaculture

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ABSTRACT

Food production industry is highly dependent on the aquaculture. Majority of aquaculture products are imported from Asia. Climate effects aquaculture production on both ways as direct and indirect method. Global food production is high at risk; the climate change poses a serious threat to both the quantity and quality of food produced. Photovoltaic thermal (PVT) technology integrated with greenhouse technology is one of the promising solutions for optimal growth of aquaculture production. The proposed system has the ability to generate both thermal and electrical power. Climatic condition has been used to develop energy balanced equation. Simulation analysis shows the increase of the temperature inside greenhouse and waterpond in extreme cold climatic condition of Srinagar in the month of February, which shows the increase in yielding and growth of aquaculture.

Keywords: Greenhouse, photovoltaic, aquaculture.

1. INTRODUCTION

Climate change, food security, and their intricate relationship have gained international attention during past few decades. Mother nature is deteriorating day by day due to pollution, deforestation due to which ecosystem is affecting. The amount of greenhouse gases is increasing day by day in the atmosphere. Extreme weather condition such as flood, cyclone, drought etc. occurs which again deteriorating agriculture and aquaculture and increases global warming. Changes in the climatic condition now become global issue. Variation in climatic condition posesa serious threat to aquatic creatures as it is causing changes in the average temperature of air as well as water. Changes in temperature of aquatic system occurs through rise of sea level and increase in temperature of water of sea, variation in monsoon patterns, tremendous weather events and indirect and direct impacts of water stress on aquatic animals including fish stocks. Climate change directly affects the growth

pattern and physiological behavior of organisms, subsequently decrease reproductive capacity and finally causing mortality. Indirectly climate change may affect the productivity, function, structure and composition of aquatic ecosystems. All these change results in decrease of fish production. It disturbs the economic growth of farmers whose life depends on pisciculture and hamper their normal livelihood [1]. The influence of water temperature affects the fish growth. The fish will thrive in temperature range of 28-32°C [2]. If temperature is higher or lower it could affect the growth rate of fish [3].

In cold climatic area, temperature of air drops below 15 °C and the difference of temperature between day and night is about 15-20°C [4]. The production of fish decreases as yielding get affected due to low temperature. This affects the fish supply and the price increases during cold condition.

Greenhouse technology is passive and low cost method adopted by aquarist to maintain the temperature of water pond to increase yield of fish. Greenhouse technology can increase water temperature by 3.58˚C to 6.79˚C in winter season [5]. Greenhouse technology is used to provide thermal energy by taking heat from sun and increase greenhouse room air temperature. This thermal energy of greenhouse helps to increase the temperature of water of water pond and maintain this temperature for longer hours. The water temperature decreases slowly in off sunshine hours as the volume is high. Room temperature of greenhouse depends on various factors such as shape, construction material and outside conditions of weather (solar radiation and ambient temperature). Therefore, Greenhouse orientation and shape have a significant impact on total solar radiation received by the greenhouse inside air temperature. Nevertheless, greenhouse technology requires a high amount of energy for heating, cooling, and ventilation [7]. Greenhouse technology integrated with photovoltaic thermal (PVT), is one of the promising solution to exponential food and energy demands. This dual use results in self sustainable productivity overall ensuring high reliability. A photovoltaic with thermal referred as PVT is an optimized framework allowing production of thermal energy and electrical energy. The application of PVT with greenhouse is highly recommendable during operation, avoiding large greenhouse emissions, long life of approximately 20 to 30 years, and use a reliable and abundant power resource [8].

In the proposed research work, an uneven semitransparent photovoltaic thermal (PVT) system integrated with greenhouse is considered. Also, a water pond is considered inside the greenhouse for fish yielding.

2. AQUACULTURE SYSTEM

In the system, a thermal model of PVT integrated with greenhouse technology for aquaculture is shown in Figure 1. The roof is covered with uneven semi-transparent photo-voltaic greenhouse structure.

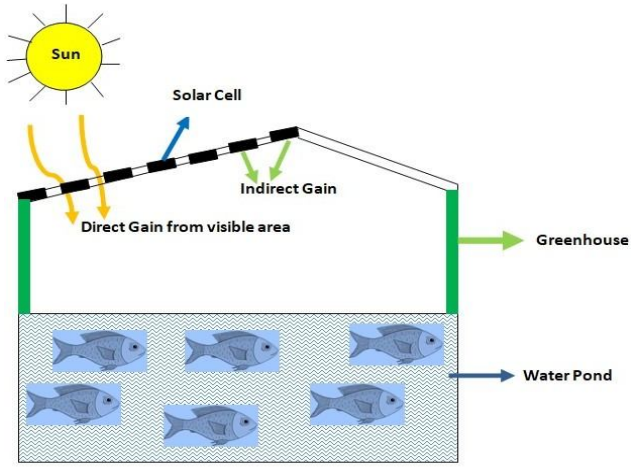

Figure 1: Semi-transparent Photovoltaic with Greenhouse Technology

Due to integration of photovoltaic thermal with greenhouse technology, two namely direct and indirect gain obtained is observed as shown in Figure 1. The direct gain is obtained from solar radiation directly coming into greenhouse from the non-packing area of photovoltaic module and heat the water of the water pond. The indirect gain is obtained from the back side of photovoltaic module (loss in terms of thermal energy) is also useful to raise the temperature of greenhouse, helps to increase the water temperature of water pond. Therefore, temperature of water increases directly or indirectly.

3. THERMAL MODELING OF PHOTOVOLTAIC INTEGRATED WITH GREENHOUSE TECHNOLOGY

Assumptions are considered for proposed system to develop an energy balance equations and form characteristic equation. They are as negligible electrical losses (between two solar cells) and heat capacity of insulating materials.

Energy balance equations of proposed system are developed as:

3.1 Photovoltaic South Roof Energy Balance Equation

Total solar radiations absorbed by solar cell = Energy converted nto electrical energy + Thermal energy lost from solar cell to atmosphere + Thermal energy lost from bottom of solar cell to the Greenhouse room

→ 1A

3.2 Greenhouse Room Air Energy Balance Equation

Thermal energy loss from room through all sides walls to the atmosphere = Solar collector thermal energy gain + Solar cell Thermal energy gain + Water Thermal energy gain

→ 1B

3.3 Energy balance Equation for Fish in the Water Pond

Thermal energy transferred from underground to the water + Thermal radiations transferred through wall to the water pond + Thermal energy transferred through the non-packing area

= Rate of thermal energy into pond + Thermal energy transferred to room air

→ 1C

Temperature of water inside water pond is calculated using above equation 1A, 1B and 1C as:

$$Tw = \left(\frac{ArsI(t)((\tau_g^2(1-\beta) + \alpha\tau_{eff}PF_3) + \tau_g \sum_{j=1}^{3} A_i I_j)}{UA_{wa} + \sum_{k=1}^{5} a_k u_k} + T_a \right)(1 - e^{-at}) + T_{w0}e^{-at} \quad \longrightarrow \text{1D}$$

4. RESULT AND DISCUSSION

Figure 2 and Figure 3 shows the hourly variation of solar radiation intensity and ambient temperature for the month of February of Srinagar using Solarimeter and thermometer. Fish needs the temperature of water as 18˚C to 35˚C for yielding and optimal growth. Based on thermal modeling, the water temperature of pond is calculated and plotted using MATLAB software.

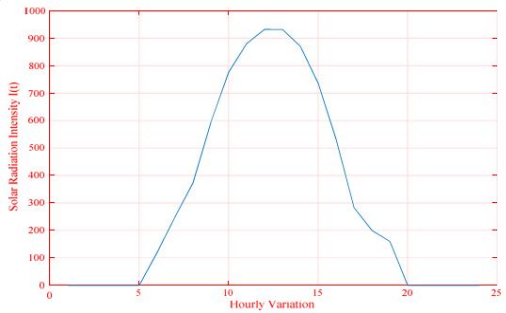

Figure: 2 Hourly variation of Solar Radiation Intensity

The ambient temperature shows the cold climatic condition as the temperature is very low. The water pond temperature is shown in Figure 4, which shows the minimum temperature as 18˚C and maximum temperature as 36˚C. This shows as the proposed system can increase the production of fish by maintaining water temperature in cold climatic condition.

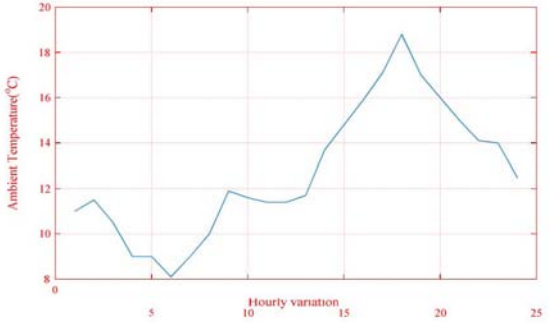

Figure 3: Hourly variation Ambient Temperature

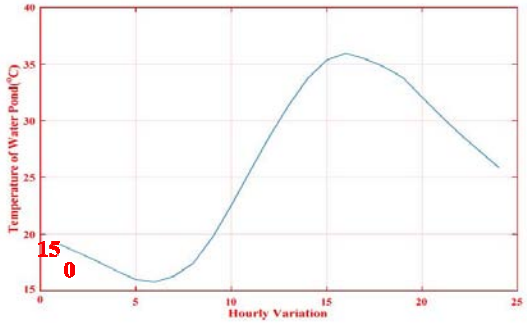

Figure 4: Hourly variation of temperature of Water Pond

5. CONCLUSION

In this work, the attempt was made to maintain the optimal temperature of water for yielding andgrowth of fish in extremely cold climatic condition of Srinagar in the month of February. The room temperature of greenhouse provides the thermal comfort and help to maintain the temperature of water of water pond for longer duration.

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Key Impacts of Iron Presence on Wastewater Treatment Through Subsurface Flow Constructed Wetlands: Critical Review

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ABSTRACT

Treatment effectiveness in subsurface vertical flow constructed wetlands is impacted by iron cations present in wastewater. Iron influences the makeup of microbial communities, pathways for the degradation of pollutants, and its interactions with organics and pollutants enhance the elimination of impurities by adsorption and precipitation. In artificial wetlands used for wastewater treatment, iron speciation is redox-dependent and involves changes to organic contaminants, phosphorus, nitrogen, and sulfur removal. But elevated iron levels can also result in the formation of iron oxides, which decrease water movement and substrate permeability. Effective design and operation of these wetlands depend on an understanding of the range of ideal iron concentrations for effective wastewater treatment.

Keywords: Iron cations, microorganisms, redox, wastewater, subsurface constructed wetlands.

1. Introduction

Constructed wetlands (CWs) are decentralized eco-systems designed and managed to treat wastewater by mimicking natural wetlands conditions [1,2] same as the physical, chemical, and biological processes [2]. CWs have been created as an alternative to traditional centralized wastewater treatment systems in the last several decades due to their economical and environmentally advantageous method of treating wastewater [1]. From the perspective of technical application, the design and construction of CWs has expanded from conventional basic models to numerous new combinations, technological modifications, and operations to increase the performance for pollution removal [3,4]. This is in line with the growing interest in CW technology [4].Researchers have previously demonstrated that CWs are viewed as a "black box" in the realm of wastewater treatment [5]. For instance, an extensive amount of research has been done on themicrobial transformations of carbon (C), nitrogen (N), phosphorus (P), and sulfur (S). Additionally, the dynamics

of new organic pollutants and heavy metals, such as antibiotics and pharmaceutical toxins, in constructed wetlands (CWs) remediation process extending sustainable application potential. The mechanisms behind these transitions have certainly become more apparent over the past few decades due to all of these evaluations [6]. Due to the fact that iron (Fe) is a necessary element, the prevention and mobility of Fe in CWs influences the geochemistry reaction of the other components in CWs in addition to taking part in numerous physiological processes including plant photosynthesis. Despite the observation of iron removal performance in certain constructed wetlands (CWs), especially those handling acid mine drainage, there is a lack of complete understanding regarding the dynamic mitigation and retention of iron in various emergent wetland layouts and intensive operations [7]. Further clarification is required about the relationship between iron cycling and the microbial transformations of all four key components and emerging pollutants in CWs. Conclusions on the fundamentals and mechanisms of the observed interactions with multiple different parameters throughout the research are hard to come by in this field of study [7,8].

The existence of Fe in diverse wastewater treated in CWs and its fundamental redox-controlled cycle in CWs with distinct setups and approaches to operation will subsequently be summed up. The relationships between the geochemical cycling of iron and the other components (C, N, P, and S) will next be covered in detail. Wetland plants' health response to Fe toxicity and deficiency in CWs created with particular treatment goals will be assessed. We will also address the function of iron plaque in the sequestration and translocation of other trace metals. Lastly, potential directions for future study on Fe in CWs will be highlighted.

2. IRON BIOGEOCHEMISTRY

One of the most abundant resources on Earth is iron, which comprises no less than 5% of the planet's crust. Since iron is a transition element, it can exist in a variety of oxidation states, ranging from -2 to +6, with +2 (soluble Fe^{2+}) and +3 (insoluble Fe^{3+}) being the most prevalent [9]. This segment will primarily elucidate the foundational aspects of ferrous biogeochemistry within the context of treatment wetlands and analogous environments. The discourse will encompass: (1) the oxidative transmutation of ferrous iron (Fe(II)) to ferric iron (Fe(III)), followed by its subsequent hydrolytic conversion to ferric hydroxide ($Fe(OH)_3$) or oxy-hydroxide; (2) the characteristic metabolic processes of select chemoautotrophic bacteria that precipitate hydroxides and oxides; (3) the aqueous interaction of ferric sulfate, a product of oxidation, yielding ferric hydroxide and sulfuric acid; (4) the nitrate-mediated oxidation of Fe(II); (5) the Feammox process; and (6) the chemical reduction of ferric oxide facilitated by the presence of sulfide.

3. Fe OCCURRENCE IN SEVERAL CWS EFFLUENTS

Wetland matrix and influent wastewater are the two primary sources of Fe in CWs used for wastewater treatment. Iron is an inevitable component of many wastewaters, such as landfill or acid mine drainage, domestic and municipal wastewater, and surface runoff, due to water's inevitable interaction with underlying geologic structures [7]. In this section, the levels of iron in different wastewaters will be compiled and discussed.

4. Fe PREVENTION AND ACCUMULATION IN CWS

Plant uptake and the sedimentation of Fe^{3+} precipitates are the two main processes involved in the preventive and retention of Fe in CWs. Numerous biotic and abiotic smaller processes of the sedimentation process are dependent on the depth and water flow path along the wetland's length. This section will address the immobility of roots and the Fe uptake performance of wetland plants [8,10]; subsequent sections will address the role of plants in regulating redox potential in the rhizosphere and guiding dynamic Fe modifications in CWs through the dispersion of oxygen and other exudates. This portion also includes the facts about how heavy rain affects remobilization and seasonal and diurnal variations in Fe reduction and oxidation in the CW bed, which contributes to our knowledge of the dynamic prevention and accumulation of Fe in CWs [11].

5. Fe CONCENTRATION LEVELSEFFECT ON PLANTS IN CWS

One crucial factor that must be taken into account for long-term operation in CWs is the condition of the wetland vegetation. One well-known element that is necessary for plant growth is iron. High quantities of iron in the reduced form (Fe^{2+}) or low bioavailability of Fe can affect the function of CWs in wastewater treatment by causing significant health symptoms in macrophytes [12]. The effect of a shortage of iron or toxicity to wetland plants in various scenarios, including types of CWs, operating tactics, and configurations, will be the main topic of discussion in this part.

6. ROOT WITH IRON PLAQUE GUIDED SEQUESTRATION AND HEAVY METAL/NUTRIENT TREATMENT

The deposition of ferruginous accretion upon the radicular epidermis of botanical entities, a phenomenon of commonplace occurrence within the confines of constructed wetlands (CWs) employed for the purification of sundry effluents, may constitute a decima of the aggregate radicular mass and extend its influence up to 5–50μm into the rhizospheric domain [13].The acidic milieu engendered by the extrusion of protons and organic exudates from the roots serves to solubilize ferrous ions from

the wetland's matricial components. The subsequent diffusion of these solubilized ferrous ions from anoxic regions to those replete with oxygen within the rhizosphere engenders the formation of this ferruginous accretion. Thus, the genesis of this plaque is a consequence of the oxidative transmutation of ferrous (Fe(II)) to ferric (Fe(III)) ions by the oxygen emanating from the roots, followed by the precipitation of ferric oxides upon the radicular surface [13,14].

The ferruginous plaque extant in natural ecosystems is generally characterized by a substantial specific surface area, attributable to its distinctive ferric phase and degree of crystallinity, and the possession of hydroxyl (-OH) functional group. These intrinsic attributes endow the plaque with the capacity to engage in reactions with diverse trace metals and nutrients, such as phosphorus, thereby exerting an influence on their biogeochemical cycles [15]. Previously, considerable scholarly endeavors have been directed towards elucidating the role of this ferruginous accretion in the sequestration of trace metals and the assimilation of nutrients, exemplified by phosphorus. Research conducted in oryza-cultivated soils and pristine wetlands has been comprehensively reviewed by the erudite works. Consequently, from the perspective of employing CWs for effluent treatment, the ensuing discourse shall elucidate and deliberate upon the potential role of this ferruginous plaque in trace metal sequestration and its interaction with phosphorus uptake [15,16].

7. MUTUAL INTERACTIONS AMONG Fe/P/S IN CWS

The governance of phosphorus is invariably among the most critical monitoring strategies in the process of effluent purification to mitigate the peril of eutrophication. The adsorption of phosphorus to the substratum within constructed wetlands (CWs) assumes a paramount role. The robust affinity of phosphate ions for ferric oxides engenders a preferential selection of ferruginous materials as the substratum in CWs. In particular, the judicious selection of specific industrial residua containing ferrum as substrata to augment phosphorus retention within the wetland matrix is emerging as a cardinal design and construction stratagem [2,17].

Moreover, within the well-rooted zones of a wetland matrix, there exist myriad spatial and temporal micro-scale redox gradients, a consequence of the liberation of oxygen from the radicular systems. These redox gradients in the radicular zones can concomitantly facilitate intricate interactions between diverse processes, as an illustration, ferrum-phosphorus sequestration and phosphorus release, ferrous reduction, and/or sulphate reduction [2,5,6,17]. The presence of sulphate may not be significantly problematic in CWs. However, the synergistic biogeochemical cycling of ferrum and sulphur, driven by redox dynamics, has been demonstrated to

influence both the availability and mobility of phosphorus in CWs.The subsequent discourse shall primarily elucidate the multifarious interactions of ferrum, phosphorus, and sulphur within the context of constructed wetlands [2,5,17].

8. ROLE OF Fe INTERACTIONS IN N REMOVAL IN CWS

Iron cycling is very important to the nitrogen biogeochemical cycle, even though it only involves the rotation of two primary chemical valences. Different nitrogen transformations were frequently combined with the oxidation and reduction of Fe. The importance of Fe cycling may be greater in situations when there are little organic carbon sources [17,18]. The processes of ammonium oxidation connected to dissimilatory reduction of iron oxides under anaerobic circumstances (Feammox) and denitrification based on nitrate-dependent Fe(II) oxidation will be mostly explored in this section.

9. PROSPECTIVE FOR FURTHERRESEARCH STUDIES

Future investigations and developments on the cycling of iron and its multiple interactions will be addressed here because of the intricacy of different wastewater contaminants and micro-redox differences in the root and rhizosphere in CWs.

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Seeing Blue With REDD+

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ABSTRACT

Today we become elated claiming the top position, it is but natural. We have defeated China at least on the population front to become the most populous country on planet earth. Planet Earth, more so, Mother Earth is facing severe challenges to sustain itself, forget about species living on it! The moment population pressure is felt, resultant is clearing of trees (read forests), claiming land from water bodies, removal of ponds and lakes for paving the way for so called 'development' by augmenting housing complexes, building approach roads, establishing work units to engage the population, utilizing woods for fuel or for furniture, and so on.

Keywords: REDD+, Earth, Rainforests

1. INTRODUCTION

Evergreen Rainforests in India are found in the Assam valley, foothills of eastern Himalayas, lower parts of Naga hills, Meghalaya, Manipur and Mizoram where rainfall is around 2300 mm annually. Tropical Rainforests are found in the Andaman and Nicobar Islands, the Western Ghats, and the greater Assam region in the north-east. Mizoram, with 88.93 % of forest cover has the highest forest cover in percentage terms, followed by Lakshadweep (84.56%). Madhya Pradesh is having largest total forest cover (77, 462 sqkm) in India, followed by Arunachal Pradesh (67,248 sqkm) and Chhattisgarh (55,586 sqkm).The challenges include uneven distribution, inaccessibility, uncontrolled deforestation without satisfactory regeneration, deficient transport and infrastructure facilities, overutilization, forest depletion caused by fires, and more.The demand for minerals and metals such as oil, aluminum, copper, gold and diamonds have rendered the rainforests destroyed to access the ground below. Developed nations relentlessly demand minerals and metals such as oil, aluminum, copper, gold and diamonds, which are often found in the ground below rainforests.

The majority of deforestation has occurred in Brazil, followed by Bolivia, Colombia, and Peru. The widespread loss of forest endangers the Amazon's ability to *mitigate climate change*. It also threatens the rain forest's rich biodiversity and the lives of millions of people who rely on the land to survive. In Sumatra (Indonesia),

more than 90% of rainforest has been degraded or destroyed, largely by palm oil production, mining, and farming. Forests are also cleared away to make way for roads, railways, towns, and cities. One third (34%) of the original tropical rainforests is gone, one third (30%) is degraded, and one third (36%) is still intact. Almost half (45%) of the remaining tropical rainforest is degraded. Between 2002 and 2019, the world lost 571 863 km², a tropical rainforest larger than the size of continental France. These are the startling findings from the first-of-its-kind State of the Tropical Rainforest report published in 2020.Deforestations are occurring because of:

- Power plants cutting and burning trees for energy
- Paper products being made from rainforest trees
- Subsistence farmers clearing land to make room for crops and cattle grazing
- Mining operations
- Governments and industries cutting forests for service and transit roads
- Hydroelectric projects that cause flooding

2. DISCUSSION

Considering the aforesaid facts drawn from available reliable sources, this presentation, 'Seeing Blue with REDD+', looks at three Is (Intuition, Inspiration and Inner Peace) that could be correlated to REDD+ (Reducing Emissions from Deforestation and Degradation) framework (under Paris agreement), the only global conservation system that preserves and protects rainforests by making them worth more alive than dead. Blue is a symbolic colour denotingcalmness, stability, inspiration, or wisdom, attributes that are needed for slowing the climate emergency. The "plus" after REDD refers to "the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries". The REDD+ framework enables rainforest nations to obtain economic value for carbon reductions resulting from actions they take to reduce deforestation and preserve their rainforests at national level. It was developed by rainforest countries under the United Nations Framework Convention on Climate Change (UNFCCC) to create financial value for the carbon stored in forests.

Rainforests produce about 20% of our oxygen and store a huge amount of carbon dioxide, drastically reducing the impact of greenhouse gas emissions. Massive amounts of solar radiation are absorbed, helping regulate temperatures around the globe. Taken together, these processes help to stabilize Earth's climate. Tropical rainforests are an extremely important *support system* for our entire planet for many reasons, including:

- They absorb carbon dioxide and release the oxygen we need for survival.
- They maintain the world's water cycle by adding water to the atmosphere which helps create clouds and hence rains.
- They are a source of food and medicine for humans, over one-fourths of modern medicines originate from tropical rainforests.
- They are home to more than 30 million species of plants and animals.

Some of the biggest threats are as below:

2.1 Demand for Beef, Soy and Palm Oil

The expansion of agriculture for beef, soy and palm oil is the biggest driver of deforestation, according to the World Wildlife Fund (WWF). The global greed for beef has led to slash-and-burn techniques to clear out land for cattle not only in rainforests, but in grasslands and savannas as well. WWF says beef and soy are driving more than two-thirds of the recorded habitat loss in South America's rainforests.

2.2 Demand for Wood and Building Materials

Much of the rainforest is cleared for logging interests, and unfortunately, a lot of it is done illegally. Timber from rainforest trees is used in construction, flooring, furniture and other in-demand items.

2.3 What could be the probable solutions?

1. Eating Less Beef, it also helps with energy efficiency, water pollution and methane reduction.
2. We need to check the Ingredient Label, and if these ingredients are seen, one should refrain from purchasing. Businesses are starting to feel the impact of eco-conscious buying, and choosing products that aren't contributing to deforestation will force companies to mend their approaches.
3. We need to buy Responsibly Sourced Materials and Foods. Mahogany, rosewood and ebony are all threatened woods that are driving rainforest destruction, and they are often used in furniture, flooring and even instruments. Also, one should stick to paper products that are made from recycled materials.
4. We need to support Indigenous Communities. Buying artisanal products made by indigenous people is a more unique way to support rainforest preservation. Research shows that indigenous people can achieve conservation results at least equal to that of the government.
5. We need to encourage Sustainable Agriculture; a lot of deforestation happens at the hands of poor farmers who are clearing land to provide for their families. A better way to address their needs is to advocate for *permaculture*, a cultivation technique that helps diversify farmers' crops and allows them to rely on renewable resources and a self-sustaining ecosystem. It also improves the soil in the rainforest.

6. We must reduce Carbon Footprint. Climate change is a huge threat to the rainforest and the species that inhabit it. While big corporations are the biggest contributors to greenhouse gas emissions, we too add to it, which means we can help reduce it, too. There are simple lifestyle changes we can make to reduce our carbon footprint, like driving less, consuming less energy, switching to renewable energy sources and recycling, etc.
7. We need to support organizations dedicated to Rainforest Preservation like, *Rainforest Alliance*: Works to bring farmers, forest communities, companies and consumers together to change the way the world produces, sources and consumes products from the rainforest; *Rainforest Foundation*: Equips indigenous people with tools, training and resources proven to reduce deforestation; *Rainforest Trust*: Works to safeguard critical habitats in the world's most biodiverse areas; *Cool Earth*: Protects the world's rainforests by giving control back to the people who live in them; *Survival International*: Strengthens the voices of indigenous leaders who are pivotal in Amazon Rainforest conservation efforts.

India's draft national REDD+ strategy aims at enhancing and improving the forest and tree cover of the country thereby enhancing the quantum of forest ecosystem services that flow to the local communities. Common carbon financed REDD+ activities include: Farmer training on sustainable land management and biodiversity conservation, non-timber forest product cooperatives like fruits, nuts, honey and cocoa, Unarmed Forest patrols to prevent illegal logging or poaching. India is fully committed to implement REDD+ activities, and, therefore, also to develop a National REDD+ Strategy to be implemented in accordance with the UNFCCC agreements. Ministry of Environment, Forest and Climate Change, Government of India initiated the preparation of National REDD+ Strategy in the year 2013. The major REDD+ activities in India include Reduction of emissions from deforestation; Reduction of emissions from forest degradation; Conservation of forest carbon stocks; Sustainable management of forests; Enhancement of forest carbon stocks.

As of August 2022, 624 individual REDD+ projects and programmes have been initiated in India with about two-thirds still active. The majority are paid for by multilateral and bilateral donors, including the World Bank and the UN-REDD initiative. REDD+ activities implemented by developing countries cover a forest area of about 1.35 billion hectares – approximately 62% of forest area in developing countries. Moreover, 17 countries reported a reduction of 11.6 billion tons of carbon dioxide, fulfilling the requirements to obtain results-based finance.

Case from India: KHASI HILLS COMMUNITY REDD+

Figure 1: KHASI HILLS COMMUNITY REDD+

The Khasi Hills Community REDD+ Project is India's first community-based REDD+ programme and will protect and restore 27,000 ha of cloud forest, in addition to preserving sacred groves and watersheds. The Khasi Hills Community REDD+ Project is situated in the East Khasi Hills District of Meghalaya. It engages ten indigenous Khasi governments (hima) with 62 villages. The area was chosen on the grounds of established Khasi traditions of forest conservation and legal right for natural resource management.

This REDD+ project aims to slow, halt and reverse the loss of community forests by providing support, new technologies and financial incentives to conserve existing forests and regenerate degraded forests. The project intervention area is a global biodiversity hotspot, providing habitat to many endangered species. Another primary objective of the project is to deliver long-term strategies to address extreme poverty facing rural families and is involved in the establishment of women-run microfinance institutions. The Khasi Hills Community Carbon project aims to reduce deforestation and restore forests at the same time. It does so by attacking the area's root causes of deforestation.

Therefore, the project focuses on reducing the number and severity of forest fires by establishing fire-lines which are maintained and monitored during the fire season by local communities. To reduce fuel wood collection, fast-growing woodlots are being established near villages to cover the demand for firewood. The project is manufacturing and installing fuel-efficient cook stoves and plans to subsidize the majority of the 5,000 households in the project area. As a result of this activity, fuel wood consumption and indoor smoke pollution will be reduced improving forest and family health.

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Trend Analysis of Ambient Noise Level in Lucknow City

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ABSTRACT

Noise generated by traffic and commercial activity like loudspeakers and DJs are the major sources of noise pollution. Lucknow city carries a million plus population engaged in industrial commercial as well as residential activity, the city has more than eleven major hospitals along with hundred plus miner hospitals as well as clinics, one major airport, dedicated four industrial areas, and one notified cantonment zone. The higher level of Noise is like parts of essential poisons. There are several activities causing noise pollution and its impact was observed on health and the environment. The study examines the concentrations of noise levels in different locations in Lucknow city. The datasets were collected continually the whole day through a continuous online monitoring system run and maintained by Uttar Pradesh Pollution Control Board and data was transmitted to the Central Pollution Control Board and average values were utilized to study the respective zone. The analysis is based on the empirical evidence and classification of various zone and their respective limits to regulate the strategic and future action plan to control noise levels.

Keywords: Government Policy, Health, Noise Pollution, Living hood activity, Noise Pollution Impact, Traffic.

1. INTRODUCTION

Noise may be classified as unwanted sound, undesirable and unpleasant sound, or sound that bothered or irritated and can lead to damage to the human ear or the human got irritated. The unwanted sound can cause several harmful effects to the Human, Vegetation, Animals, and Property. Some of the adverse effects of the high levels of noise may cause decreases in the performance efficiency of humans, Lack of concentration, Fatigue, may cause Abortion Causes, Temporary or Permanent Deafness, Effect on ecologically i.e. Vegetation- Poor quality of Crops, High Blood Pressure, and Effect on animals –can cause nervous system of animals. Lucknow district is located at 26° 30'- 27° 10' North latitude and 80° 30'- 81° 13' East longitude having a population 2817105 as per census 2011(census 2011) about 8836 units registered(DC MSME) as on 2011 different type of processing and goods

manufacturing unit as well as service provider area (notified as commercial area) for industry it include Eleven major Hospitals such as Dr. Shyama Prasad Mukharji Hospital (Civil), SGPGI, Lok Bandhu Hospital, RML Hospital, Balrampur Hospital, KGMU, Shahara Hospital, Medanta Hospital, Apollo Hospital, Command Hospital and Army Hospitals and more than hundred medium and small hospitals and clinic in its periphery. The Government of India (GoI) has notified the Ambient Noise standard to control noise pollution and betterment its citizen health. Singh, K.P. and Singha, S. (1983) defined noise as a type of atmospheric pollution in the form of waves. Ritovska et al., (2004) classification of noise polluter sources in various cities.

Table-1: Different sound levels and harmful effects

Noise level(dBA)	***Possible psychological and physiological effects may cause due to Noise Pollution***
65	Annoyance, mental and physical fatigue.
90	Very long exposure may cause permanent hearing loss.
100	Short exposure may cause temporary damage; long exposure may cause permanent damage.
120	Pain.
150	Immediate loss of hearing.

Source: Ogunsote (1991)

The Noise Pollution (Control and Regulation) Rules, 2000 defined the National Ambient Noise Quality Standards and categorized several categories i.e., Industrial Areas, Commercial Areas, Residential Areas, and Silence Zone to monitor and control noise pollution in India.

Table-2 :SCHEDULE

(See rule 3(1) and 4(1))

Ambient Air Quality Standards in Respect of Noise

Area Code	Category of Area / Zone	Limits in dB(A) L_{eq}*	
		Daytime	Night time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note: -

1. Day Night time: 22.00 to 6.00
2. A Silence zone is ademarcated area within 100 meters of hospitals, educational institutions, courts, religious places, or any other area that is notified by the competent authority.
3. Mixed categories of areas may be notified as one of the four above-listed categories by the competent authority.

* dB(A) L_{eq} denotes the time-weighted average of the sound level in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which Noise is measured.

"A", in dB (A) L_{eq}, denotes the frequency weighting in the measurement of Noise and corresponds to frequency response characteristics of the human ear.

L_{eq}: It is the energy mean of the Noise level (Sound Intensity) over a specified period.

Classification of Industrial Area, Commercial Area, Residential Area, and Silence Zone of Lucknow city.

Table-3: Categorization of Lucknow city in several areas/zone

Sl. No.	Location of Monitoring stations	Category of area/zone
1.	Talkatora	Industrial area
2.	Hazratganj	Commercial area
3.	S.G.P.G. I	Silence zone
4.	Indira Nagar	Residential area
5.	Gomti Nagar	Silence zone
6.	Chinhat	Industrial area
7.	IT College	Silence zone
8.	Aliganj	Commercial area
9.	Vibhuti Khand	Residential area
10.	CCS Airport	Commercial area

2. STUDY AREA

There is ten Real-Time National Ambient Noise Monitoring Networks (RTNANMn) have been installed in the Lucknow district in different areas/zone of the city covering Industrial, Silence, Residential, and Commercial areas. CPCB has installed ten (10) RTNANMn in Lucknow in different areas of the city covering Industrial (02 locations), Silence (03 locations), Residential (02 locations), and Commercial zone (03 locations).The data is transmitted to CPCB and UPPCB servers. Data is also made accessible to the public. Ambient Air Quality Standards in respect of Noise pollution have been notified based on area-specific viz. Industrial, Silence, Residential &Commercial area, and time specific viz. day and night time. Hence, trend analysis of noise level has been carried out concerning every location for day and night time. The data has been analyzed concerning each location in L_{eq} for day and night. The duration was taken from 2017 to 2020 (till May 2020).

Table-4: Effects on the population's health of Sound levels at night

Average night noise intensity effects on Health observed in the population level over a year $L_{night, outside}$	***Health effects observed in the population*** *(Note. The guidelines assume an average attenuation of 21 dB(A) between inside and outside noise levels.)*
Up to 30 dB	Although individual sensitivities and circumstances may differ, it appears that up to these levels, no substantial biological effects are observed. **Lnight, outside** of 30 dB is equivalent to the no observed effect level (NOEL) for night noise.
30 to 40 dB	Several effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, and arousal. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill, and the elderly) are more susceptible. However, even in the worst cases, the effects seem modest. **Lnight, outside** of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise
40 to 55 dB	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.
Above 55 dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, and a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

- **Location: Talkatora**

The station in Talkatora is located Near District Industries Centre in Talkatora Industrial Area. The monitoring station is coming under the Industrial category. It has been observed that the noise level found always meets the stipulated norms for industrial are as during the day as well as at night during 2017, 2018, 2019, and 2020.

The minimum value from 2017 to 2019 was observed at 58.667 dB (daytime) in November 2018 and 23.792 dB (night time) in July 2019, which reached the maximum value of 75.024 dB (daytime) in December 2017 and 76.028 dB (night time) in July2018. It indicates that the maximum value during night time is slightly higher than during daytime. Further, in 2020, the minimum value was observed 52.587 dB in January and 47.202 dB in April during the day and night time. Similarly, the maximum value was observed as 80.197 dB in February and 78.371 dB in January for day and night time respectively.

The trend of noise level for 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in Figure 1.

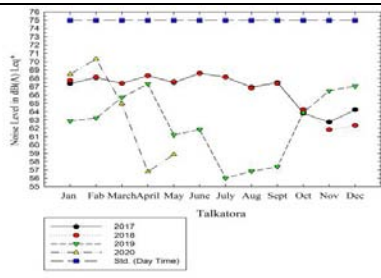

Figure 1: Trend analysis of Talkatora Location Daytime

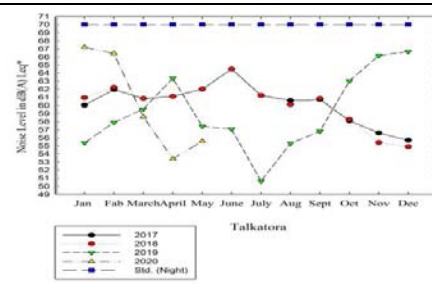

Figure 2: Trend analysis of Talkatora Location Night time

- **Location: Hazratganj**

The station in Hazratganj is located at DRM Office. The monitoring station is coming under a commercial area. Hazratganj is also called as the center point of Lucknow and it is the main commercial hub of Lucknow City. It has been observed that the Noise level found mostly exceeded the notified Standards for commercial are as during the day as well as at night during 2017, 2018, and 2019 except for August, September, and October in 2018 and August, and September in 2017. A reducing trend observed in 2020 as the sound level reduces from January to April due to Lockdown and again it exceeds in May as Lockdown was relaxes in May.

The minimum value **on a particular date** from 2017 to 2019 was observed 28.067 dB (daytime) in July 2017 and 27.009 dB (night time) in August 2018, which reached the maximum value of 85.748 dB (daytime) in August 2019 and 83.468 dB (night time) in September 2019. Further, in 2020, the minimum value **on a particular date** was observed 52.77 dB in April month and 46.57 dB in March during the day and night time. Similarly, the maximum value was observed as 76.25 dB in May and 78.03 dB in January for day and night time respectively.

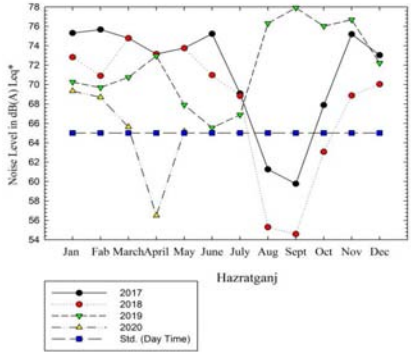

Figure 3 : Trend analysis of Hazaratganj location Daytime

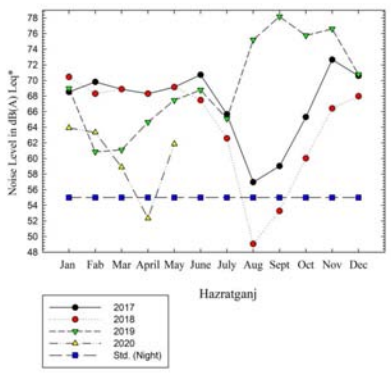

Figure 4: Trend analysis of Hazaratganj Location Night time

- **Location: SGPGI**

The station in SGPGI is located Near Railway Reservation Counter in SGPGI, Raebareilly Road. The monitoring station is coming under Silence Zone. It has been observed that the Noise level found always exceeded the notified Standards for the Silent zone during the day as well as at night during 2017, 2018, and 2019 except September 2019. It was also observed that the sound level exceeds very sharply in 2020. It may be due to the excessive movement of vehicles due to the pandemic COVID 19 and construction activity near the monitoring station.

The minimum value **on a particular date** from 2017 to 2019 was observed 15.91dB (daytime) in September 2019 and 6.33 dB (night time) in September 2019, which reached the maximum value of 76.86 dB (daytime) in June 2018 and 77.475 dB (night time) in August 2019. It indicates that the minimum value during day and night time in consecutive three years (2017, 2018, and 2019) not meeting the notified Standards anytime. Further, in 2020, the minimum value **on a particular**

date was observed 44.62 dB in January and 36.50 dB in March during the day and night time. Similarly, the maximum value **on a particular date** was observed as 92.87 dB in March and 98.06 dB in May for day and night time respectively.

The trend of Noise levels for 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in the Table below:

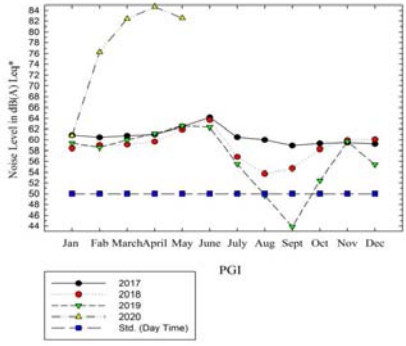

Figure 5: Trend analysis of PGI Location Daytime

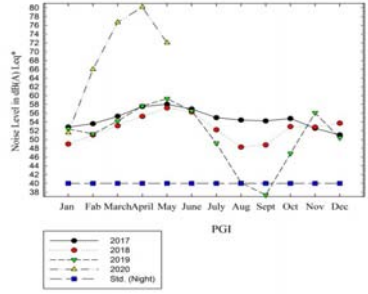

Figure 6: Trend analysis of PGI Location Night time

- **Location: Indira Nagar**

The station in Indira Nagar is located at Sector-11, Near RLB Memorial School. The monitoring station is coming under Residential Area. It has been observed that the Noise level found always exceeded the notified Standards for Residential Areas during the day as well as at night during 2017, 2018, and 2020. But; it meets with the notified Standards since 2019. The higher values in 2020 may be due to the start of construction activity in nearby areas.

The minimum value **on a particular date** from 2017 to 2019 was observed 39.354 dB (daytime) in October 2019 and 30.012 dB (night time) in January 2019, which reached the maximum value of 63.547 dB (daytime) in February 2018 and 66.091 dB (night time) in November 2019. Further, in 2020 the minimum value was observed 40.04 dB in January and 37.86 dB in February during the day and night time. Similarly, the maximum value **on a particular date** was observed as 112.43 dB in March and 112.44 dB in March for day and night time respectively.

The trend of Noise levels for 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in the Table below:

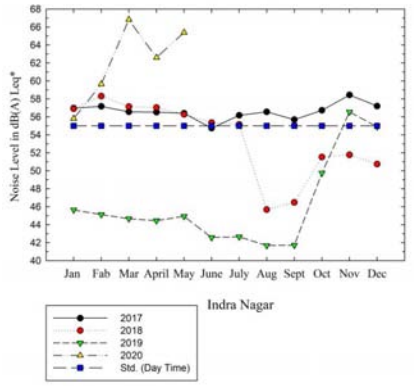

Figure 7: Trend analysis of Indira Nagar location Daytime

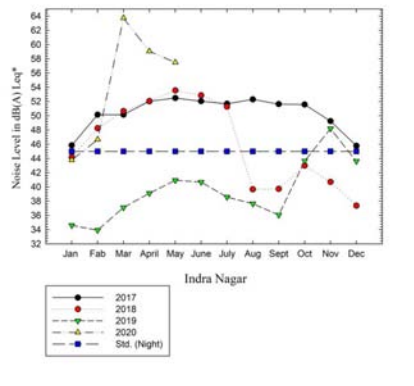

Figure 8: Trend analysis of Indira Nagar Location Night time

- **Location: Gomti Nagar**

The station in Gomti Nagar is located at RML Hospital, Vibhuti Khand, Gomti Nagar. The monitoring station is coming under the Silence zone/area. It has been observed that the concentration of Noise level found always exceeded the notified Standards for the Silence zone during the day as well as at night during 2017, 2018, 2019, and 2020.

The minimum value **on a particular date** from 2017 to 2019 was observed 61.293 dB (daytime) in October 2017 and 54.746 dB (night time) in January 2018, which reached the maximum value of 74.902 dB (daytime) in May 2018 and 82.561 dB (night time) in April 2018. It indicates that the minimum value during day and night time in consecutive three years (2017, 2018, and 2019) not meeting the notified Standards anytime. Further, in 2020, the minimum value was observed 55.20 dB in March and 50.40 dB in April during the day and night time. Similarly, the maximum value **on a particular date** was observed as 69.98 dB in May and 63.79 dB in February for day and night time respectively.

The trend of Noise levels for 2017, 2018, and 2019 indicates only a slight deviation. It can be seen in the Table below:

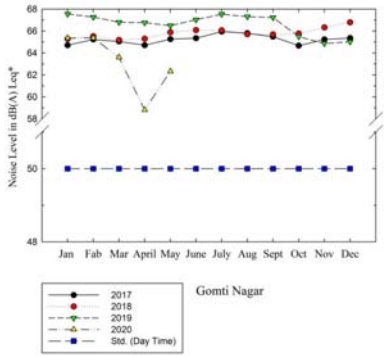

Figure 9: Trend analysis of Gomti Nagar Location Daytime

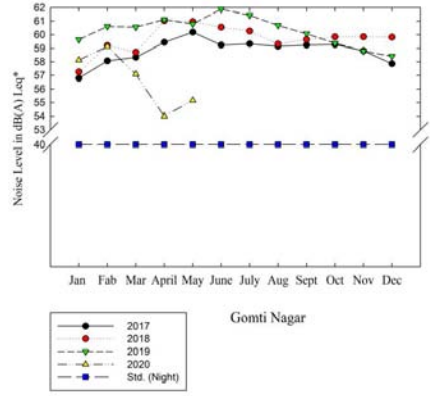

Figure 10: Trend analysis of Gomti Nagar Location Night time

- **Location: Chinhat**

The station in Chinhat is located in an Industrial Area. The monitoring station is coming under Industrial Area. It has been observed that the Noise level found always meets the notified Standards for Industrial Are as during the day as well as at night during 2017, 2018, 2019, and 2020.

The minimum value **on a particular date** from 2017 to 2019 was observed 50.253 dB (daytime) in March 2019 and 43.176 dB (night time) in November 2018, which reached the maximum value of 74.412 dB (daytime) in May 2017 and December 2018 and 66.613 dB (night time) in March 2019. Further, in 2020 the minimum value was observed 55.93 dB in March and 46.47 dB in January during the day and night time. Similarly, the maximum value **on a particular date** was observed as 76.55 dB and 69.92 dB in May for day and night time respectively.

The trend of average Noise levels in 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in the Table below:

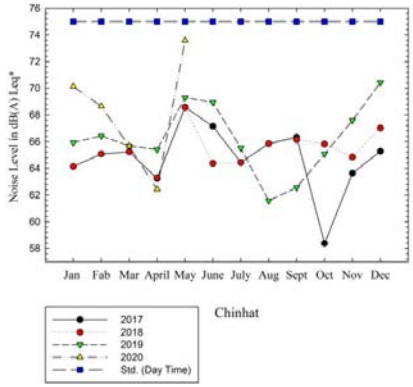

Figure 11: Trend analysis of Chinhat Location Daytime

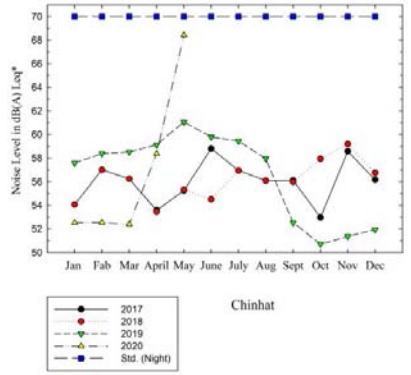

Figure 12: Trend analysis of Chinhat Location Night time

- **Location: IT College**

The station in IT College is located at Nirala Nagar. The monitoring station is notified under the Silent zone/area. It has been observed that the concentration of Noise level found always exceeded the notified Standards for Silent Zone during the day as well as at night during 2017, 2018, 2019, and 2020.

The minimum value **on a particular date** from 2017 to 2019 was observed 55.816 dB (daytime) in December 2018 and 53.717 dB (night time) in November 2018, which reached the maximum value of 83.725 dB (daytime) in December 2019 and 91.402 dB (night time) in August 2017. It indicates that the minimum value during day and night time in consecutive three years (2017, 2018, and 2019) not meeting the notified Standards anytime. Further, in 2020, the minimum value was observed 52.87 dB and 51.37 dB in March during the day and night time. Similarly, the maximum value **on a particular date** was observed as 69.04 dB in January and 62.97 dB in March for day and night time respectively.

The trend of average Noise levels for 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in the Table below:

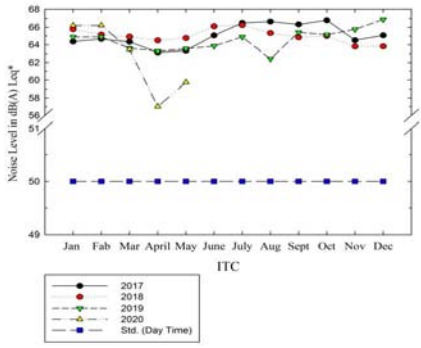

Figure 13: Trend analysis of IT Collage Location Daytime

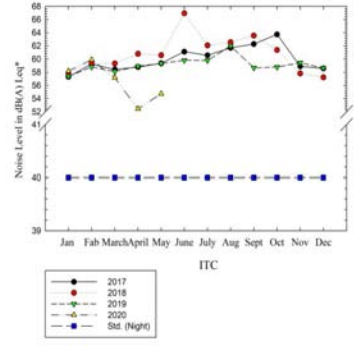

Figure 14: Trend analysis of IT Collage Location Night time

- **Location: Aliganj**

The station in Aliganj is located at Sector-J, Aliganj. The monitoring station is coming under the commercial category. It has been observed that the Noise level found always exceeded the notified Standards for commercial zone/categories during the day as well as at night during 2017, 2018, and 2019.But; it meets with the notified Standards since March 2020.

The minimum value on a particular date from 2017 to 2019 was observed 71.405 dB (daytime) in May 2019 and 61.919 dB (night time) in August 2019, which reached the maximum value of 80.998 dB (daytime) in March 2018 and 83.98 dB (night time) in June 2018. It indicates that the minimum value during day and night time in consecutive three years (2017, 2018, and 2019) not meeting the notified Standards anytime. Further, in 2020, the minimum value was observed 50.638 dB and 48.404 dB during the day and night time in May respectively. Similarly, the maximum value **on a particular date** was observed as 67.234 dB in January and 64.093 dB in February for day and night time respectively.

The trend of average Noise levels for 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in the Table below:

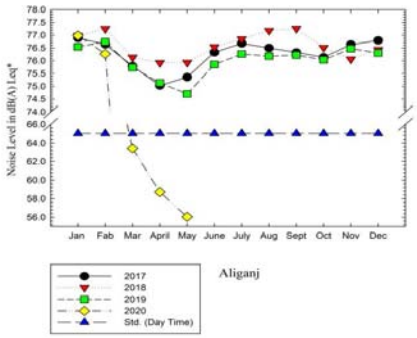

Figure 15: Trend analysis of Aliganj Location Daytime

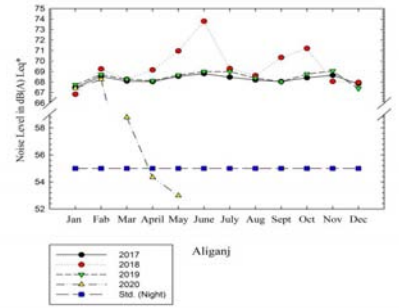

Figure 16: Trend analysis of Aliganj Location Night time

- **Location: Vibhuti Khand, Gomtinagar**

The station in Vibhuti Khand is located at Uttar Pradesh Pollution Control Board, Head Office, Building No. TC-12 V, Vibhuti Khand, Gomti Nagar. The monitoring station is coming under Residential Area. It has been observed that the Noise level found always exceeded the notified Standards for Residential Are as during the day as well as at night during 2017, 2018, 2019, and 2020 (Till May 2020).

The minimum value **on a particular date** from 2017 to 2019 was observed 58.888 dB (daytime) in August 2018 and 51.579 dB (night time) in December 2019, which reached the maximum value of 89.644 dB (daytime) and 93.457 dB (night time) in December 2019 respectively. It indicates that the minimum value during day and night time in consecutive three years (2017, 2018, and 2019) not meeting the notified Standards anytime. Further, in 2020, the minimum value was observed 54.134 dB and 50.238 dB during the day and night time in April month. Similarly, the maximum value **on a particular date** was observed as 71.616 dB in March and 66.644 dB in May for day and night time respectively.

The trend of average Noise levels for 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in the Table below:

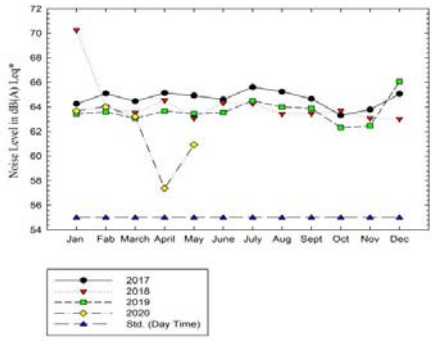

Figure 17: Trend analysis of Vibhuti Khand Gomti Nagar Location Daytime

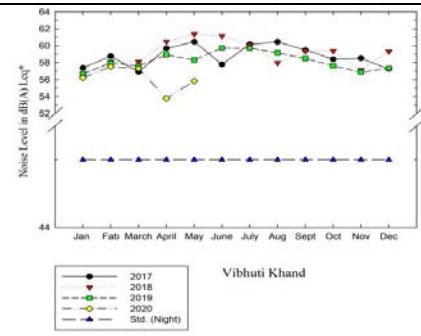

Figure 18: Trend analysis of Vibhuti Khand Gomti Nagar location Night time

- **Location: Chaudhary Charan Singh (CCS) Airport**

The station in CCS Airport is located at Amausi. The monitoring station is coming under Commercial Area. It has been observed that the Noise level found always meeting the notified Standards for Commercial Areas in the daytime, but not meeting the norms at night during 2017, 2018, and 2019. In 2020, Noise level meeting the notified Standards after March onwards.

The minimum value **on a particular date** from 2017 to 2019 was observed 55.521 dB (daytime) in January 2018 and 50.893dB (night time) in January 2017, which reached the maximum value of 85.390 dB (daytime) and 94.075 dB (night time) in December 2019 respectively. Further, in 2020, the minimum value was observed 52.975 dB and 47.439 dB during the day and night time in April month respectively. Similarly, the maximum value **on a particular date** was observed as 69.968 dB and 63.538 dB for day and night time in February month respectively.

The trend of average Noise levels for 2017, 2018, and 2019 indicated only a slight deviation. It can be seen in the Table below:

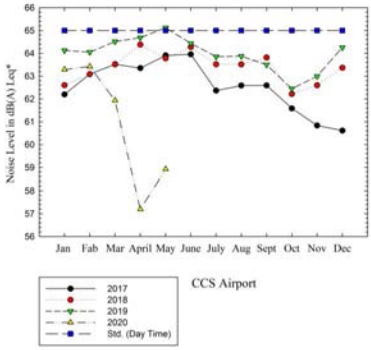

Figure 19: Trend analysis of Chaudhary Charan Singh (CCS) Airport Location Daytime

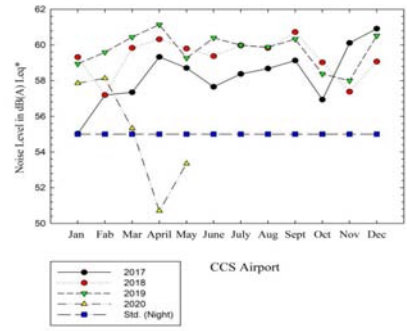

Figure 20: Trend analysis of Chaudhary Charan Singh (CCS) Airport Location Night time

3. CONCLUSION

For trend analysis undertaken in the period 2017-19, it is noted that except for Indira Nagar, there has been no appreciable change. In the case of Indira Nagar, the probable reason might be restricted traffic on account of construction / restricted movement during Lucknow Metro construction activities. The status of % variation in Noise level from 2017 to 2019 is as below:

S. No.	Location	Area Category	% Reduction/ Deviation (+Reduction and – increasing)
1	Talkatora	Industrial Area	6.29 (Daytime)
			2.03 (Night time)
2	Hazratganj	Commercial	1.08(Daytime)
			3.51(Night time)
3	S.G.P.G. I	Silence	6.44(Daytime)
			6.88(Night time)
4	Indira Nagar	Residential	18.32(Daytime)
			21.54(Night time)
5	Gomti Nagar	Silence	2.10(Daytime)
			2.48(Night time)
6	Chinhat	Industrial	2.57(Daytime)
			1.44(Night time)
7	IT College	Silence	0.83 (Daytime)
			1.43 (Night time)
8	Aliganj	Commercial	0.32 (Daytime)
			0.24 (Night time)
9	VibhutiKhand	Residential	1.56 (Daytime)
			0.95 (Night time)
10	CCS Airport	Commercial	2.31(Daytime)
			2.48(Night time)

a. Trend analysis of the Noise level of Lucknow City from 2017 to 2019 based on the Real Time Noise Monitoring Stations at 10 locations indicates mostly slight reduction or increase (reduction to 6.88 and increase upto 2.57 %) in the Noise level except Indira Nagar (Residential Zone), where reduction is observed 18.32%(day) and 21.54%(night).
b. The increase or decrease trend in the Noise level is not significant and change is observed only for upto 02 dB from 2017 to 2019 except in Indira Nagar where the decreasing trend is observed upto 10 dB.
c. An increasing trend was observed especially in the Commercial zone. While most of the place decreasing trend was observed.
d. The Noise level in Residential, Commercial, as well as the silent zone, is mostly found to exceed the notified Standards.
e. In the case of Industrial Areas, the Noise level is always found to conform to notified standards in Day as well in Night time.

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Polymer and Its Degradation

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ABSTRACT

Polymers are macromolecules having very high molecular masses. They are made up of smaller units called monomers, these monomers join by covalent bonds to form long chains. Polymer degradation is the complex process in which polymers are broken down into smaller molecules. Detailed information about polymers and their degradation, including various types, is provided, offering crucial insights that will help readers in multiple ways. The motivation behind this work stems from the critical need to develop eco-friendly material and reduce environmental impact.

Keywords: polymer degradation, monomers, eco-friendly, polyethylene, hydrolysis.

1. INTRODUCTION

Large molecules of very high molecular masses consisting of many repeated subunits (monomers) are known as polymers. These monomers are interconnected by covalent bonds. The process in which monomer molecules are joined together to form a polymer is known as polymerisation. Nature of the monomer unit, the arrangement and length of the polymer chain significantly affects the properties and behaviour of polymers. Polymers can either occur naturally in plants and animals or be synthetically created by humans. They touch almost every aspect of modern life. Computers, water bottles, auto-parts, toys and textile fibres all contain polymers. They also play a crucial role in various industries including packaging, medical, automative, agriculture etc. Some of the popular polymers which are used for manufacturing include polyethylene and polypropylene. Their molecules consist of anywhere from 10,000 to 200,000 individual monomers.

In the following represented example, multiple styrene monomers are polymerised to form a lengthy chain polymer known as polystyrene. The squiggly line show that the polymer molecule continues further in both directions at the left and right ends.

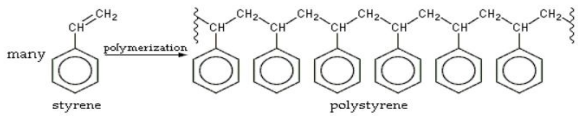

Figure 1: Process of Polymerization

Polymers can be classified on the basis of their source, polymerization method, structure and properties. Based on the source, natural and synthetic polymers are the two main type of polymers. Polymers that are found in living organism such as protein, DNA, cellulose etc are known as natural polymers whereas polymers that are synthesized through chemical process such as nylon, polystyrene, polypropylene etc are known as synthetic polymers.Based on polymerisation, Main polymers include addition and condensation polymers.Addition polymers are formed by the linking of monomers without releasing any small molecule whereas elemination of small molecules like water takes place in case of condensation polymers. Polypropylene and nylon are the examples of addition and condensation polymers respectively. Structurally, Polymers can be linear, branched and cross-linked. In case of linear polymer, Monomers are arranged in a straight chain. Branched polymers have side chains branching off the main chain. Interconnection of chains takes place in cross-linked polymers which enhances their strength and stability. Furthermore, thermoplastics, thermosetting polymers and elastomers are categorised based on the property of polymers. Thermoplastics soften and can be reshaped on heating whereas thermosetting polymers harden permanently when subjected to heat and cannot be reshaped. Elastomers return to their original shape after reformation.

2. POLYMER DEGRADATION

A complex process in which polymeric material loses its original properties on its exposure to environmental conditions and mechanical load is known as polymer degradation. Generally, degradation is an unwanted process but in certain cases, controlled polymer degradation is useful. For example, it can be used in the recycling and natural degradation of waste polymer (1). The cleavage of macromolecules is an important part of the polymer degradation. If monomers are end products, the process is known as depolymerization which is the reverse of polymerization (2). When cleavage of macromolecules is not the primary process in degradation, Then, it is known as polymer aging or corrosion (3).Active centers are formed at the beginning of the process of polymer degradation. After this, radicals are created in polymer by various processes and the type of polymer degradation is determined by the method of initiation used. A general reaction representing the formation as well as degradation of polymers is given below:

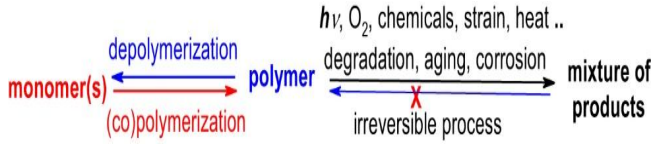

Figure 2: formation and degradation of polymers

3. TYPES OF POLYMER DEGRADATION

There are mainly five types of polymer degradation which includes thermal degradation, photooxidation, hydrolysis, biodegradation and chemical degradation. A detailed explanation of each type is mentioned below:

4. THERMAL DEGRADATION

The type of degradation in which the intensity of vibrations within the molecule increases with an increase in temperature is known as thermal degradation. In this, simultaneous involvement of other compounds such as oxygen does not take place(4) (5). It means that even at the absence of air the polymer will begin to degrade if the temperature is high enough. Thermal oxidation usually occurs atsomewhat lower temperature as compared to this process (6).An example of this type of degradation is the thermal degradation of poly vinyl chloride.

5. PHOTO-OXIDATION

The process in which the surface of polymers degrade due to the combined action of light and oxygen is known as photo-oxygen. In this process, the chain of polymer breaks and the resulting material becomes increasingly brittle. This results in mechanical breakdown and ultimately the creation of microplastics. This process is called photo-tendering in the context of textiles.Exposure of a plastic product to sunlight detrimentally affects its useful life. Chalking and cracking occurs during this process and the colour of the polymer is also changed along with the loss of physical properties.

For example: When polystyrene is subjected to UV irradiation in the presence of air, it undergoes a rapid yellowing and a gradual embrittlement.

6. HYDROLYSIS

The major degradation mechanism wherein the vulnerable bonds in polymer chain react with water molecule and form smaller chains after breaking up is known as hydrolysis. It includes various factors like chemical reactivity of polymer bonds, polymer-water thermodynamic interactions, diffusion rates of reactants and products including water, polymer bonds, small polymer segments etc. This process can be both harmful and useful. For example: One of the most harmful degradation process is the hydrolytic chain scission of the ester linkage in polyester because during this the molecular weight of the polymer is reduced and its mechanical properties are lost as well. On the other hand it plays a very important role in controlled drug-delivery systems.

7. BIODEGRADATION

The chemical decomposition of a substance which is obtained by the enzymatic work of microorganism that resulted in a change in chemical composition as well as in structural and mechanical properties is known as biodegradation. Metabolic products such as biomass, methane, carbon dioxide and water are formed at the end of the process. These products are eco-friendly and contributes in reducing the environmental pollution.There are mainly four stages of biodegradation of a polymeric material - (bio)deterioration, (bio)fragmentation, assimilation, and mineralization.

8. CHEMICAL DEGRDATION

The processin which polymers are broken down into monomers through the chemical reactions is known as chemical degradation. The extent of chemical degradation is affected by various factors which includes the presence of additives, humidity,chemical structure of the polymers,presence of catalysts and temperature. An example of chemical degradation is the degradation of poly-vinyl chloride.

9. IMPORTANCE OF POLYMER DEGRADATION FOR THE ENVIRONMENT

The environmental impact of plastics and many other synthetic materials is incredibly affected by the process of degradation. There are various reasons for which the proper understanding and management of polymer degradation is important. Some of them are mentioned below with their brief explanation.

9.1 Environmental Pollution

Microplastics are formed by the non-degradable and slowly degradingpolymers. These microplastics are small fragments that contaminate air, water bodies and soil. They can also be ingested by marine life and enter the food chain which creates health hazards for both animals and humans. Furthermore, Harmful chemicals or additives are also released by some polymers during their degradation. In order to minimize the release of these toxic substances,we must use the proper degradation mechanism.

9.2 Design of Sustainable Polymers

Understanding how polymers degradeallows the designation of eco-friendly polymers that decompose under specific conditions without causing environmental harm.

For example: Developing polymers that break down in composting environment but remain stable during their useful life.

The proper knowledge of polymer degradation also helps in performing lifecycle analysis of polymers ensuring their environmental footprint is minimized from production to disposal.

9.3 Waste Management And Reduction

Biodegradable polymers reduces the aggregation of plastic waste in the environment. They break down into natural substances biomass, carbon dioxide and water through the action of microorganism. Apart from this, effective degradation of polymers plays an extremely important role in landfill reduction. It reduces the volume of wastes in landfills which reduces the space needed for landfill and also helps in waste management.

9.4 Resource Recovery And Recycling

Polymer degradation also helps in developing efficient chemical recycling methods. Polymers are broken down into monomers which are then reused to create new materials. This process conserves resources and reduces the demand for virgin raw material. Easier recovery and recycling also requires degradable polymers which promotes a circular economy where the materials are reused and recycled rather than discarded.

9.5 Regulation And Policy

Regulations and standards for polymer degradation are set by the government and environmental agencies. It ensures that the materials which are used in consumer products are environment friendly. Some examplesfor these kinds of products include single use plastic, mandates for biodegradable plastics etc.

Policies that promote the development and use of degradable polymers can incentivize innovation in materials science, leading to the creation of new, sustainable materials.

10. CONCLUSION

Ultimately, this research has provided a comprehensive examination of polymers specifically emphasizing on their categorization and classification. It is proved that polymers represent a highly sophisticated field of materialand are found in almost all the materials used in our daily lives. Furthermore, a detailed information the degradation of polymers along with its types including thermal degradation, photo-oxidation, hydrolysis, biodegradation and chemical degradation is mentioned in this

article.The importance of polymer degradation in preserving the environment is also covered in this study.

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RFID based Smart Electronic Voting Machine

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ABSTRACT

This study describes the smart electronic voting machine using RFID. As the elections provides a strong influence on the people and made the prominent feature of the country, in India where anyone can cast their vote according to their requirements. This project proposes a good idea of making a smart voting machine that is very good for election process comparing that of from traditional voting machine where ballot papers are used. This project has RFID sensor that is very effective to provide the security to the election process as by the use of RFID no one can misuse it and only the authorized person is able to see the results by using the RFID reader or card.

Keywords: RFID, Arduino UNO, LCD screen, Buttons.

1. INTRODUCTION

The EVMs were commissioned in 1989 by Election Commission of India in collaboration with Electronics Corporation of India Limited. The EVMs were first used in 1982 in the by- election to North Paravur Assembly Constituency in Kerala for a limited number of polling stations. EVMs reduce the time in casting a vote and declaring the results.

In recent years, the introduction of electronic voting machines (EVMs) has revolutionized the landscape of electoral systems across the globe. With the advent of digital technology, traditional paper-based voting methods have gradually given way to more efficient and sophisticated electronic alternatives. EVMs represent a significant advancement in the realm of democracy, aiming to streamline the voting process, enhance accuracy, and bolster the integrity of elections. By replacing cumbersome paper ballots with intuitive touch screen interfaces or keypad inputs, EVMs offer voters a user-friendly experience while facilitating swift and precise tabulation of votes.

2. OBJECTIVE

The main objective of our project is to design and make a smart electronic voting machine that reduces the time usage on traditional voting machine and provides a easiness in casting a vote and provide the results in no time. This project helps others to cast their vote according to their needs.

3. WORKING PRINCIPLE

EVM operate on a simple principle of digital recording and tabulation. When a voter presses a button or touches a screen to cast their vote, the machine records their choice digitally. At the end of the voting period, the EVM tallies up all the counts of the votes and produces the final count. This system aims to provide a faster, more accurate and efficient way of conducting elections compared to traditional paper methods. The working principle of electronic voting involves several key steps:

- Voter authentication
- Ballot selection
- Vote recording
- Verification
- Vote tallying
- Prevention of duplicate voting
- Secure transmission
- Anonymity
- Audit ability and transparency
- Accessibility features
- Compliance and certification

3.1 Voter Authentication

Each eligible voter is issued a unique RFID card or tag, containing their voter information and a unique identifier. Before voting, the voter presents this RFID card to the EVM. RFID Reader: The EVM is equipped with an RFID reader, which reads the information stored on the RFID card when the voter presents it.

3.2 Verification

The EVM verifies the authenticity and eligibility of the voter based on the information read from the RFID card. This verification process typically involves checking the voter's registration status, identity, and any other relevant criteria defined by election authorities.

3.3 Prevention of Duplicate Voting

RFID technology helps prevent duplicate voting by ensuring that each RFID card can only be used once. Once a card is used to cast a vote, it cannot be used again in the same election.

3.4 Secure Transmission

After the voter is authenticated, they interact with the EVM's interface to cast their vote electronically. The vote data is securely transmitted and stored within the EVM's internal memory or a secure external server.

3.5 Anonymity

The EVM ensures the secrecy of the ballot by not associating the RFID tag information with the actual vote cast. This ensures that each vote remains anonymous and cannot be traced back to the individual voter.

3.6 Audit ability and Transparency

EVMs using RFID technology often include features for auditing and verifying the integrity of the voting process [5]. This may include the ability to generate paper audit trails or cryptographic methods for ensuring the accuracy of the vote count.

3.7 Security Measures

EVMs employ various security measures to protect against tampering, unauthorized access, and manipulation of vote data. These measures may include encryption, tamper-evident seals, physical security protocols, and strict access controls.

3.8 Accessibility Features

EVMs using RFID technology may incorporate accessibility features to accommodate voters with disabilities, such as audio instructions, tactile interfaces, or alternative methods for presenting RFID cards. 9. Compliance and Certification: EVMs using RFID technology must adhere to strict standards and regulations set forth by election authorities to ensure fairness, transparency, and accuracy in the voting process. They often undergo rigorous testing, certification, and auditing processes before being deployed in elections.

By integrating RFID technology into electronic voting machines, election authorities aim to enhance the efficiency, security, and trustworthiness of the voting process while ensuring the integrity and secrecy of each vote cast.

4. BLOCK DIAGRAM

The block diagram consists of RFID tag in which RFID card or reader, DC power supply, buzzer, Arduino UNO, polling switching.

4.1 RFID

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. An RFID system consists of a tiny radio transponder called a tag, a radio receiver, and a transmitter. When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. This number can be used to track inventory goods. Passive tags are powered by energy from the RFID reader's interrogating radio waves. Active tags are powered by a battery and thus can be read at a greater range from the RFID reader, up to hundreds of meters.

4.2 Arduino

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2010. The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment) [7], via a type B USB cable. It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a rectangular 9-volt battery.

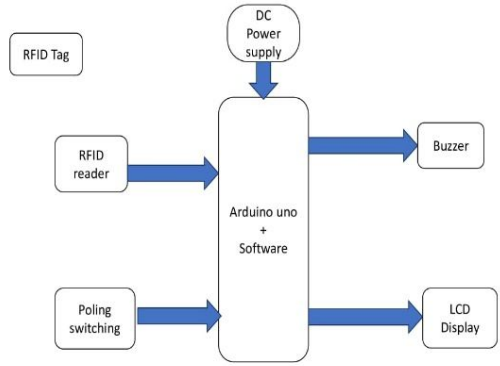

Figure 1: The Arduino Uno Flow chart

4.3LCD Display

A LCD display is a type of alphanumeric liquid crystal display (LCD) module that is commonly used in electronic devices such as digital clocks, calculators, and small

embedded systems. The refers to the number of characters and lines that the display can show at once - 16 characters can be displayed on each of the 2 lines. The LCD display typically consists of a backlight, a controller chip [9], and a row of pins for connecting to a microcontroller or other electronic device. The display uses a parallel interface to communicate with the controlling device, with each character or command sent as a series of data and control signals.

5. CIRCUIT DIGARAM

Figure shows the circuit diagram of smart electronic voting machine. It shows the overall connection of all the components with each other and how they are performing their functions individually.

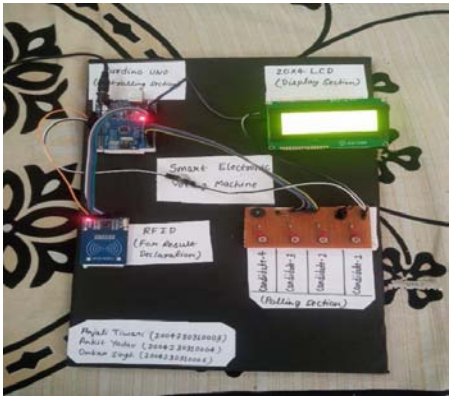

Figure 2: The circuit diagram of smart electronic voting machine

6. CONCLUSIONS

This project provides others to allow them to vote independently, the implementation of smart electronic voting machines leveraging RFID technology presents a promising avenue for modernizing electoral processes. Throughout this study, we have explored the numerous advantages that RFID-based systems offer, including enhanced efficiency, accuracy, and accessibility for voters of all backgrounds. By utilizing RFID tags embedded in voter cards or other identification mediums, the process of authentication and ballot casting can be streamlined, reducing waiting times and improving overall voter experience.

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Optimization Technique Used For Solar Dryers With Thermal Storage Using Taguchi Method

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ABSTRACT

Solar energy is the largest renewable energy kind in the world. The current article contains the optimization approach used by the Taguchi method for solar dryers with thermal storage. Ginger (Zingiber officinalis, Roscoe, for example), has powerful anti-inflammatory properties including oleoresin. A lot of attention has been paid to Supercritical Fluid Extraction (SFE) since it is inert, cheap, readily accessible, Oduor less and tasteless, favorable to the environment. Various experimental studies to decrease time consumption have been carried out and increase solar dryer output. Solar dryers are optimized to improve their functioning precision and to reduce the drying time and cost. Several methods may be utilized to get optimal outcomes to optimize the entire setup. Taguchi optimization technique has been applied for the solar dryer experimental research in dry gingers in the current work. The findings revealed the optimum setup for dry ginger consisting of air speed, air flow and humidity.

Keywords: Optimization, Solar Dryers, Thermal, Ginger, Taguchi Method.

1. INTRODUCTION

Drying and dehydrating is the most important everyday route where dehydration removes the moisture accessible on foodstuffs which enhance the lives of dry goods compared to fresh foodstuffs. Some changes take occur in the drying process both chemical and physical and complicated when the estimate relies on many Temperatures, humidity, and time variables, etc. The drying process requires strict content monitoring of moisture under direct sunlight. This component assesses the dehydration of foodstuffs.

Some agricultural goods have an extremely high humidity ratio and thus seem to be fresh and edible. In developing nations, adding, and reducing water with considerations of decaying variables is one of the few components that the loss of such goods should rely primarily on tropical and sub-tropical areas. These losses are

primarily due to a lack of storage, harsh handling, transit, and many other causes. While it may be said that nations moving towards developing countries can lower agricultural and food-related losses and of improving the quality of the goods to be dried.

Energy storage not only contributes significantly to energy conservation but also improves energy system reliability and performance. Each system has a gap between energy supply and demand for energy. Energy storage may offset this mismatch and therefore save cash.

2. LITERATURE REVIEW

M. Moheno-Barruet et. al. (2021) The testing findings indicated that the drying rates were the greatest at 9 V with a drying rate of 1.5, 09 g/min and 0.55 g/min, and a drying range of 465 min and 1.46, 1.46 and 0.36 g /min for plantains at a drying rate of 495 min. Due to drying curves, the drying velocity in taro was found to be greater than in plantain. The database was used thereafter to develop the artificial neural network (ANN) architecture. produced during the trial stage of the solar dryer. The inputs for the model included six environmental variables and an operational variable, which supplied a drying velocity estimate for ANN (vd) producing R = 0.9822 between the experimental data and the data simulated via linear regression. Johannes. P Angula and Freddie L. Inambao (2020) The technology to store the usage of materials deemed appropriate for the storage of thermal power is primarily dependent upon thermal power that may be released based on application for later use. It attempts to find the most appropriate and cost-effective materials that may be utilized for developing an optimum thermal power Storage device to store and release solar energy in hours of non-sunlight. The study has found two economically feasible concept ideas for the Design and construction of the system for thermal energy storage. Concept 1 is a rock bed system and Concept 2 is a thermal energy storage system with a hot tank.

Arshad Adeel (2019) With technological advances in nanotechnology, several thermal energy stock (TES) materials with potential thermal transportation characteristics were developed and improved. Solid-liquid phase change materials (PCMs), owing to their extremely favorable thermal characteristics, are widely utilized as TES materials for many energies uses. Potential applications, such as solar and Thermal, electrical, thermal, building, textile, foam, micro- and nano-PCM industry are thoroughly studied. Finally, this study emphasizes the potential future research pathways for thermal energy storage in micro-/nano-PCMs.

S. Krishnan and B. Sivaraman (2017) A solar dryer with 3 equally spaced trays that produce a maximum heat flow of 0.5 m2 (each of which provides a family) was

built and its performance assessed. The dryer tests were carried out with and without thermal storage over three days during April, when the sunlight remained significant at 11.39° N Latitude and 79.69° E Longitude at Annamalai Nagar. The PCM was loaded in 20 aluminum tubes, 20 mm in diameter, with a length of 500 mm and 100 aluminum cans of 150 ml (excluding space for phase change). The findings were analyzedbased on air velocity, temperature gradient and sun intensity for the change in thermal absorption and store.

Kumar Mahesh et. al (2016) Solar has attracted many leading academics across the globe to engage in the solar application area as an abundant, renewed, and sustainable energy source. In addition to numerous current drying process developments, which integrate various forms of auxiliary heating source with sunlight, a solar drying scheme does not only rely on solar power for its operation but is also undergoing recent fuel consumption trends. A study of different kinds of solar panels is included in this article including direct solar panels, indirect solar panels, Hybrid Solar Panels and its numerous drying uses.

3. DIFFERENT OPTIMIZATION TECHNIQUES USED IN SOLAR DRYING

The optimization methods are used to simulate the various sun drying processes and associated machinery to forecast the optimum value set. The most utilized optimization methods successfully applied to solar drying processes are ANN, GA, RSM and Taguchi.

3.1 Application of ANN to Solar Drying Processes

Technological defects with biological systems. Different scientists have explored many neural network (NN) topologies for the modelling of the drying process. In terms of model correctness and simplicity, the choice of a suitable NN topology is essential. Dynamic modelling of the Agricultural drying characteristics by means of optimization techniques like the use of Artificial intelligence techniques have grown, including genetic algorithms and neural networks because neural network knowledge is suitable for determining the response of plants and fruit that are complicated procedures that cannot be used simply using math's. Grain drying studies were performed to discover non-linear and system behavior using neural networking is challenging to explain.

Multiple linear regression (MLR) analysis and artificial neural networks were used to optimize a solar box drier (ANN). In the network and the predictive neural network model the conventional back-propagation study method demonstrated better forecasts than the regression drying efficiency model.

3.2 Application of GA to Solar Drying Processes

The genetic algorithm is a worldwide search algorithm intended to mimic biological evolution principles in natural genetic systems. Different kinds of operators are employed in GA, although selection, recombination and mutation are frequently used. The GA replicates this process and determines ideal objectives. The genetic algorithm is one of the approaches of searching for the optimum value of the complicated objective function, based on crossover and mutation as in genetics. The intelligence artificial, neural neural network genetic algorithms Morimoto, Baerdemaeker& Hashimoto (1997a) have developed an optimal fruit store management technique. Morimoto, Purwanto, Suzuki, & Hashimoto (1997b) have been using genetic algorithms during fruit preservation to optimize heat treatment.

To estimate the next moisture content, and thus the drying rates, a feed-based neural network was utilized to estimate the moisture ratio by temperature, air speed, time period and moisture content. Later, the optimal input circumstances were found by utilizing a genetic algorithm. The findings indicated that the drying time was completely reduced using the optimal circumstances. Shahawar et al. used a rapid and exclusive non-dominated genetic sorting (NSGA-II) technique to detect optimal values of the PV/T system investigated to achieve better electrical and thermal efficiency.

3.3 Application of RSM to Solar Drying Processes

RSM is a set of mathematical and statistical methods, helpful for modelling and analysis in situations where the interest response is affected by many factors and aims to maximize that response.

Response Surface Methodology (RSM) was used to improve soybean seed drying operation parameters. The research was done utilizing a three-level 4-factor factor fractional design to determine the optimal combination of initial humidity levels, drying air temperature, air velocity and loading depth, which may lead to high germination, Vigor and field development.

3.4 Application of Taguchi method to Solar Drying Processes

Taguchi is a DOE instrument. Compared with DOE, this technique lowers the number of experiments. The Taguchi technique is primarily used to obtain optimum values and minimize the number of experimental studies efficiently. The researches in sun drying applications of the Taguchi technique are limited.

In addition, the Taguchi technique was used to find the optimal Extraction parameters for drying ginger to get high oil yields for ginger. The controls were reaction time, drying temperature, extraction pressure and particle size of ginger powder.

4. MATERIALS AND METHODS

In the current study experimental method has been carried out as a product in a solar dryer with drying gingers. The research was completed between 9 a.m. and 6 p.m. and the findings were recorded each hour. The dryer panels contained a total of 10 kg of ginger fresh. Each hour, measurements were detected in the chamber using measuring equipment for temperature, moisture, air flow etc. In the experiment the Taguchi Optimization technique was utilized to find the optimum configuration of the input parameters for an effective drying process.

4.1 Taguchi method

The Taguchi method is used mainly for producing high-quality SFEs and effectively reducing the number of experiments. The L9(34) orthogonal arrays were selected and there were 4 columns and 3 levels of 9 experimental runs (rows). The SN-to-noise ratio (SN-ratio, μl) was calculated using the loss function, which generated a repeated value translation function and was used as a variance measure for the experiment. The loss function depends on optimal quality standards and is used as an indicator of ideal conditions for a high S/N ratio value. The goal was to identify the best SFE parameters for improving the production of ginger oil in drying ginger. The production of ginger oil was considered to be more efficient in this respect. The loss function of the S/N ratio(ηij) is greater-than-better.:

$$\eta_{ij} = -10 \log\left(\frac{1}{n}\sum_{k=1}^{n}\frac{1}{y_{ijk}^{2}}\right) \text{(db)} \quad (2)$$

The optimum Process Parameter Level was established and the important variables for predicting an optimum performance of the S/N ratio (ηf) could be calculated based on chosen levels of the strong impact. The predicted S/N ratio (ηf) may be represented as:

$$\eta_f = \overline{\eta} + \sum_{i=1}^{\alpha}(\eta_i - \overline{\eta}) \ (db) \quad (3)$$

Where α is the average S/N ratio, α is the number of process parameters that have a substantial influence on the optimum conditions of the SFE process and α is the S/N ratio for the selection of optimal process parameters and its level.

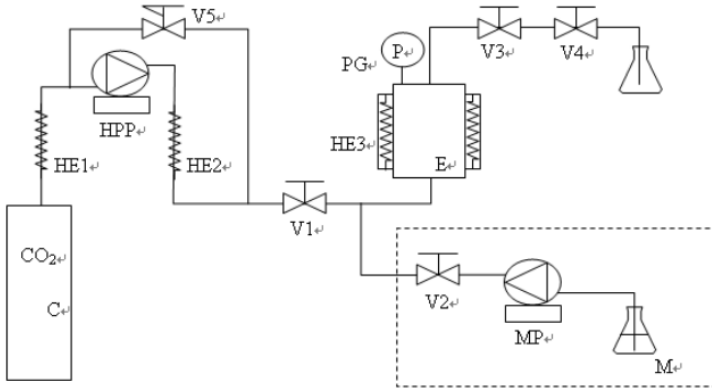

Figure 1: Scheme of supercritical carbon dioxide extraction equipment at batch-stirred apparatus for synthesis under high pressure

5. RESULT AND DISCUSSION

Table-1: Readings obtained in the experiment

Time	Ambient Temp. (^{0}C)	Ambient Relative Humidity (%)	Upper Tray Temp. (^{0}C)	Lower Tray Temp. (^{0}C)	Exhaust Temp. (^{0}C)	Exhaust Relative Humidity	Air Velocity (m/s)	Air Flow (m^3/s)	Solar Radiation (W/m^2)
9:00am	30.3	80.3	41.3	37.2	38.2	62.3	1.1	14.5	150.4
10:00am	31.4	79.5	43.7	37	38.5	60.6	2.12	28.9	161.2
11:00am	32.5	73.1	50.2	41.4	43.3	52.6	2.45	34.5	180.4
12:00pm	34.9	68.2	48.6	45.1	49.5	40.5	3.01	40.4	236.22
1:00 pm	35.5	62.4	59	51.9	53	36.2	2.8	39.3	210.15
2:00 pm	37.3	59.4	58.5	51.6	53.6	33.9	2.6	33.5	226.19
3:00 pm	36.1	63.4	49.6	47.5	45.9	47.5	1.5	18.6	196.5
4:00 pm	33.2	55.4	52.9	45.8	47.6	40.1	2.53	33.7	164.4
5:00 pm	31.3	62.7	44	41.9	41.8	50.3	1.43	19.2	150.3
6:00 pm	30.2	76	35.9	36.5	33.8	74.1	1.1	1.45	110.8
Mean	33.0	68.04	48.37	43.59	44.5	49.8	2.06	26.4	178.6

5.1 Results For Taguchi Approach

Moisture, airflow, air velocity and sun radiation measured optimization results. The very first phase signal was generated for the noise table. The criteria used was much bigger in this method. The findings were computed using the ANOVA method.

Table-2: S/N table for Optimization

S.N.	Ambient Relative Humidity	Air Velocity	Air Flow	Solar Radiation	S/N Ratio
1	73.1	2.45	34.5	180.4	45.12473
2	73.1	2.8	39.3	203.45	46.16915
3	73.1	1.5	18.6	184.56	45.32275
4	62.4	2.45	34.5	187.58	45.46373
5	62.4	2.8	39.3	210.15	46.45059
6	62.4	1.5	18.6	198.5	45.95521
7	63.4	2.45	34.5	195.3	45.81404
8	63.4	2.8	39.3	201.54	46.08723
9	63.4	1.5	18.6	196.5	45.86725

Response Table for Signal to Noise Ratios
Larger is better

Table-3 : Rank Table

Level	Ambient Relative Humidity	Air Velocity	Air Flow
1	45.96	45.72	45.72
2	45.92	45.47	45.47
3	45.54	46.24	46.24
Delta	0.42	0.77	0.77
Rank	3	1.5	1.5

Analysis Of Variance (Anova)

Table-4: Result fromA NOVA

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Ambient Relative Humidity	2	156.0	21.24%	156.0	77.99	2.85	0.170
Air Velocity	2	468.9	63.84%	468.9	234.47	8.56	0.036
Error	4	109.6	14.92%	109.6	27.40		
Total	8	734.5	100.00%				

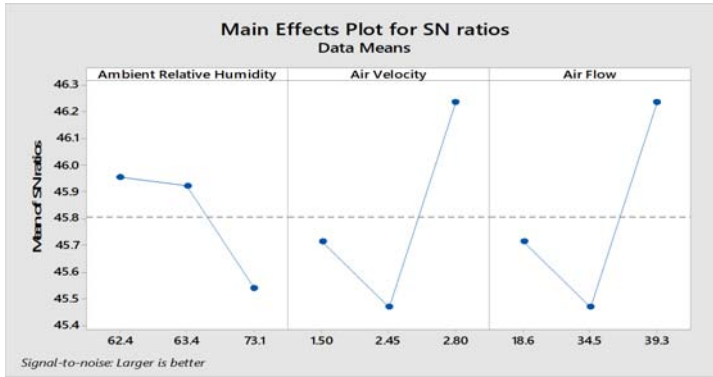

Figure 2: Response Graph for S/N Ratio

6. CONCLUSION

In this research, optimization techniques have been used for solar dryers with thermal storage. Studies on the use of response surface technique and Taguchi methods in sun drying systems are limited in the literature. Researchers may utilize these methods to simulate sun drying systems since they decrease the number of experimental tests. The experiment was conducted satisfactorily and hourly measurements were carried out. The results indicated that the maximum solar radiation intensity is about 236.72 W/m^2 at 12.00 pm. The measurements were further adjusted using the Taguchi L9 orthogonal array to achieve optimum solar dryer performance configuration. Air flow, air speed and humidity variables were dependent on the required S/N ratio.

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Biodiesel Production: An Agricultural and Environmental Aspect in India

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ABSTRACT

Biodiesel production has received considerable attention in the recent past as biodegradable and non-polluting fuel. Substituting petro-diesel with biodiesel may reduce air emission, increase the domestic supply of fuel, and create new market for agriculture. An alternative approach would be one focus on multi-purpose; short-duration annual crops that can either simultaneously yield fuel along with food/fodder or can be cultivated in rotation with food crops, so that there are a lot of opportunities for small formers. The central policy of biodiesel concerns for creation and protection of environment. The economic benefits include support to the agriculture sector tremendous employment opportunities in plantation and processing. Biodiesel fuel plays an important role for the replacement of petro-diesel to eco-friendly fuel. Various studies showed that pollutants like CO, CO_2, SO_X, HC, PAH, PM etc can be reduced by using blended and pure biodiesel. NO_X emissions are increased by using biodiesel. Biodiesel is an environment friendly biofuel since it provide a means to recycle of CO_2; biodiesel does not contribute global warming. Biodiesel is produced from various plant oils like Jatropha oil, Cottonseed oil, Pongania oil, Palm oils, Rapeseed oil, Castor oil converted to biodiesel through the process of transesterification. This study is initiated to investigate the potential of jatropha oil as source of biodiesel. Biodiesel can be converted into profitable business model with the increasing demand for alternative energy. The supply should meet the everyday demand of the public at strategy point replacing petro-diesel. This review paper describes the production, its properties, agricultural benefits, marketing and future potential of biodiesel.

Keywords: Biodiesel, Transesterification, Economic, Agriculture, Environment.

1. INTRODUCTION

Energy has played an important role in economic development of most countries in the world as shown by an evidently high and positive correlation between energy consumption and living standards. At present, most of the world's primary commercial energy supply is derived from natural and exhaustible petroleum resources. Worldwide

petroleum consumption has been increasing continuously at the rate of 6-7 percent per year [1]. The world petroleum reserves are being depleted at an alarming rate and it is predicted that the length of their supply is not exceeding 40-50 years [2]. Additionally, emission from engine combustion is a major cause of atmospheric pollution. The accumulation of carbon dioxide and other greenhouse gases in the atmosphere has resulted in climate changes which have negative consequences on human livelihoods, the global climate and the environment at large.

Concerns over energy security, climate changes and rising oil prices are driving forces to encourage the use of alternative fuel such as biodiesel. The demand for biodiesel has increased continuously in recent years because it is renewable, cheaper and more environmentally friendly. It has been proven that biodiesel can reduce overall carbon dioxide emissions by 78 percent when compared with the petroleum-based diesel. Moreover, its properties are similar in terms of engine performance to the petroleum-based diesel fuel. Also, its additional advantages include greater lubricity, biodegradability, superior combustion efficiency and low toxicity [3, 4]. Compared with petroleum diesel, using biodiesel in a petroleum diesel engine, substantially reduce emission of unburned hydrocarbon (HC), carbon monoxide (CO), sulphates, polycyclic aromatic hydrocarbon (PAH), nitrated polycyclic aromatic hydrocarbon (nPAH), and particulate matter (PM). B100 provides the best emission reduction, but lower-level blends also provide good benefit. B5 to B100 has been shown to reduce PM, HC, CO, NO_x, SO_2, CO_2 emission percentage [5] shows in figure 1.

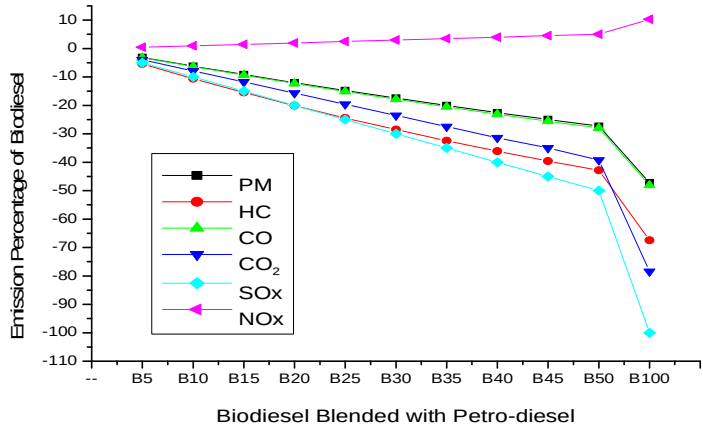


Figure 1: Used biodiesel blend to reduce PM, HC, CO, NO_x, SO_x, CO_2 emission percentage.

The benefits of biofuels over traditional fuels include greater energy security, reduced environmental impact, foreign exchange savings, and socioeconomic issues related to the rural sector. Furthermore, biofuel technology is relevant to both developing and industrialized countries. For these reasons, the share of biofuels in the automotive fuel market is expected to grow rapidly over the next decade. Biofuels could be peaceful energy carriers for all countries. They are renewable and available throughout the world. Policy- makers will need to pay more attention to the implications for the transition to biofuel economy. The concept of sustainable development embodies the idea of the inter-linkage and the balance between economic, social and environmental concerns [6, 7]. Biodiesel is a synthetic diesel-like fuel produced from vegetable oils, animal fats or waste cooking oil. It can be used directly as fuel, which requires some engine modifications, or blended with petroleum diesel and used in diesel engines with few or no modifications [8, 9]. At present, biodiesel accounts for less than 0.2% of the diesel consumed for transport. Biodiesel has become more attractive recently because of its environmental benefits [10, 11]. With cooking oils used as raw material, the viability of a continuous transesterification process and recovery of high quality glycerol as a biodiesel by-product are primary options to be considered to lower the cost of biodiesel [12, 13].

There is wide disparity in the per-capita energy consumption between rural and urban areas like: 75% of rural households depend on firewood for cooking, 10% on dunk cake and about 5% on LPG as against 22% of urban households depend on firewood for cooking, another 22% on kerosene and 44% on LPG. Similarly for home lighting, while 50% of rural households depend on kerosene and another 48% on electricity, 89% of urban households depend on electricity and another 10% on kerosene.

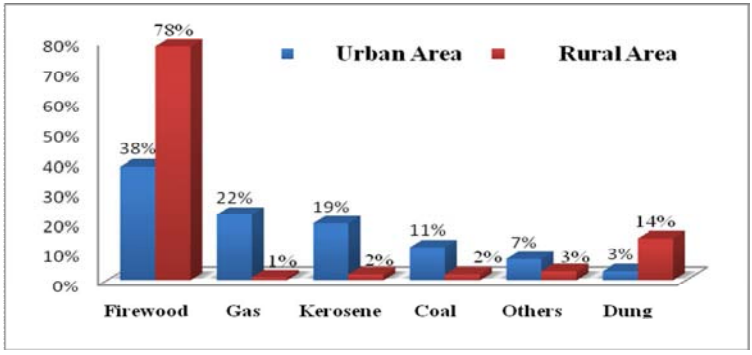
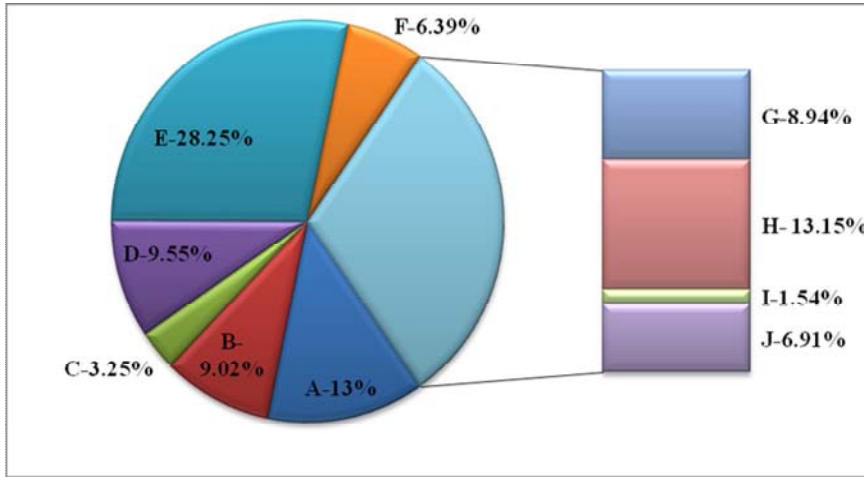


Figure 2: Cooking and lightning energy scenario of rural and urban India

About 80% the rural energy used is derived from biomass; this puts heavy pressure on the already declining vegetation in villages. Use of inefficient chulhas often increases the drudgery of women and children who are involved in collection of fuel wood [14]. More than 90% of the cooking is done with fire wood and bovine dung, i.e., cow-dung [15], show in following figure 2. Increased energy conservation, improved energy efficiency and enhanced energy production from renewable sources (such as edible and non-edible oil) may definitely help India to become self sustaining in terms of energy availability.

1.1 Diesel consumption in India

Being largely dependent on imports, India needs to be prepared to meet its future petroleum requirements, improving the energy efficiency of transport modes and vehicle technology. It can be pursued by improving energy efficiency of transport modes fuel quality, and vehicle emission standards and introduction of alternative energy. India Consumption pattern of diesel by transport and non-transport sectors shown in Figure 3.



A- Agriculture sectors, B-Industries, C- Railways, D- Buses, E-HCV/LCV, F-Three wheelers, G-Cars/USV, H-Privates, I-Mobile tours, J- Others

Figure 3: India Consumption pattern of diesel by transport and non-transport sectors

1.2 Agricultural and economical approach of Biodiesel

In previous economic studies of biodiesel production, the main economic factors such as capital cost, plant capacity, process technology, raw material cost and chemical costs were determined [16].The major economic factor to consider for input costs of biodiesel production is the feedstock, which is about 75–80% of the total operating cost. Other important costs are labour, methanol and catalyst, which must be added to the feedstock [17]. Using an estimated process cost, exclusive of

feedstock cost, of US$0.158/l for biodiesel production, and estimating a feedstock cost of US$0.539/l for refined soy oil, an overall cost of US$0.70/l for the production of soy-based biodiesel was estimated [18]. Palm oil is the main option that is traded internationally, and with potential for import in the short term [19].

The cost of feedstock is a major economic factor in the viability of biodiesel production. Nevertheless, the price of waste cooking oil is 2.5– 3.5 times cheaper than virgin vegetable oils, thus can significantly reduce the total manufacturing cost of biodiesel. Biodiesel obtained from waste cooking vegetable oils has been considered a promising option. Jatropha oil is available with relatively cheap price for biodiesel production in comparison with fresh vegetable oil, costs shown in Table 1. Economic advantages of a biofuel industry would include value added to the feedstock, an increased number of rural manufacturing jobs, an increased income taxes, investments in plant and equipment, reduced greenhouse gas emissions, reduced a country's reliance on crude oil imports and supported agriculture by providing a new labour and market opportunities for domestic crops.

Table-1: Cost comparison of different feedstock

Feedstock	Country	Yield hectare (Kg)	Rate/barrel (US $)
Soybean oil	USA	375	73
Rapeseed oil	Europe	1000	78
Jatropha oil	India	3000	43
Palm oil	Malaysia	5000	46

In the recent years, the importance of non-food crops increased significantly. The opportunity to grow non-food crops under the compulsory set-aside scheme is an option to increase the biofuel production.

3. LITERATURE REVIEW

The idea of using vegetable oils as fuel for diesel engines is not new. Rudolf Diesel used peanut oil as fuel in one of his engines at the Peris Exposition of 1900 [20]. However, a series of problems (e.g. engine knocking, carbon deposits, excessive engine wear) proved that the direct use of vegetable oil is not a satisfactory solution, as the engine must be modified according to the conditions of use and type of the oil. These problems can be alleviated by modifying the oil through transesterification, as the resulting product has very similar characteristics to diesel fuel and can be used in all type of diesel engines [21]. The most common sources of oil for biodiesel production in the United States are soybean oil and yellow grease. In Indian context, the bulk of efforts have been directed toward obtaining biodiesel by chemical transesterification of jatropha oil [22], soybean oil [23], sunflower [24] cottonseed,

rapeseed, and palm oil [25]. However, it is fact that alternative starting oils also need to be studied. Jatropha constitute one such potential source for biodiesel [22].

2.1 Biodiesel Initiatives in India

India took initiatives on biofuels nearly a decade ago to reduce its dependence on oil imports and improve energy security. The country began a 5% ethanol blending pilot program in 2001 and formulated a National Mission on Biodiesel in 2003 to achieve 20% biodiesel blends by 2020–2021. Like many other countries around the world, India has endured setbacks in its biofuel program caused by supply shortages, sharp fluctuations in oil prices, and global concerns over food security. Its National Policy on Biofuels, adopted in December 2009, proposes a non-mandatory blending target of 20% for both biodiesel and ethanol by 2017 [26]. The following Figure 4 briefly shows the history of biodiesel initiatives in India and summarizes the National Policy on Biofuels. The formulation of the National Mission on Biodiesel in 2003 was the first step for developing biodiesel program in India. The program called for mandatory 20% biodiesel blending by 2011–2012, with *jatropha curcas* as the primary feedstock. Jatropha, a small shrub that grows on degraded land and produces non-edible oilseeds, can be used to manufacture biodiesel. Among the 400 non-edible oilseed crops found in India, jatropha was selected for the program because of its high oil content (40% by weight) and low gestation period (23 years) compared with other oilseed crops [27]. To meet the 20% blending target, the recommendation was to cultivate jatropha on 17.4 million hectares (ha) of underused and degraded lands.

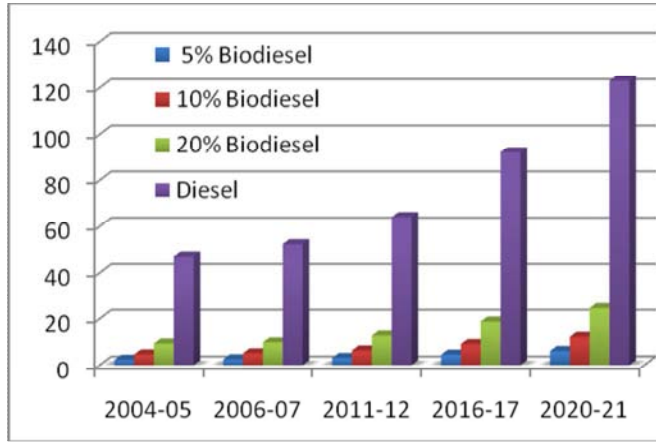


Figure 4: Petrodiesel and Biodiesel demand and blending target (2020-21) in India

The biodiesel program was to be implemented in two phases: a research and demonstration phase from 2003 to 2007 (Phase I) and an implementation phase from 2007 to 2012 (Phase II). The main goals of Phase I was to cultivate 400,000 ha of land, establish a research network of 42 public universities, and achieve a 5% blending target. Under Phase II, a 20% blending target would be achieved by 2020–2021. To support the program, the Ministry of Petroleum and Natural Gas ratified the National [27].

2.2 Present and future market of Biodiesel

The global biodiesel industry is among the fastest-growing markets in chemical industry has ever seen. World capacity, production, and consumption of biodiesel grew on average by 32% per year during 2000-2005, and the industry looks set for even faster growth rates – 115% per year for capacity, and 101% per year for demand – in the years to 2008 and beyond [28]. The market potential for biodiesel is defined by the size of the existing fossil diesel fuel market.

There is no major technical limitation on replacing fossil diesel with biodiesel. There is, however, a limitation on feedstock availability – vegetable fats and oils and animal fats – and this, in turn, depend on the availability of farm lands to grow the crops. The growth of biodiesel industry will be determined largely by government legislation and regulation. In general, governments use a variety of subsidies and tax breaks to stimulate demand growth [29]. Glycerin is the by-product of biodiesel production. Traditionally, biodiesel producers sell this raw glycerin to processors, or purify it on-site to make pharmaceutical-grade glycerin. With the biodiesel production boom, the glycerin market has become flooded with huge amounts of both crude and refined glycerin [29].

3. SOURCES OF BIODIESEL

Biodiesel is an eco-friendly, alternative diesel fuel prepared from domestic renewable resources i.e. edible, non-edible oils, fats and waste oils, that runs in diesel engines –car, buses, trucks, construction equipment, boats generators and oil home heating units. Edible and non-edible oils have become more attractive recently because of their environmental benefits and in fact, it is made from renewable resources. There are more than 350 oil bearing tree and crops identified, among which only Sunflower ,Soybean ,Cottonseed, Rapeseed, Peanut, Palm oil, etc. are edible oil and Jatropha curcas, Cottonseed oil, Mahua ,Karanja, Neem, Simarouba glauca, which are either surplus and or non-edible type, can be use for preparation of biodiesel [30, 31]. While non-edible oils are suitable crops, the long maturation phase and the lack of experience are major barriers for adoption. But annual crop like sorghum and castor, which are already being cultivated, and which

can be used to produce biofuels are better options, and some alternative short duration multipurpose crop are also used for biodiesel production.

3.1 Jatropha plantation

Jatropha is one the options that come in everybody's mind when biodiesel are discussed. India has more than 50 million hectare of wasteland, which could be utilized for cultivating plants. Jatropha Curcas, a shrub and toxic tree with smooth gray bark, belongs to the family Euphorbiaceae. It can grow all over the tropics as well as endures on poor soil and severe heat but the leaves drop in cold weather and arid conditions. The minimum average rainfall requirement is about 250 mm per year and it can grow well under average rainfall 900-1200 mm. The height of Jatropha is around 4 m. Within 1 year, Jatropha starts producing seeds but the maximum productivity is after 4 or 5 years. Its life span is over 20 years.

Table-2: Fatty acid composition of Jatropha oil

Fatty acid	Molecular Formula	Structure	Composition (wt %)
Myristic	$C_{14}H_{28}O_2$	14:0	0.5-1.4
Palmitic	$C_{16}H_{32}O_2$	16:0	12-7.0
Stearic	$C_{18}H_{36}O_2$	18:0	5.0-9.7
Oleic	$C_{18}H_{34}O_2$	18:1	37-63
Linoleic	$C_{18}H_{32}O_2$	18:2	19-41

The utilization of Jatropha is found in every part of the tree. The utilization of Jatropha products are for liquid fuel, biomass, fertilizer, glycerol, medicine and detoxified animal feed [32].Estimates of jatropha seed yield vary due to a lack of research data, the genetic diversity of the crop, the rang of environments in which it is grown and jatropha perennial life cycle. Seed yield under cultivation can range from 1,500 to 2,000 kg per hectare, corresponding to extractable oil yield of 540 to 680 litres per hectare. The fatty acid composition of jatropha oil has been reported in Table 2 [33]. The seed contains toxins, such as phorbol esters, curcin, typsin inhibitors, lectin and phytates, which render the seeds, oil and seed cake non-edible if not detoxified.

Jatropha, the wonder plant produces seeds with oil content of around 34%. The jatropha oil can be used directly as liquid fuel in older diesel engines, in generators and pumps running at a constant speed or in newer engines with small modifications in the fuel system. The jatropha oil can also be mixed with petroleum diesel before use in the diesel engine, which combines the properties of the petroleum diesel with

the lower environmental impact of the non-edible oil [34]. However, viscosity of jatropha oil is 20-25 time higher than the viscosity of petroleum diesel, which cause problems when using the unmodified oil or blends with high percentage of jatropha oil in an engine. Thus there is a need for modification of the oil to reduce viscosity and make it more suitable as an engine fuel.

3.2 Karanja (Pongania globra's)

Karanja is a medium size tree is found almost throughout in India. Karanja tree is wonderful tree almost like Neem tree. The common name of the oil is karanja seed oil and botanical name (*Pongania glabra's*) belongs to *Leguminaceae* family. Karanja is widely distributed in tropical Asia, and it is non-edible oil of India origin. It is found mainly in the Western Ghats in India, northern Australia, and Fiji and in some regions of eastern Asia.

Table-3: Fatty acid composition of Karanja oil

Fatty acid	Molecular Formula	Structure	Composition (wt %)
Palmitic	$C_{16}H_{32}O_2$	16:0	3.7-7.9
Srearic	$C_{18}H_{36}O_2$	18:0	2.4-8.9
Lignoceric	$C_{20}H_{40}O_2$	24:0	1.1-3.5
Oleic	$C_{18}H_{34}O_2$	18:1	44.5-71.3
Linoleic	$C_{18}H_{32}O_2$	18:2	10.8-18.3
Dosocasnoic	$C_{22}H_{44}O_2$	22:0	4.45
Tetracosonaic	$C_{24}H_{48}O_2$	24:0	1.09

The plant is also said to be highly tolerant to salinity and can be grown in various soil textures viz. stony, sandy, and clayey. Karanja can grow in humid as well as subtropical environments with annual rainfall ranging between 500-2500 mm. This is one of the reasons for wide availability of this plant species. The tree bears green pods which after some 10 month change to a tan colour. The pods are flat to elliptic, 5-7 cm long and contain 1 or 2 kidney shaped brownish red kernels. The yield of kernels per tree is reported between 8 and 24 kg. The kernels are white and covered by a thin reddish skin. The composition of typical air dried kernels is: moisture 19 percent and protein 17.4%. The present production of karanja oil approximately is 200 million tons per year. The time needed by the tree to mature range from 4-7 years and depending on the size of the tree the yield of kernels per tree is between 8 and 24 kg. The oil content extracted by various authors ranges between 30 to 33% [35]. The oil is used by common people due to its low cost and easy availability. The fatty acid composition of karanja oil has been reported in Table 3 [33]. The

total karanja tree has got excellent medicinal properties; karanja wood is commonly used as a fuel. Its wood is susceptible to insect attack, so wood is not considered as quality timber. But it may be used in agricultural instruments, tools and combs.

3.3 Castor (Ricinus communis)

Castor bean is belongs to Euphorbiaceae family, common to all the warm regions of world. It is a fast growing fibrous non wood plant native to eastern Africa, especially the Ethiopian area. Castor bean is grown as an annual in temperate zone and as a perennial in the tropics. This crop is cultivated for its seeds, which contain up to 45% of fast drying natural oil rich in ricinoleic acid used mainly in medicine and industry. World annual production of castor is 1.1 million tons of seed and its yield around 0.7 tonne per year. The main producers are India, Brazil, and China. Castor bean is currently cultivated an about 700,000 hectares mostly in Gujarat and Andhra Pradesh under rain fed conditions.

Castor grows well under hot and humid tropical conditions and has growing period of 4 to 5 months. Castor is grown either as a pure crop in rotation with wheat, linseed etc. or is grown mixed with cotton, groundnut, arhar, green gram, jowar, bajra and cowpea. The average yield of seed per hectare and oil per hectare is 1250kg per hectare and 550 litres per hectare. India is the world's largest producers and exporter of castor oil [36]. Biodiesel obtained from castor oil has a lower cost compared to the ones obtained from other oils due to its solubility in alcohol transesterification occurs without heating [37]. The biodiesel produced from castor bean also satisfies the relevant quality standard without regard to viscosity and cold filter plugging points. Several studies investigated castor bean as alternative feedstock for the production of biodiesel and result supported that methyl ester (biodiesel) can be successfully used as a petroleum diesel.

The comparative advantage of castor is that its growing period is much shorter than that of Jatropha and pongamia and there is considerably greater experience and awareness among farmers about its cultivation. Being an annual crop it gives the farmers the ability to rotate or shift away easily depending on market conditions [36]. It can help to improve the living conditions of small farmers as well as supply environmentally friendly energy for multiple purposes.

3.4 Simarouba Glauca (Paradise Tree Or Laxmi Taru)

Simarouba Glauca belongs to *Simaroubaceae Quasia* family. It had also been known as Paradise tree Laxmitaru and Acetuno. Laxmitaru, is a multipurpose tree that can grow under a wide range of hostile ecological conditions. Its origin is native to North America, now found in different regions of India. It was a medium sized tree generally attains a height about 20 meter and trunk diameter approximately 50-

80 cm and life about 70 years. It could grow under a wide range of agro climatic condition like warm, humid and tropical regions. Its cultivation depends upon rainfall distribution (around 400 mm), water holding capacity of the soil and sub-soil moisture. It was suited for temperature range 10-40°C, pH of the soil should be 5.5-8. It produces bright green leaves 20-50 cm length, yellow flowers and oval elongated purple coloured fleshy fruits [38]. Laxmi taru seed contain about 40% kernel and kernels content 55-65 % oil. The amount of oil would be 1000-2000 kg/ha/year for a plant spacing of 5 m ×5 m. It was used for industrial purposes in the manufacture of soaps, detergents lubricants etc. The oil cake being rich in nitrogen (7.7 to 8.1 %), phosphorus (1.07 %) and potash (1.24 %) could be used as valuable organic manure [39]. Laxmitaru was rich source of fat having melting point of about 29°C.

Table-4: Fatty acid composition of Simarouba oil

Fatty acid	Molecular Formula	Structure	Composition (wt %)
Stearic	$C_{18}H_{36}O_2$	18:0	27.3
Oleic	$C_{18}H_{34}O_2$	18:1	54.6
Palmitic	$C_{16}H_{32}O_2$	16:0	12.3
Linoleic	$C_{18}H_{32}O_2$	18:2	2.3
Arachidic	$C_{20}H_{36}O_2$	20:2	1.2
Erucie	$C_{22}H_{40}O_2$	22:2	0.4
Linolenic	$C_{24}H_{48}O_2$	24:0	0.2
Heptadecanoic	$C_{17}H_{30}O_2$	17:2	0.1

The major green energy components and their source from laxmitaru (simarouba) were biodiesel from seed, ethanol from fruit pulps biogas from fruit pulp, oil cake, leaf litter and thermal power from leaf litters, shell, unwanted branch etc. The percentage composition of fatty acids present in laxmitaru (simarrouba) oil was determined by gas chromatographic (Chemito CERES 800 plus GC). Simarouba glacica oil consists of 96.11 % pure triglyceride esters. The fatty acid composition of laxmitaru (Simarouba Glauca) oil has been reported in Table 4 [31].

4. BIODIESEL PRODUCTION

Tree born oil can be directly used in agricultural machinery without oil and engine modification. However, the quality of oil will be better and there will be less long term problems if it is first converted into biodiesel [40]. The test results of Tree born oil have shown that its properties meet the USA (ASTM D6751), Germany (DIN 51606), Indian (BIS) and European organization (EN 14214), and Australian fuel standard [41].

Figure 5 presents the unit process of biodiesel conversion in common batch of transesterification using methanol, sodium methoxide, hydrogen chloride and sodium hydroxide [42]. Efficiency of the process reaches 95% by weight of conversion rate

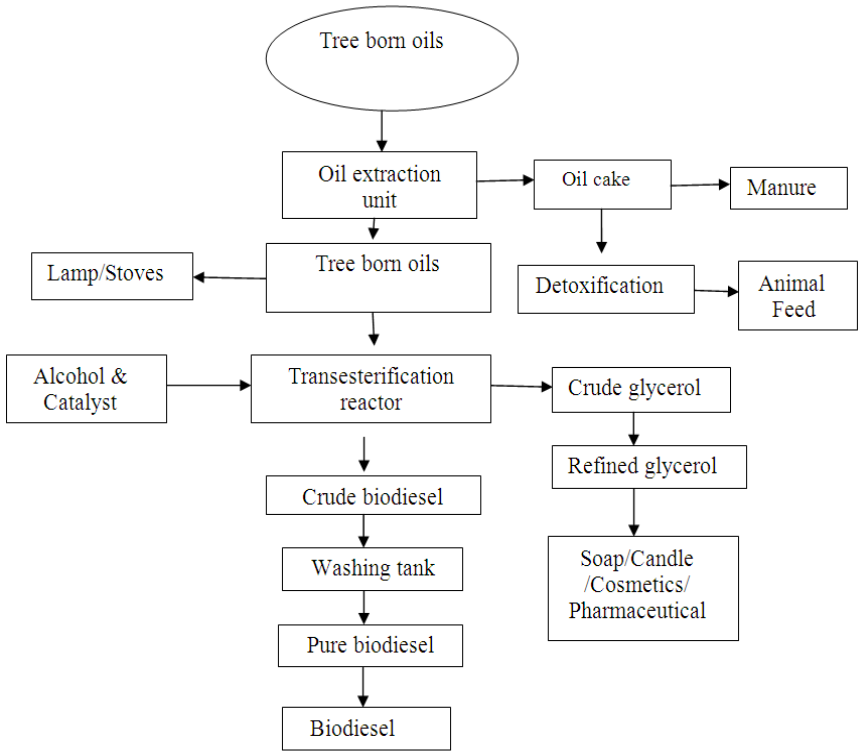


Figure 5: Process flowchart for biodiesel production from Tree born oils and by products

4.1 Tree born oil co-products as biomass

Co-products from TBOME (Tree born oil methyl esters) production can be converted into various useful forms. The study views those products as co-products which will be used for energy purposes. Per FU, the co-products obtained are wood, leaves, and coat having dry weight 4,000, 2,000 and 800 kg respectively from the process of plantation. Press cake, dry weight 91.5 kg, is obtained from the oil production process.

5. RESULT AND DISCUSSION

5.1 Characterization of Tree born oil biodiesel

Physical and chemical properties of biodiesel (TBOME) were determined by using standard test methods. These standard values were calculated and compared with USA (ASTM D6751), Germany (DIN 51606), Indian (BIS) and European organization (EN 14214). Kinematic viscosity, flash point, pour point, cloud point, saponification value, iodine value, and acid value etc. The experimental values of physical and chemical properties of biodiesel (TBOME) like kinematic viscosity, density, saponification value, iodine value and acid value given in Table 5.

Table-5: Comparison of fuel properties of TBOME (biodiesel) and Petro-diesel

Properties	Petro-diesel	Biodiesel
	ASTM D0975	ASTM D6751
Density at 30°C (kg/m3 or g/gL)	0.876	0.875- 0.90
Viscosity at 40°C	1.9-4.1	1.9-6.0
Specific gravity (kg/m3 or gm/mL)	0.850	0.88
Flash point °C	60-80	100-170
Pour point	-35 to -15	-15 to 16
Cloud point	-15 to 5	-3 to 12
Acid value (mg NaOH/g)	0.35	<0.8
Iodine value	…	….
Saponification value (mg NaOH/g)	…	…
Ash content (%)	0.01	<0.02
Water content (%)	0.02	0.03

5.2 Economical scenario of Biodiesel

The whole business idea is about how make use of biodiesel fuel with gasoline so that we can provide cheaper, greener and cleaner fuel. The biodiesel industry is yet to be matured and hence is a great opening towards a new era of eco-friendly fuel within the domestic boundaries of the country. The product is still in its introduction stage and hence there is a bright future for it. Thus, proper infrastructure is needed for the development of this market. A 'Tree born oil extraction plant' is to be set up using the sophisticated technology available for meeting the future demand. In an attempt to revive India's biodiesel industry, country's Ministry of New and Renewable Energy (MNRE) and Confederation of Indian Industry (CII) have recommended price increase for biodiesel from Tree born oil [43].

According to a study done by the ministry along with Confederation of Indian Industry , price of biodiesel from Tree born oil needs to be raised to Rs 36/litre from the present Rs 26.50/litre to make it sustainable and for suitable growth of the Indian biodiesel industry [44]. The study estimates that if the blending initiative of 20% Tree born oil based biodiesel are achieved in year 2020-21, India will save around Rs. 3000 crore and will generate revenue of around Rs.5500 crore in rural economy with an opportunity of investment to the extent of Rs.1700 crore on an annual basis. This initiative would also help in reduction of greenhouse gas emission by 3 million metric tonnes (MMT) on an around basis [45].

5.3 Economical analysis of biodiesel

Cost vulnerability of petroleum imports is a serious issue for the policy makers as drastic fluctuations in prices of crude oil in international market during last two and a half years has drawn serious attention on a nation's energy needs by using all possible sources. Availability of sufficient quantity of Tree born oil biodiesel for blending with petro-diesel at an affordable price holds the key to successful adoption of bioenergy program in India. One of most important aspect to ensure timely implantation of National Biofuels policy to be implemented by 2020-21 is the economic parity of Tree born oil biodiesel with petro-diesel. Table 6 below indicates that likely sales cost of Tree born oil biodiesel in India may be around Rs 30-32 per liter. The variation in the cost may depend upon the procurement cost of Tree born oil seeds.

Table-6: Tentative cost of biodiesel production in Indian rupee

Cost component	Rate (Rs/Kg)	Quantity (Kg)	Cost (Rs)
Seed	10	3.28	32.8
Cost of collection and oil	2.36	1.05	2.48
extraction	1	2.23	-2.23
Less cake produced	6.67	1	6.67
Transesterification cost	50	0.095	-4.75
Less cost of glycerol produced			34.97
Cost of biodiesel per kg			1.39
Declared goods tax@4%			36.37
Total cost per kg			30.91
Cost of biodiesel per liter			
(specific gravity of 0.85)			

5.4 Tree born oil marketing mix model in Indian scenario

5.4.1 Tree born oil: The plant that is generally cultivated for the purpose of extracting Tree born oil is Tree born oil seed. The seeds are the primary source from which the oil is extracted. Owing to the toxicity of Tree born oil seeds, they are not used by humans. The major goal of Tree born oil seed cultivation, therefore, is performed for the sake of extracting Tree born oil seeds. The oil content is 25-30% in the seed. The oil contains 21% saturated fatty acids and 79% unsaturated fatty acid. These are some of the chemical elements in the seed, cursin, which is poisonous and render the oil not appropriate for human consumption. Marketing mix of Tree born oil production shown in figure 6.

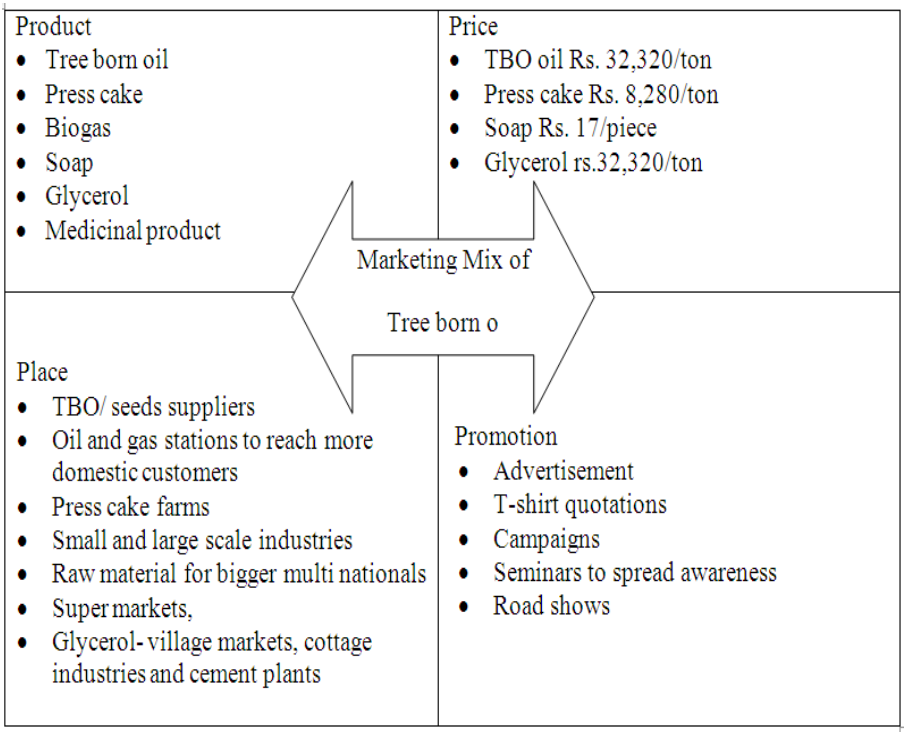


Figure 6: Marketing mix of Tree born oil production.

5.4.2 Press cake : This is a by-product of Tree born oil which is generally used as an animal feed. The other uses of this by-product are as a fertilizer, as a source for biogas and can replace the usage of firewood. India has been using biogas plants since ages. These plants are run through the cow dung. But the press cake generate biogas much faster than the conventional cow dung, its carbon: nitrogen (C:N)

composition. This gives a new business opportunity which is capable of generating electricity and employment. By becoming energy efficient in the field of electricity many villages can get a constant and cheaper supply of electricity. Also its effluent slurry provides good organic manure with rich manorial properties. The lab studies reveals that a combination of 75% cattle dung and 25% Tree born oil cake gives best result [46].

5.4.3 Soap : Tree born oil has anti-microbial properties and if used as soap is proven to be more active to get rid of the S. aureus and E.coli than any other plant-oil based soap. Adding other ingredients such as essential oil, gives relaxing sensation, and heals some skin problems such as acne, eczema related to fungi and other, making the soap a healthy natural choice to use. This gives another business opening for rang of new soaps for any company. Just like Karnja, jojoba, jatropha, Castor, laxmi taru, etc soaps can grab a new share of market [32].

5.4.4 Glycerol: Glycerin is the by-product of biodiesel production. Traditionally, biodiesel producers sell this raw glycerin to processors, or purify it on-site to make pharmaceutical-grade glycerin. Purified glycerol can be used cement grinding aid which gives finer cement. This gives a better quality cement at cheaper processing charge [40]. With the biodiesel production boom, the glycerin market has become flooded with huge amounts of both crude and re fined glycerin. The traditional supply/demand pattern for glycerin has moved into a period of severe imbalance.

5.4.5 Medicinal Product : Tree born oil seeds has been also used as a traditional folk medicine in many countries. Tree born oil seeds are a source of several secondary metabolites of medicinal importance. The leaf, fruits, latex and bark contain glycosides, tannins phytosterols, flavonoids and steroidal sapogenins that exhibit wide ranging medicinal properties. Commercial exploitation for biopharmaceuticals is one of the prospective future potential of this plant [41].

5.4.6 Logistics and business analysis : India’s major expense is towards importing crude oil which is leading to budgetary deficits. The major competitor to the biodiesel market is the petro-diesel market. Though it is subject to excise and taxes, it is till date the most conventional source of fuels in the market. Thus, the major problem is to make biodiesel readily available to the public just like any other form of fuel. The positioning of biodiesel in the Indian market should be such that it provides benefit to the country both environmentally and economically [44].

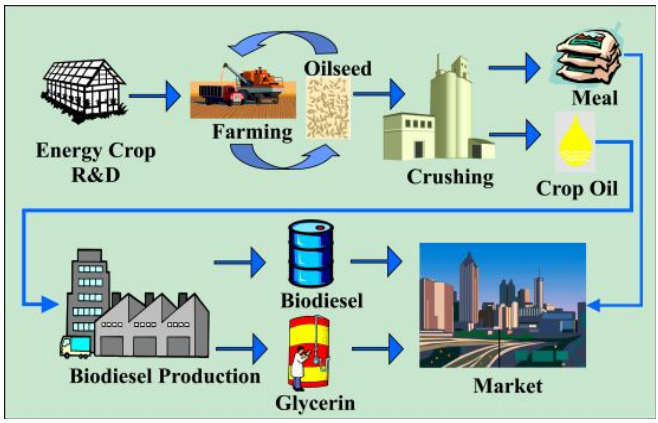


Figure 7 : Supply chain of biodiesel

Biodiesel producers and users are inextricably tied to the petroleum industry. Biodiesel fuel is mixed with petroleum derived "petro"-diesel, marketed through the conventional petroleum marketing system, and used in engines designed to operate on petro-diesel. The biodiesel blends, whether B2 to B5 (2 % to 5% biodiesel in 98% to 95% petro-diesel), B20 or B100, are subject to the same engine performance and emissions expectations as petro-diesel. The fact that the original compression ignition (diesel) engines were designed to operate on peanut oil is historically interesting, but the reality of today's liquid fuel business is that as biodiesel producers, we are competing in a petroleum dominated market shown in figure 7.

5.4.7 Global market scenario: A new research predicts the global bio fuels market would double over the next decade, from $82.7 billion in 2011 to $185.3 billion in 2021. Although growth is expected to climb steadily through 2016, more robust growth is expected between 2017 and 2021, as a combination of higher oil prices, emerging mandate obligations, availability of new feedstocks, and the scaling up of advanced technologies drive increased investment in the industry [47].The international market for biodiesel is booming: Despite severe protests by environmental organisations, the European Commission has stipulated for agrofuel (more frequently referred to as biofuel) blends to be increased to 10 % by 2020. India even aim for 20 % by 2017 and Japan for 20 % by 2030. The global production of diesel based on plants is estimated to reach 30 billion litres in 2010, which is three times the amount produced today.1 Such rapid growth does not allow us much time to discuss the pros and cons of agrofuel cultivation.

Biodiesel is a variety of ester-based oxygenated fuels derived from natural, renewable biological sources such as vegetable oils. Its name indicates, use of this fuel in diesel engine alternate to diesel fuel. Biodiesel operates in compression ignition engines like petroleum diesel thereby requiring no essential engine modifications. Moreover it can maintain the payload capacity and range of conventional diesel. Biodiesel fuel can be made from new or used vegetable oils and animal fats. Unlike fossil diesel, pure biodiesel is biodegradable, nontoxic and essentially free of sulphur and aromatics.

6. CONCLUSION

Biodiesel is renewable energy and can help to improve future energy security and economic development of India. As per the study we can see that the market prospects for getting Tree born oil business in the main stream for making it beneficial for the current Indian Economy. This marketing model provides various pathways as to how go about making the Biodiesel the fuel of the future. Thus, if this bio-tech research goes hand in hand with the management and business openings in India, India could take another step towards being the economic super-power. Scientific research should therefore be directed towards development of a wide variety of crops and technologies that are suited to the diverse socio-economic and environmental conditions to in rural development.

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Developing Two-dimensional Graphene for Hydrogen Storage Application

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ABSTRACT

The two-dimensional materials like graphene, molybdenum disulfide (MoS_2), and MXene are extensively tested for hydrogen storage applications. However, due to strong covalent bond these materials mostly allow physisorption of hydrogen. Recently, the defect-engineering have been utilized to modify the strength of bonding of hydrogen with the two-dimensional (2D) graphene. By creating vacancies, doping with boron or nitrogen atoms, or inducing strain, researchers can significantly alter the electrical, optical, and mechanical characteristics of 2D materials. These controlled defects can enhance conductivity and increase the hydrogen storage capacity of the graphene. In this paper, we review the effects of various native defects on the hydrogen storage capacity of the 2D graphene. Indeed, atomic level precision of defect engineering enables the graphene to become a good hydrogen storage medium.

Keywords: Graphene, Hydrogen storage, MXene.

1. INTRODUCTION

In the early 1930s, scientists theorized that purely two-dimensional (2D) materials were thermodynamically unstable due to thermal fluctuations that would cause their structure to break down [1]. It was believed that such materials could only exist at absolute zero temperature [1]. However, in 2004, Konstantin Novoselov and Andre Geim at the University of Manchester, UK, during their experiments, successfully isolated a one-atom-thick layer of graphite, known as graphene [2], using mechanical exfoliation. This material, previously thought to be thermodynamically unstable, exhibited remarkable mechanical and electronic properties, making it highly promising for next-generation devices [3]. Following this discovery, researchers identified various other 2D materials, such as hexagonal boron nitride [4], transition metal dichalcogenides (TMDs) [5,6], and black phosphorus [7], each with unique properties and structures. These two-dimensional materials typically feature strong covalent bonds and are mostly free from dangling bonds, ensuring in-plane stability [8]. Therefore,

adsorption on most of the two-dimensional materials occurs via van der Waals interactions [9].

Defects are crucial in altering the properties of materials [10-12]. These defects encompass vacancies, dislocations, grain boundaries, and substitutional atoms, which can markedly impact the electrical, thermal, and mechanical properties of materials [10-12]. For example, vacancies may change the electronic structure by creating localized states within the band gap [10,11], and grain boundaries can influence the strength and flexibility of the material [13]. Mastering the understanding and manipulation of these defects is vital for enhancing the performance of 2D materials in applications such as electronic devices, sensors, and catalytic systems, thus positioning defect engineering as a significant research focus in nanotechnology [12,13].

Hydrogen is increasingly recognized as a promising renewable energy source [14,15], but its storage for on-site use remains a significant challenge [14,15]. Effective hydrogen storage must allow for easy storage and release of hydrogen under near-ambient conditions, which requires an optimal hydrogen binding energy that is balanced—not too strong nor too weak [16,17]. For reversible hydrogen adsorption, the ideal binding energy should range between -0.2 and -0.6 eV per H_2 molecule [18]. Various materials [19,20], including metal hydrides [21], metal-organic frameworks (MOFs) [22], and carbon adsorbents [23,24], are typically employed for this purpose. Among these, carbon-based nanomaterials like carbon nanotubes [25], fullerenes [26], and graphene-based materials [27-29] stand out due to their low weight, high availability, cost efficiency, and extensive surface area.

In this study, we explore the use of graphene and its modified forms for hydrogen storage applications. Our primary emphasis is on the findings derived from first-principles calculations and Density-functional theory methods [30]. Compared to metal hydrides and other hydrogen storage materials, graphene-based systems offer advantages [27-37] such as being lightweight, having excellent mechanical properties [1], and possessing high surface areas [1]. Although their gravimetric density (GD) and volumetric density (VD) may not be outstanding [28,29], they are sufficient to fulfill the objectives set by the Department of Energy (DoE) [31].

2. PRISTINE GRAPHENE

Using the density-functional theory, the binding energy of the hydrogen atom/molecule is calculated using the following expression:

$E_b = [E_{(graphene\ system+nH/H2)} + E_{graphene\ system} + nE_{H/H2}]/n$

Here, E_b, $E_{(graphene\ system+nH/H2)}$, $E_{graphene\ system}$ and $E_{H/H2}$, and n are binding energy per H atom or H_2 molecule, total energy of hydrogen adsorbed graphene system (pristine or modified), total energy of graphene system, total energy of H_2/H and n is number of absorbed H_2/H [32].

Pristine graphene has a hydrogen binding energy between -0.01 and -0.09 eV per H_2 molecule [28], which does not meet the DOE's standards. Empirical evidence shows that under optimal conditions (high pressure and low temperature), hydrogen (H_2) can form a uniform, dense monolayer on graphene, achieving a GD of 3.3%, [29] which doubles if both sides of the graphene sheet are utilized. The process of chemisorbing hydrogen on graphene faces considerable barriers [30], around 1.5 eV, due to the need for H_2 dissociation (dissociative adsorption). Conversely, chemisorption of atomic hydrogen is more favorable, with typical values for H binding energy and chemisorption barriers being about 0.7 eV and 0.3 eV, respectively [32].

Theoretical research has shown that the adsorption of the first hydrogen atom modifies the local structure of graphene [32], which encourages further hydrogen binding due to a collective stabilization effect. When hydrogen atoms form "dimers" on the graphene surface [32], there is an energy gain of up to 1 eV compared to single, isolated hydrogen atoms. Scanning Tunneling Microscopy (STM) studies on epitaxial graphene on SiC [37] have observed atomic hydrogen absorption, revealing the formation of dimer structures, preference for adsorption on elevated graphene regions, and clustering at higher hydrogen concentrations. For hydrogen storage, graphene's maximum achievable gravimetric density (GD) through chemisorption is 8.3% [31] which exceeds the "ultimate" target set by the DOE.

A DFT study utilizing hybrid functionals [36] predicted that hydrogen absorption in bilayer graphene is dependent on the spacing between the layers [37]. The study found that the highest adsorption energy, approximately 0.1 eV, occurred at an interlayer separation of 6-8 Å [37], which is nearly double the typical graphite interlayer distance of 3.4 Å [38]. This increase is attributed to Van der Waals forces between the layers, creating a nano pump effect that boosts the internal hydrogen pressure relative to the external pressure, leading to significant compression. Consequently, the gas density (GD) in bilayer graphene at high pressure and low temperature can reach 30-40% higher than in a monolayer [37].

4. MODIFIED GRAPHENE

Various modifications to graphene have been proposed to enhance its hydrogen storage capacity. These modifications include metal decoration [36,37], doping with

heteroatoms such as nitrogen and oxygen, and the introduction of strain, curvature, and edges [37]. We will explore the impact of these modifications on the hydrogen storage capacity of modified graphene.

One approach to modifying the hydrogen storage capacity of graphene is to employ metal atoms, such as alkali metals (e.g., lithium, sodium, potassium) and transition metals (e.g., titanium, scandium, vanadium). For instance, each adsorbed lithium atom on graphene [38] and nanostructured graphene [39] can attach up to four H_2 molecules, resulting in a gravimetric density exceeding 10 wt%. Titanium atoms can bind with up to four hydrogen molecules [40], and if these atoms are attached to both sides of graphene, a theoretical gravimetric capacity exceeding 7% can be achieved. Additionally, a stable ethylene–titanium complex [41] has the potential to attach up to ten hydrogen molecules, further increasing the hydrogen storage capacity. Theoretical studies have also suggested that calcium-decorated graphene nanoribbons [42] could achieve a gravimetric density of 5% with minimal clustering of calcium atoms. Using graphene oxide as a substrate, where transition metals such as titanium atoms bind to epoxy and hydroxyl groups [43], offers a promising approach to attain a gravimetric density of approximately 5%.

An intriguing experimental result was observed when graphene, obtained by reducing graphene oxide, was decorated with palladium atoms [44]. An increase in the gravimetric density from 0.6% to 2.5% at 30 bar and room temperature was achieved, attributed to the spillover mechanism [44]. This effect facilitates the dissociation of hydrogen molecules followed by the chemisorption of hydrogen atoms on the palladium atoms. These hydrogen atoms eventually migrate to the graphene surface and are adsorbed there.

5. GRAPHENE WITH DEFECTS

Commercially produced low-cost graphene often has topological defects. Given the interest in graphene for hydrogen storage, S. Yadav et al. [32] investigated the impact of various topological defects—such as Stone-Wales, single vacancy, and different double vacancy defects—on its hydrogen binding capacity. They explored the potential of these defects in improving storage systems. The study revealed that single vacancies exhibited the strongest binding energy [32] within the desirable range for reversible hydrogen adsorption. While Stone-Wales and double vacancy defects [32] did not significantly enhance binding ability compared to pristine graphene, they did not negatively impact hydrogen storage capacity either [46]. Defects with various planar carbon rings, like Stone-Wales and double vacancies [32], showed similar hydrogen binding values, with the binding value for a specific site within such a ring being independent of the nature of surrounding rings or defect size [32].

Additionally, the study examined multiple defect systems [32]. A grain boundary system, resembling an S7 grain boundary defect with pentagon and heptagon rings, showed hydrogen binding energy like Stone-Wales and double vacancy defects. In a metal-decorated system [32], vacancy-anchored nickel adatoms and an adjacent undecorated vacancy were simulated. The results indicated that the undecorated vacancy reduced the nickel adatom's binding [32] ability compared to a system without vacancies. Conversely, a single vacancy significantly [32] enhanced the hydrogen binding ability of an adjacent Stone-Wales defect, bringing its hydrogen binding energy into the desirable range for reversible hydrogen adsorption. Two high defect density systems [32] were designed to test their capacity to bind multiple hydrogen molecules [46]. The first system, with closely spaced single vacancies, achieved a maximum gravimetric density of 5.81% [32], while the second system, with closely spaced single vacancies and Stone-Wales defects, reached 7.02% [32]. These results were obtained at relatively small graphene interlayer spacings, with optimal average hydrogen binding energy at 3 Å spacing and weaker binding ability at both smaller and larger spacings [32]. Thus, defect engineering of graphene systems shows significant promise for meeting hydrogen storage requirements without the challenges associated with metal decoration currently proposed.

5. CONCLUSION

In summary, the research highlights the promising potential of defect-engineered graphene for hydrogen storage applications. The potential of pristine graphene for hydrogen storage falls short of DOE standards, with a hydrogen binding energy range of -0.01 to -0.09 eV per H_2 molecule. However, under optimal conditions, graphene can achieve a density of 3.3%, doubling if both sides are utilized. Chemisorption barriers hinder hydrogen binding, yet chemisorption of atomic hydrogen is more favorable. The adsorption of the first hydrogen atom alters graphene's structure, facilitating further binding. Studies reveal atomic hydrogen absorption, dimer formation, and clustering on graphene. Theoretical predictions suggest bilayer graphene's enhanced adsorption for increased interlayer spacing. Modifying graphene boosts storage capacity. Metal decoration, nitrogen/oxygen doping, and strain/curvature introduction are explored. Alkali and transition metals enhance storage, with lithium achieving over 10 wt% density. Calcium-decorated graphene and titanium attachment to graphene oxide show promise. Palladium-decorated graphene exhibits increased density via spillover mechanism.Defects in graphene, like single vacancies, improve hydrogen binding without diminishing storage capacity. Grain boundary and metal-decorated systems reveal varied binding abilities. High defect density systems reach gravimetric densities up to 7.02%, showing promise for meeting storage requirements.In summary, graphene modifications offer avenues for surpassing DOE standards. Metal decoration, defect engineering, and optimized

conditions enhance hydrogen storage, promising advancements in clean energy technology.

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"MISSING WOMEN" in Indian Sub National Government: An Empirical Analysis

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ABSTRACT

Divergent gender ratios have been a chronicle problem for many decades and have been vital to various reporting of "missing women" across the developing world. The problem of missing women in India is a significant cause of concern because we see the large congregation of "surplus" males mainly belonging to low socioeconomic class, who have reached adulthood, and concerns are that their scantiness of marriageability, and concomitant sidelining in society, may lead to violence, societal threatening antisocial behavior, instability and insecurity overall.

In lieu of the same, this paper strives to analyze the problem of differential sex ratio amongIndian states and attempt to understand if the infant mortality rate and the literacy rate differential do affect the gender disparity. The method used to analyze the impact of infant mortality rate and literacy rate on sex ratio is the fixed effect dummy variable multiple regression model (LSDV), using the census data for various decades comprising all Indian states. Finally, we examined the propound model for India's case using state-level data for empirical validity.

The data used in this work were secondary data sourced from the RBI Handbook on Statistics on the Indian States for seven consecutive censuses, i.e., 1051, 1961, 1971, 1981, 1991, 2001 & 2011, respectively. SPSS 28 is used to analyze the data. The results obtained reveal that the F-value of 21.145 was statistically high, suggesting the overall fitness of the model. The observed R^2 - 0.806 is also high and indicates that 80.6% of the total variation was accounted for by the independent variables included in the model.

Keywords: Gender Disparity, Literacy Rate, Infant Mortality Rate, Missing Women.

1. INTRODUCTION

Energy has In India, the gender ratio is skewed towards males, or in other words, we can say that as compared to men, the number of women has always been slighter. In the initial phases of the 20th century, the sex ratio of India was 972, which

continuously declined till 1941. It is a sigh of relief that there is an improvement in the sex ratio of India by 10 points as per the census of 2011 compared to the census of 2001. Haryana has the lowest sex ratio in India, with 879 females per 1000 males, whereas the highest sex ratio is 1084 in Kerala.

The leading cause of concern for the Indian States is the continuous decline in the sex ratio. Cause of concern and so it is for the policymakers of the nation. The government of India is trying to fill up this aperture as soon as possible. The government of India has launched various social schemes like “Beti Bachao BetiPadhao”(“Save Girls, Educate Girls”)and has dispersed the coverage of the enormous schemes in all districts of the country. We are hopeful that the pragmatic results of these schemes will soon be in front of everyone.

The United Nations Population Funds Agency’s World Population Report, in 2020, which was themed 'Against My Will – Defying the practices that harm women and girls and undermine equality’ stated that, more than 45 million females are mislaid in Indian demography and the main reason which was responsible was predominantly due to pre and post-birth sex selection practices originating from son preference and gender inequality.

In the age group 0–6 years, when we examined the Child Sex Ratio, we observed that according to the census 2001, the child sex ratio of India was 927, which decreased to 919 in the census 2011, and this is a significant cause of concernamong the Indian states. In Arunachal Pradesh, the highest child sex ratio was observed, which stood at 972 per one thousand males. On the contrary, Haryana has the lowest child sex ratio, which stood to be 834 per thousand males as per census report 2011. We see an alarming trend of falling child sex ratio between 1981-2011, which will have along-term impact on the demographic distribution in India, as shown in Figure 1.

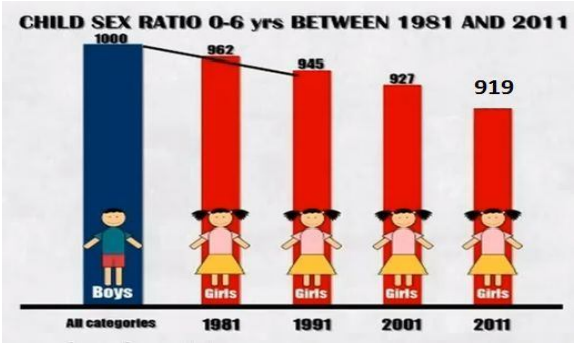

Figure 1 : Childsex ratio:0-6 from 1981 to 2011
Source: Census of India: various census reports

After analyzing the data census-wise, it was observed that the best performing states in gender ratio were Kerala, Tamil Nadu, Andhra Pradesh, Chhattisgarh, Manipur, followed by other states according to the 2011 census. The least performing states discovered are Haryana, Sikkim, Punjab, Bihar, Uttar Pradesh followed by other states,as shown in Table 1.

In all the census data, we find that Kerala has outperformed all other states regarding Sex Ratio, and Haryana has always lagged. The most surprising fact was the lag of the capital state i.e., Delhi. Since Arunachal Pradesh was established later, the data is unavailable for census 1951. Therefore, it is a laggard state in Figure 2, though it ranks better than the least performing states.

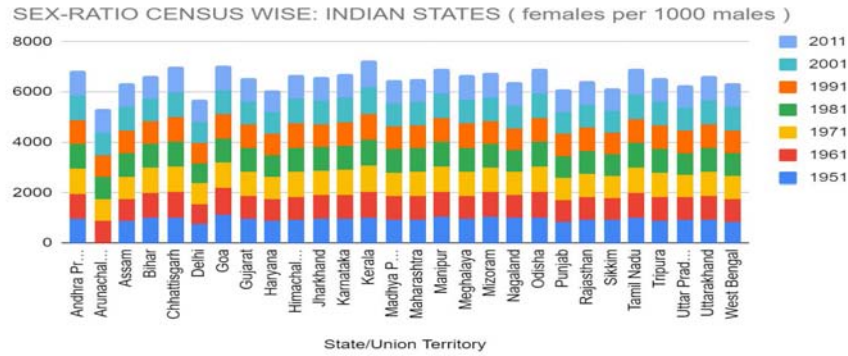

Figure 2 : Census wise sex ratio in various Indian states from 1951 to 2011
Source: Census Commissioner Office, Government of India.
https://m.rbi.org.in/SCRIPTs/PublicationsView.aspx?id=19995

Table-1: Sex ratio in various Indian states: 2011 census

Sl. No.	States	Sex Ratio as per 2011 census
1	Kerala	1084
2	Tamil Nadu	995
3	Andhra Pradesh	992
4	Chhattisgarh	991
5	Manipur	987
6	Meghalaya	986
7	Odisha	978
8	Mizoram	975

9	Himachal Pradesh	974
10	Karnataka	968
11	Goa	968
12	Uttrakhand	963
13	Tripura	961
14	Assam	954
15	Jharkhand	947
16	West Bengal	947
17	Nagaland	931
18	Madhya Pradesh	930
19	Rajasthan	926
20	Maharashtra	877
21	Arunachal Pradesh	920
22	Gujrat	918
23	Bihar	916
24	Uttar Pradesh	908
25	Punjab	893
26	Sikkim	889
27	Haryana	877

Source: Census 2011, Government of India

According to Social scientist and developmental feminist activist KamlaBhasin, it was perceived that with the increase in Literacy Rate and, therefore, education levels the mindset of people will change and also the impact of the introduction of stringent law (Pre-conception & Pre-Natal Diagnostic Techniques Act, 1994), there will be solutions to the problem. Although the picture was different in her statement, she said, “But look at the situation now. The more educated and more affluent are the ones who are engaging in this practice, and it is simply because of the patriarchal mindset that property cannot go to the daughter, and the daughter is a burden. They will not think about killing their daughters, but they do not dare to oppose the dowry system, and thus, daughters continue to be a burden. In contrast, bride-price is to be paid in tribal areas and daughters are no burden at all, so the sex ratio is balanced”.

Let’s look at the literacy rate of India.As shown in Figure 3,considering various Census data, we conclude that the overall literacy rate has been growing over the years. Therefore we expect a positive correlation with the gender ratio in multiple states.

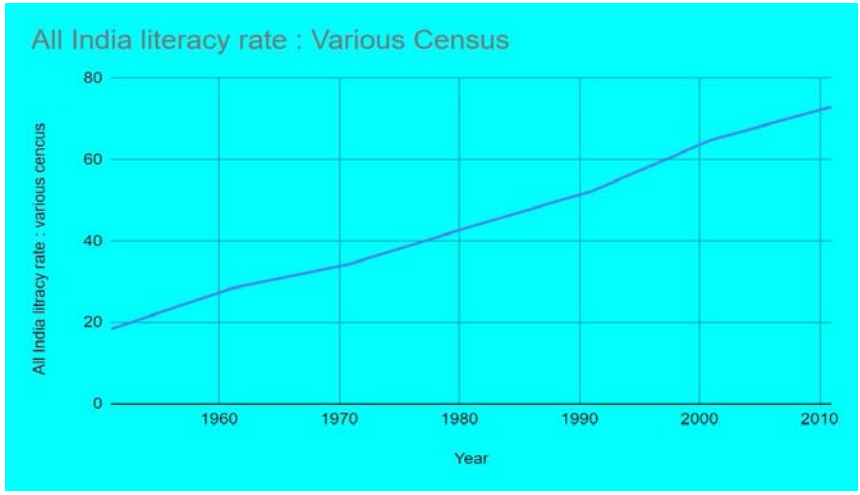

Figure 3: All India literacy rate: various census
Source: Reserve Bank of India, Authors Calculation

Amelioration of almost 9.2 percent in the Literacy rate of India has been shown as per the Population Census of India 2011. From 65.38% in 2001, it has gone up to 74.04 percent in 2011, therefore, marking an uplift of over 9 percent in the last 10 years. Figure 4 depicts states' position in terms of literacy rates for the censuses of 1961, 1971, 1981, 1991, 2001 and 2011.Kerala ranks highest with a 93.91 percent literacy rate in India. Mizoram stands at second position with a literacy rate of 91.58 percent. Bihar stands to be the last in terms of literacy rate with a 63.08 percent literacy rate in India. The majority of Indian states have shown improvements in this regard.In the future, we may expect that India will gradually do away with the disparities in literacy rates among the Indian States.

When we look into the state-level data more precisely for literacy rate we find that the highest literacy rate scores are in the states of Kerala, Delhi, Goa, Mizoram, and Maharashtra followed by other states. On the other side, the lowest-scoring states are Himachal Pradesh, Bihar, Rajasthan, and Uttar Pradesh, followed by several other states. Also, it is to mention here that the nation experiences a wide gender disparity in literacy rate 65.46 percent for women, and it stands out to be 82.14 percentfor men.

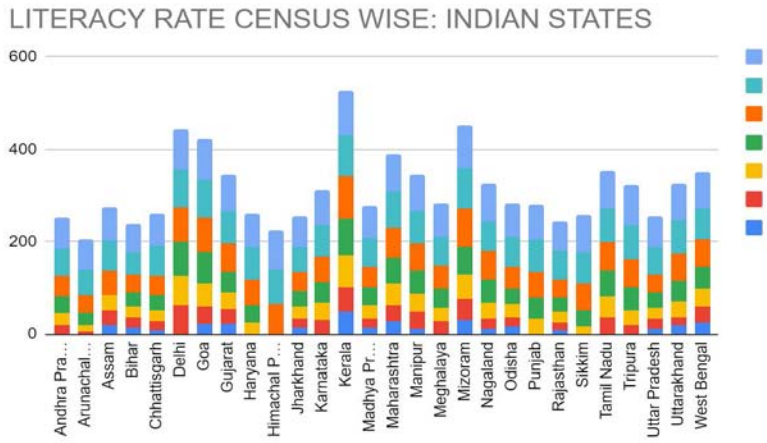

Figure 4: Literacyrate in Indian states: various censuses
Source: Reserve Bank of India, Calculation done by Authors

(Clark 2000; Murthy, et al., 1995), states that education plays a crucial role in reducing the magnitude of gender inequality. Theyattempted to explore this segment to see whether Infant mortality and Literacy rate explain the differences in sex ratio and have some impact on the same.Considering their second variable, Infant Mortality Rate, the empirical studies suggest that it is one of the fundamental components of demographic change. The accompanying data is crucial for studies related to population studies.

As far as Infant Mortality Rate is concerned, if we compare the decadal changes, we find that the present rate is about one-fourth compared to the 1971 census,as shown in Figure 5.In the last decade, the Infant Mortality Rate has diminished by almost 35 percent as far as rural areas are concerned and in urban areas by about 32 percent. As a result, the infant mortality ratefor all India has decreased from 50 to 32 in the last decade.Figure 5 explains the trend of the Infant Mortality Rate in India in various decades.

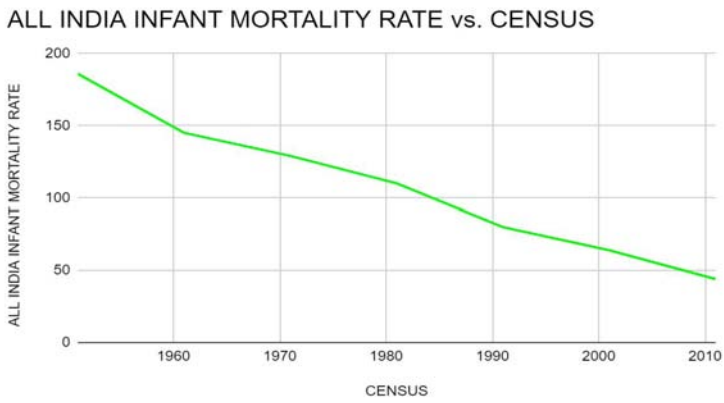

Figure 5: All India infant mortality rate:various census
Source: Office of the Registrar General and Census Commissioner, Government of India.

Analyzing the state-wise data (Figure 6)Madhya Pradesh is the state which suffers from the worst infant mortality rate in the country and on the other hand the state of Nagaland has the best infant mortality rate. The best performing states regarding infant mortality rates are Nagaland followed by Kerala, Goa, Manipur, and Sikkim, while the least performing states are Madhya Pradesh followed by Odisha, Rajasthan, Uttar Pradesh, Assam, and other states, respectively.

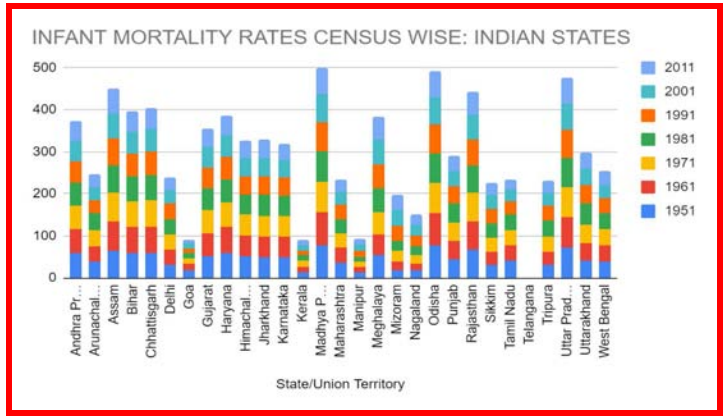

Figure 6 : Infantmortality rates in Indian states: census wise
Source: Reserve Bank of India, Calculation done by Authors

With an increase in the Literacy rate and decrease in Infant Mortality Rate, we could expect a positive impact on the sex ratio disparity in the Indian States. Surprisingly, when we try to find out various factors responsible for these differentials, we don't get a satisfying answer to this matter. As per Nobel Laureate Amartya Sen (Sen, 1992)"The elevated prevalence of gender definite abortions in the western part of Indiaandnorthern India cannot be elucidated by the presence of medical facilities as in the case of West Bengal and Kerela we see that they do not have less of these than the state of Madhya Pradesh or any other laggard state. Neither could any observation was made if the religion disparity is responsible up to some extent as the Muslims and Hindus were spread across the country, and their behavior was much influenced by their local surroundings. Surprisingly, the division based on income levels of states any conclusion could not be drawn because we have Punjab and Haryana as the most performing states in terms of incomelevels. Still, they are the ones who are the most laggard states in terms of sex ratio and gender disparity along with states of Uttar Pradesh and Madhya Pradesh, who are laggard both in terms of income levels as well as sex ratio. Even the variations in economic growth fail to explain these phenomena as we have Bihar where the growth rate is in stagnation and we also have Gujrat with an impressive growth rate. Even in the states where the female literacy rate is high, we cannot draw a particular conclusion that increased education levels in women bring down the gender disparity on all fronts. As far as the other Asian economies are concerned, we must mention South Korea, China, Singapore, and Taiwan in this context.

These observations do not let anybody come to a fair conclusion about gender disparity in various economies and have become a never-ending saga to introspect multiple factors responsible for the same.The uncertain answer to these questions calls for intensive research today. Therefore my work is an attempt to study the impact of Infant Mortality and Literacy Rate on Gender Disparity in the various Indian States in this direction.

2. REVIEW OF LITERTRE

(Bose S, Trent KJ, 2006)found, the main cause of son preference in India is responsible for gender disparity and the root cause lies in deeply entrenched socio-economic and cultural, partisanship contra females both including girl child and adult and there is substantiation that this sort of gender prejudice is growingand disseminating in contemporary India and its states in particular.

(Agarwal, 2012) states that the configuration of sex in children remainsrobust and has a significant association with females who have experienced abortion, even

when enough has been done regarding work status, education, women's autonomy, wealth status, media exposure, and rural/urban residence.

Data from National Family Health Survey-5, 2018, on son predilection, and the deployment of amniocentesis and ultrasound during pregnancy abortions, sex ratios at birth present strong substantiation of the large deploy of gender-specific abortions, peculiarly in the states of Punjab, Haryana & Gujrat.

(Arnold et al.,2002) estimated that more than one lakh gender distinct abortions of fetuses were executed every year in India in the late 1990s. The government regulation may havea minor effect, but practically the situation worsens day by day and would fail to bring down the societal parameter of son preference.

Various factors are responsible for selective abortions in the Asian Economies and a study by(Gupta et al.,2003) reveals that proclivity for sons in the Asian continent can be mainly attributed to the societal structure, such as patriarchy, less earning capacity, dowry worries, and family hierarchy which makes it difficult to raise a daughter.

Mortality Rates and gender ratios at birth are inversely related in populations, says (Madhukar Shivaji Rao Dama,2012) in his study and states that there is a correlation between mortality indices and gender ratio at birth. In the complete analysis, it was discovered that mortality rates were a notable predictor of sex ratios.

(Purnima Upreti1& Rajesh Kumar Singh, 2017) reveals that gender ratio at birth surged with proceeding literacy and maternal age standing of females. However, it deteriorated with growth in birth order and the number of live girl child and women in the families. Much succeeding research (Agnihotri, 2000; Dreze&Sen, 2002) has revealed that the sex differential in child mortality was a weighty, probably the substantial, contributor to the high sex ratio in India in recent years.Some studies(Bhattacharya, 2006; Drèze and Sen, 2002; Miller, 1981).It was divulged that boys received more medical supervision than girls and that health dysfunctioning was allowed to exist more in the case of girls than boys. The health of female children was neglected, and therefore, this became the prime reason for the disadvantaged position of females in India rather than getting more influenced by female infoeticide.(Cai&Lavely, 2003) revealed that in China the sex ratio disparity is not a new phenomenon, as in the case of India. It is believed that in various periods in the past, the families in China used infanticide to command the size of the family maintained their gender balance too.

There are various studies (Singh, 2013) conducted to see the impact of literacy rate on gender disparity and a study by Sandeep Singh concluded that literacy finally fails to change the thinking of people in various states and Union Territories of India.(Kumar & Yadav, 2011) reinstate that literacy rate and sex ratio are independent of each other, and the growth in literacy rate is not considered to fill the gap between male-femalepopulation. So, it is the need of the hour to make changes and uplift the literacy in the nation and make it more formidable, which definitely will bring change in the psychology of society towards girls & females, failing to do this and overcome the problem of unbalanced sex ratio we can expect a plethora of problems in all aspects of our lives at current and definitely in future.In Haryana sex ratio and literacy are negatively correlated, which denotes that in the districts where literacy is highest, the sex ratio is minimum and vice-versa. As in the case of Gurgaon and Mewat reveals (Suman & Meena, 2017).(Imam, 2020) found that as per census 2001, there was no correlation between sex ratio and literacy rate but the result was reversed per the 2011 census. A strong correlation was observed between the sex ratio and literacy rate. It was also reflected using the fact that few districts of the state of Bihar experienced a very high literacy rate and also recorded a very high sex ratio.

(Shetty &Shetty, 2014) reveal that there was an improvement of the female literacy rate in India from 29.85percent in 1981 to 65.45 percent in 2011. The sex ratio also showed improvement as it raised to f943 from 934 in the same period. However, they insisted that the regional disparity existed as the changes observed in sex ratio and female literacy rates in individual states were not uniform. There was significant regional dissimilitude among states. (Lal, 2019) in his study states about the state of Haryana stated that there was a positive correlation between sex ratio and literacy rate.(Murthi&Dreze, 1995) did a district-level analysis on gender bias in India and concluded that they play a vital role in explaining the gender biases in these districts.After studying the legislatures related to gender disparity and control measures (Basu, 2009) mentioned harmful practices against females in India and stated that these measures had less impact on the patriarchal society.

Sex ratio is in favor of men in India, disclosed (Singh, 2010; Rajaram&Zararia, 2009) studied human rights about women in Gujrat and concluded that Gujrat is suffering in terms of gender injustice.(Bhaskar & Gupta, 2007) wrote on missing girls in India and explored the role of customs, and development factors of the economy in exploring the effectiveness of the same.(Bhattacharya, 2011) explored the gender disparity in the world's emerging economies and stated that this problem

was persistent in all categories of the emerging economies. (Hassan, 2000) in his study found the sex disparity in the state of Haryana to be very prominent. In a similar study, the changing dynamics of the male-female ratio was observed by (Clarke, 2000)

Somestudies (Colclough, 1982; Dreze,2003; Das V. et al., 2011) mentioned the positive impact of literacy rate on the sex ratio. It was a responsible factor in terms of uplifting the women in societies.(Kaur, 2012) in her study on China and India mentioned the adverse impact on the society and economy due to gender biases, disparity, and sex selection. (Richmond, 2000) studies the particular case of the state of Himachal Pradesh and observed the phenomena of excessive mortality in females. (Jha et al.,2011) analyzed the trend of sex-selective abortions in India and found it very common in almost all states of India. (Jayaraj& Subramanian, 2009) found that if positive changes take place in the gender ratio in India it has its implication on the population's wellbeing.

Few studies reveals the fact that the females fail to get a proper representaion in the jobs and also the chances of being on board declines when they experience motherhood and proper childcare fecilities are a big missing at the workplace.(Kowalewska Helen, 2021) revealed that many countries fail to bring women on board because they lack in providing proper childcare environmrnt and services and therefore it becomed really problamatic for women to come on front. (Madsen Å, Brekke I, FekjærSilje B, 2021) found that the attiration rate of females increases as the male percentage increases in the workplace and also the child birth increased the attiration rate as compared to the women having younger children.

The career progression, advancement and opportunities of training to enhance skills suffer a lot because of labour market discrimination.(Rafferty A, 2019).Even in the countries referred as most equal one, i.e. the scandinavian economies, (Seierstad C, Healy G, 2012) revealed that women in these countries face discrimination in terms of gender eqality and job opportunities. Also the evidence of discrimination at the university level was found.Discrimination is found to be lower in some studies where women empowerment was witnessed. (Triventi M,2013)

3. DATA DESCRIPTION & RESEARCH METHODOLOGY

Firstly, the time-series properties of all the variables, viz. sex ratio, infant mortality rate, and literacy rate were examined before taking up the panel data regression approach. The test is conducted in SPSS (R Essentials - Stationarity Tests). Inthe investigation, different methods of panel unit root tests were applied.

Table-2: Panel unit root tests

	Sex Ratio	**Mortality Rate**	**Literacy Rate**
Test (2)	Phillips-Perron	Phillips-Perron	Phillips-Perron
Alternative Hypothesis (2)	Stationary	Stationary	Stationary
P-Value (2)	0.01	0.01	0.01
Note (2)	p-value smaller than printed p-value	p-value smaller than printed p-value	p-value smaller than printed p-value
Truncation Lag (2)	4	4	4
Test (3)	Augmented Dickey-Fuller	Augmented Dickey-Fuller	Augmented Dickey-Fuller
Alternative Hypothesis (3)	Stationary	Stationary	Stationary
P-Value (3)	0.01	0.01	0.01
Note (3)	p-value smaller than printed p-value	p-value smaller than printed p-value	p-value smaller than printed p-value
Truncation Lag (3)	5	5	5
Test (4)	KPSS Test for Stationarity	KPSS Test for Stationarity	KPSS Test for Stationarity
Null Hypothesis (4)	Level	Level	Level
P-Value (4)	0.1	0.1	0.1
Note (4)	p-value greater than printed p-value	p-value greater than printed p-value	p-value greater than printed p-value
Truncation Lag (4)	4	4	4

The Phillips - Perron, Augmented Dicky-Fuller, and KPSS tests for stationarity were conducted. Here, the alternative suggests the stationarity of data and signifies that unit root at level is absent. Therefore we were assured in terms of acceptance of the alternative hypothesis and rejection of the null hypothesis. The results of all the panel unit root tests are presented in Table 2 and the results suggest that all variables into consideration are stationary at levels. The p value obtained in all the tests denotes that we reject the null hypothesis as the p value obtained is smaller than the printed p value.

The sex ratio response function is measured using the panel estimation method after ensuring the static properties of the data set. The Fixed-Effects Model is used for the analysis after the Hausman test validates the use of fixed effects. The absence of heteroscedasticity was assured through a diagnostic check as shown in Figures 7 and 8. Though the model suffered from autocorrelation, it is shown that the result of a Durbin-Watson value=.916 is obtained in Table 3.

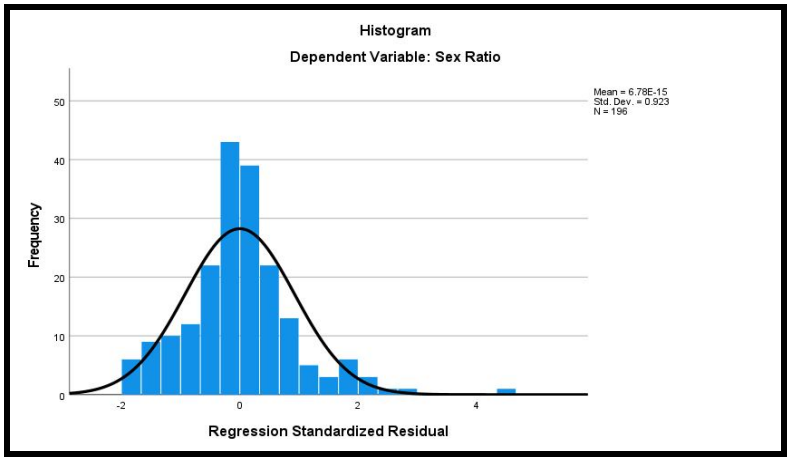

Figure7: Hausman test

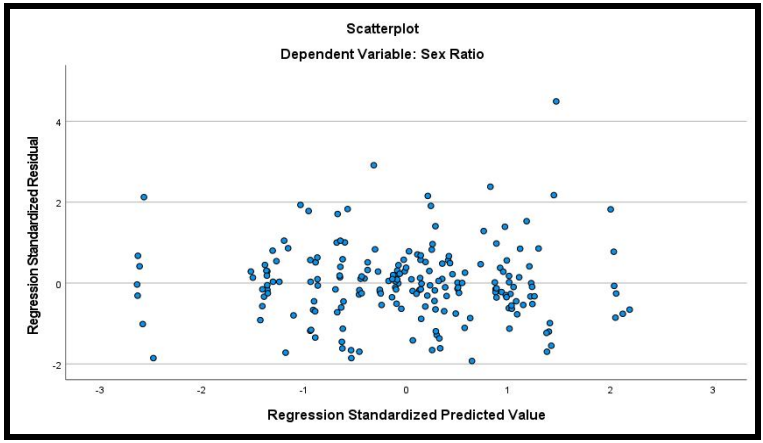

Figure 8: Scatter plot

Table-3: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R square change	F Change	df1	df2	Sig. F change	Durbin-Watson
1	.896[a]	.804	.769	26.263	.804	23.423	29	166	<.001	.916

a. Predictors: (Constant), westbengal, Literacy Rate, Manipur, Gujrat, Meghalaya, Sikkim, Karnataka, Haryana, Uttarakhand, Nagaland, Assam, Tripura, Punjab, Maharashtra, Odisha, Tamilnadu, Madhya, Chatt, Arunac, Mizoram, Uttarpradesh, Rajasthan, Delhi, Bihar, Kerela, Infant Mortality Rate

b. Dependent Variable: sex ratio

This research was conducted to estimate the differentials in sex ratio within the Indian States using the Least square dummy variable (LSDV) regression model. Secondary data were sourced for the analysis from the RBI Handbook on Statistics on the Indian States for seven consecutive censuses, i.e., 1051, 1961, 1971, 1981, 1991, 2001 & 2011.The variables considered were sex ratio as the dependent variable and Infant mortality rate and Literacy Rate as independent variables. SPSS 28 is used to analyze the data set.

As we know, Panel Data is a combination of cross-section data and time-seriesdata, where the same unit cross-section is measured at different periods. In other words, panel data is data from some of the same individuals (IndianStates) observed in a certain period (variousCensus). For example, if we have T periods (t = 1,2, ..., T) and N the number of individuals (i = 1,2, ..., N), then with panel data, we will have total observation units of $N \times T$. In this case, the $N \times T = 28 \times 7 = 196$ as the number of censuses considered is 7 and the number of states considered is 28.

The fixed-effect model denotes that the sex ratio differentials in Indian states are due to disparities in Infant Mortality Rate and Literacy Rate. Still, other explanatory variables are also responsible for the gap in sex ratio in Indian states. The responsible factors could be cultural diversity, son preference, structure of marriage, income levels, medical facilities, government policies, etc. Therefore, we should probably control that there are these differences among various Indian states.

The fixed-effect model says we should add a term in the equation F_e for an individual specific fixed effect. We need to build that into our model to say that each state is different from each other and all of them are different from the reference state i.e., Andhra Pradesh. So we have created dummy variables for each state, giving each state a different Y-intercept. So we have considered Andhra Pradesh as a reference state to avoid the problem of perfect multicollinearity.

This estimation model used here is the technique of the Least Squares Dummy Variable (LSDV).

$$Y_{it} = \boldsymbol{\beta}_{\theta} + {}_{1}X_{1it} + \boldsymbol{\beta}_{2}W_{1it} + F_{e} + e_{it}. \quad (1)$$

Y_{it} = Dependent Variable (sex ratio)

$\boldsymbol{\beta}_{\theta}$= Constant

$\boldsymbol{\beta}_{1=}$ coefficient of variable 1

$\boldsymbol{\beta}_{2=}$ coefficient of variable 2

$\boldsymbol{\beta}_{1}X_{1it}$ = independent variable 1 (infant mortality rate)

$\boldsymbol{\beta}_{2}W_{1it}$ = independent variable 2 (sex ratio)

F_e = fixed effect

E_{it} = error term,

where F_e is an unobserved variable that varies from one state to the next but does not change over time.

4. RESULTS AND DISCUSSIONS

Since the country, state, and regions are heterogeneous and we know that the panel data allows us to study for each Individual at various periods, we can consider individual state analysis as the panel data set has more advantages over the cross-section and time-series data. It is observed that the coefficient for the majority of states is in favor of the notion that the sex ratio differential in various states is explained by the differential in mortality rate in various Indian states and Literacy rate differential in the different Indian States. The Infant mortality rate is found to be a more determining factor in comparison to the literacy rate. Priori expectations are therefore fulfilled in these findings, as shown in Table 4

Table-4: Panel data analysis for Indian states:coefficients

Model		Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(constant)	1052.162	23.982	-	29.241	<0.001
	Arunac	-117.671	18.631	-.395	-6.316	<0.001
	Assam	-56.395	16.654	-.190	-3.386	<0.001
	Bihar	-25.746	14.616	-.093	-1.761	.080
	Chhatt	24.807	14.772	.090	1.679	.095
	Delhi	-174.703	17.727	-.587	-9.855	<0.001
	Goa	-14.308	26.782	-.052	-.534	.594
	Gujrat	-45.300	14.480	-.164	-3.128	.002
	Haryana	-107.608	15.795	-.331	-6.813	<.001
	Himachal	-10.527	19.005	-.025	-.554	.580

	Jharkhand	-42.018	14.916	-.152	-2.817	.006
	Karnataka	-23.071	15.529	-.078	-1.486	.140
	Kerela	21.282	26.247	.077	.811	.419
	Madhya	-31.435	18.374	-.114	-1.711	.089
	Maharashtra	-66.000	17.992	-.239	-3.668	<.001
	Manipur	-34.026	27.168	-.123	-1.252	.212
	Meghalaya	-16.689	15.127	-.056	-1.103	.272
	Mizoram	-38.840	19.696	-.141	-1.972	.050
	Nagaland	-103.147	23.294	-.373	-4.428	<.001
	Odisha	29.176	17.927	.106	1.627	.106
	Punjab	-111.163	17.098	-.342	-6.502	<.001
	Rajasthan	-51.028	15.753	-.185	-3.239	.001
	Sikkim	-132.064	19.313	-.406	-6.838	<.001
	Tamilnadu	-15.508	18.804	-.052	-.825	.441
	Tripura	-53.890	18.592	-.181	-2.898	.004
	Uttarpradesh	-67.942	17.071	-.246	-3.980	<.001
	Uttarakhand	-43.661	15.509	-.158	-2.815	.006
	Westbengal	-90.005	17.140	-.326	-5.251	<.001
	Infant Mortality Rate	-1.193	.602	-.393	-1.981	.049
	Literacy Rate	-.247	.119	-.102	12.069	.040

a. Dependent Variable: Sex Ratio

The most significant results were for Delhi (coeff -174.703, p value =< .001) followed by Sikkim, (coeff -132.064, p value =< .001) ArunanchalPradesh, (coeff -117.671, p value =< .001) Punjab, (coeff -111.163, p value =< .001) Haryana, (coeff -107.608, p value =< .001) Nagaland, (coeff -103.147, p value =< .001) West Bengal, (coeff -90.005, p value =< .001) Uttar Pradesh, (coeff -67.942, p value =< .001) Maharashtra, (coeff -66.000, p value =< .001) Assam, (coeff -56.395, p value =< .001).

The results indicate that out of 28 states in eighteen states, and results are statistically significant. The non-significant results are for Bihar, Chhattisgarh, Goa, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Tamil Nadu, and Odisha. The independent variables are statistically significant (Infant mortality rate and Literacy Rate)

Although there is a problem of autocorrelation in the data, with Durbin - Watson value being less than 2, i.e., .916, overall the model is fit to use as denoted by the F statistics = 21.145, R2 = .804, along with < .001 significance level according to the results in Tables 5 to 7.

Table-5: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	413586.160	29	14261.592	21.145	<.001[b]
	Residual	99822.064	148	674.473		
	Total	513408.225	177			

a. Dependent Variable: sex ratio

b. Predictors (constant), Litracy rate,Manipur, Sikkim, Haryana, Meghalaya, Karnatak, assam, Tripura, Punjab, Gujrat, west Bengal, Nagaland, Uttarakhand, Tamilnadu, Himanchalpradesh, odisha, Maharashtra, Madhya Pradesh, Aruranchal Pradesh, Goa, Chattisgarh, Jharkhand, Mizoram, Uttar Pradesh, Delhi, Rajastan, Bihar, Kerela, Infant Mortality Rate

Table-6 : Variables entered/removed[a]

Model	Variables Entered	Variable Removed	Method
1	Literacy Rate, Manipur, Sikkim, Haryana, Meghalaya, Karnataka, Assam, Tripura, Punjab, Gujrat, west-Bengal, Uttarakhand, Nagaland, TamilNādu, Himachal Pradesh, Odisha, Maharashtra, MadhyaPradesh, Arunachal, goa, Chhattisgarh, Jharkhand, Mizoram, UttarPradesh, Delhi, Rajasthan, Bihar, Kerala, Infant mortality rate [b]	none	Enter

a. Dependent Variable: Sex Ratio

b. All requested variables entered.

Table- 7: Residual Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	808.92	1045.24	938.06	49.016	196
Residual	-50.586	117.985	.000	24.231	196
Std. Predicted Value	-2.635	2.187	.000	1.000	196
Std. Residual	-1.926	4.493	.000	.923	196

a. Dependent Variable: Sex Ratio

b. All requested variables entered.

5. CONCLUSIONS

There will be severe consequences due to the declines in sex ratio in general and child sex ratio in particular. For example, women represent 40 percent of the global labor force. In the world's agricultural labor force 43 percent representation is noted, and as per the world's university students' strengths, almost half of the representation comes from females. If their skills and talents are used more fully, undoubtedly productivity will be raised.Unless distortions in sex ratioare of a substantial magnitude, it fails to make its presence felt in the societal structure of the nation. Beforeportraying the decline of the sex ratio in the selected Indian states, we must understand that many of the state's situation is more based on speculations than on empirical findings and extensive research. Though the Sub National governments are attempting to fulfill the problem of gender disparity, we should realize that this is a structural problem and no solution can be of short term in nature as far as more males or missing women of India are concerned. Apart from positivity in the results of Infant Mortality and Literacy Rate, we also have to see that laws are abiding in case of abandonment, infanticide, and negligence of girl child. Also,trafficking and kidnapping penalties are harsh enough to get conducive results. The Indian government and the state government can move forward towards other measures as well. Public awareness campaigns guaranteed equal social and economic rights for males and females, primary health care facilities, especially in rural India, should be available free of charge so that the financial constraints could be overruled, and proper care of girl Childs can be taken. The government of India is providing some special supportive measures to families with a single girl child.

South Korea has already started showing positive results in terms of Gender Disparity and we are looking forward to India and the laggard Indian states too will come up with conducive results. Conscious efforts are needed to deconstruct the patriarchal idea of integrity and reconstruct society'sbelief systems at par with other nations. We are looking forward to using progressive legal measures by implementing awareness programs and large-scale social movements soon.

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APPENDICES:-

Time Series Tests for Variable: SEXRATIO

	Values
Test(2)	Phillips-Perron
Alternative Hypothesis(2)	Stationary
P-Value(2)	0.01
Note(2)	p-value smaller than printed p-value
Truncation Lag(2)	4
Test(3)	Augmented Dickey-Fuller
Alternative Hypothesis(3)	Stationary
P-Value(3)	0.01
Note(3)	p-value smaller than printed p-value
Truncation Lag(3)	5
Test(4)	KPSS Test for Stationarity
Null Hypothesis(4)	Level
P-Value(4)	0.1
Note(4)	p-value greater than printed p-value
Truncation Lag(4)	4

Computations done by R package tseries

Time Series Tests for Variable: MORTALITYRATE

	Values
Test(2)	Phillips-Perron
Alternative Hypothesis(2)	Stationary
P-Value(2)	0.01
Note(2)	p-value smaller than printed p-value
Truncation Lag(2)	4
Test(3)	Augmented Dickey-Fuller
Alternative Hypothesis(3)	Stationary
P-Value(3)	0.01
Note(3)	p-value smaller than printed p-value
Truncation Lag(3)	5
Test(4)	KPSS Test for Stationarity
Null Hypothesis(4)	Level
P-Value(4)	0.1
Note(4)	p-value greater than printed p-value
Truncation Lag(4)	4

Computations done by R package tseries

Time Series Tests for Variable: LITRACYRATE

	Values
Test(2)	Phillips-Perron
Alternative Hypothesis(2)	Stationary
P-Value(2)	0.01
Note(2)	p-value smaller than printed p-value
Truncation Lag(2)	4
Test(3)	Augmented Dickey-Fuller
Alternative Hypothesis(3)	Stationary
P-Value(3)	0.01
Note(3)	p-value smaller than printed p-value
Truncation Lag(3)	5
Test(4)	KPSS Test for Stationarity
Null Hypothesis(4)	Level
P-Value(4)	0.1
Note(4)	p-value greater than printed p-value
Truncation Lag(4)	4

Computations done by R package tseries

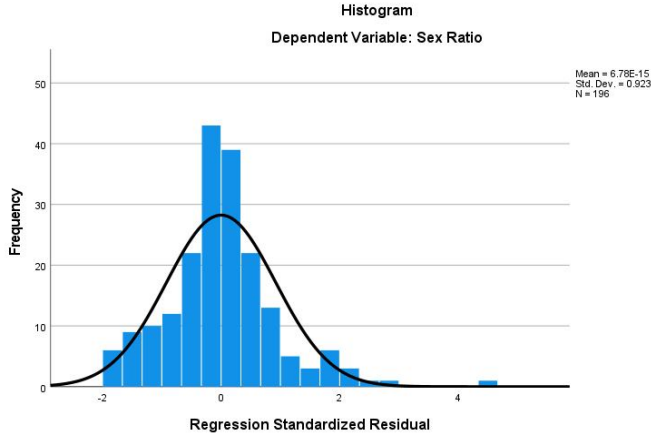
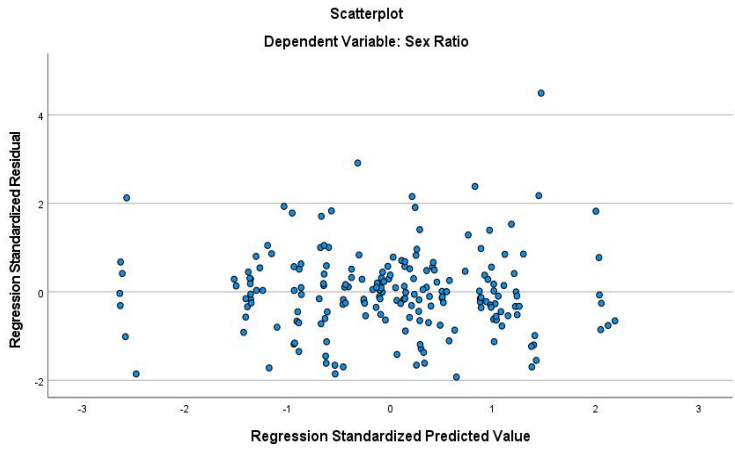


CHART-7



Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.896[a]	.804	.769	26.263	.804	23.423	29	166	<.001	.916

a. Predictors: (Constant), westbengal, Litracy Rate, Manipur, Gujrat, Meghalay, sikkim, Karnatak, Haryana, uttarakhand, nagaland, Assam, tripura, punjab, Maharashtra, odisha, tamilnadu, Madhya, Himachal, Chhatt, Goa, Arunac, Jharkhand, mizoram, uttarpradesh, rajasthan, Delhi, Bihar, Kerela, Infant Mortality Rate

b. Dependent Variable: Sex Ratio

APPENDIX-V

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1052.162	35.982		29.241	<.001
	Arunac	-117.671	18.631	-.395	-6.316	<.001
	Assam	-56.395	16.654	-.190	-3.386	<.001
	Bihar	-25.746	14.617	-.093	-1.761	.080
	Chhatt	24.807	14.772	.090	1.679	.095
	Delhi	-174.703	17.727	-.587	-9.855	<.001
	Goa	-14.308	26.782	-.052	-.534	.594
	Gujrat	-45.300	14.480	-.164	-3.128	.002
	Haryana	-107.608	15.795	-.331	-6.813	<.001
	Himachal	-10.527	19.005	-.025	-.554	.580
	Jharkhand	-42.018	14.916	-.152	-2.817	.006
	Karnatak	-23.071	15.529	-.078	-1.486	.140
	Kerela	21.282	26.247	.077	.811	.419
	Madhya	-31.435	18.374	-.114	-1.711	.089
	Maharashtra	-66.000	17.992	-.239	-3.668	<.001
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	Meghalay	-16.689	15.127	-.056	-1.103	.272
	mizoram	-38.840	19.696	-.141	-1.972	.050
	nagaland	-103.147	23.294	-.373	-4.428	<.001
	odisha	29.176	17.927	.106	1.627	.106
	punjab	-111.163	17.098	-.342	-6.502	<.001
	rajasthan	-51.028	15.753	-.185	-3.239	.001
	sikkim	-132.064	19.313	-.406	-6.838	<.001
	tamilnadu	-15.508	18.804	-.052	-.825	.411
	tripura	-53.890	18.592	-.181	-2.898	.004
	uttarpradesh	-67.942	17.071	-.246	-3.980	<.001
	uttarakhand	-43.661	15.509	-.158	-2.815	.006
	westbengal	-90.005	17.140	-.326	-5.251	<.001
	Infant Mortality Rate	-1.193	.602	-.393	-1.981	.049
	Litracy Rate	-.247	.119	-.102	-2.069	.040

a. Dependent Variable: Sex Ratio

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	413586.160	29	14261.592	21.145	<.001[b]
	Residual	99822.064	148	674.473		
	Total	513408.225	177			

a. Dependent Variable: Sex Ratio

b. Predictors: (Constant), Litracy Rate, Manipur, sikkim, Haryana, Meghalay, Karnatak, Assam, tripura, punjab, Gujrat, westbengal, uttarakhand, nagaland, tamilnadu, Himachal, odisha, Maharashtra, Madhya, Arunac, Goa, Chhatt, Jharkhand, mizoram, uttarpradesh, Delhi, rajasthan, Bihar, Kerela, Infant Mortality Rate

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Litracy Rate, Manipur, sikkim, Haryana, Meghalay, Karnatak, Assam, tripura, punjab, Gujrat, westbengal, uttarakhand, nagaland, tamilnadu, Himachal, odisha, Maharashtra, Madhya, Arunac, Goa, Chhatt, Jharkhand, mizoram, uttarpradesh, Delhi, rajasthan, Bihar, Kerela, Infant Mortality Rate[b]	.	Enter

a. Dependent Variable: Sex Ratio

b. All requested variables entered.

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	808.92	1045.24	938.06	49.016	196
Residual	-50.586	117.985	.000	24.231	196
Std. Predicted Value	-2.635	2.187	.000	1.000	196
Std. Residual	-1.926	4.493	.000	.923	196

a. Dependent Variable: Sex Ratio