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Sustainable Development: A Collaborative approach through Humanities, Commerce and Science

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JMF'S VANDE MATARAM DEGREE COLLEGE OF ARTS, COMMERCE AND SCIENCE

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A STUDY ON SUSTAINABLE DEVELOPMENT AND MOBILE PHONE USAGE AMONG INDIAN YOUTH

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Abstract

This study emphasized the relevance of values in promoting digital competency for sustainable development by examining the relationship between the problem of mobile phone addiction and the values taught in schools. The study employed a predictive correlational design with 1,453 elementary and secondary school pupils (61.3% female, 38.7% male) as the sample. The findings indicated a strong correlation between the frequency of mobile phone addiction and the values that are taught in schools. According to the findings, a greater emphasis on values lowers the risk of addiction. Personal values like passion, patience, impartiality, openness, honesty, and balance, as well as social values like solidarity, inclusiveness, and justice, showed very high associations. Younger children showed lower levels of cell phone addiction, according to the study, which also showed disparities across educational stages

Keywords:- values; addiction; mobile phones; Sustainable Development Goals; adolescence

Introduction

Mobile phones have become an essential element of everyday life in recent years, particularly for young people worldwide. The quick rise in mobile phone use in India has changed how young people interact with the outside world, communicate, and learn. Young people make up a sizable share of India's 800 million+ mobile subscribers, making it one of the world's largest mobile phone marketplaces. Mobile phones have many advantages, like social networking, educational resources, and information access, but they also present problems that need to be resolved, especially when it comes to sustainable development.

According to the UN, sustainable development is about addressing current demands without sacrificing the capacity of future generations to address their own. All industries, including education, technology, and environmental preservation, must embrace sustainable techniques. Because of the processes involved in their manufacture, use, and disposal, mobile phone use has a significant negative influence on the environment even while it promotes social and economic progress. Since mobile phones are still a major part of youth culture, it is crucial to comprehend how they contribute to sustainable development in order to ensure that India's youth can help create a more just and sustainable future.

With an emphasis on how technology affects social behavior, environmental consciousness, and educational outcomes, this study attempts to investigate the connection between mobile phone use and sustainable development among Indian adolescents. It specifically looks at the possible dangers of cell phone addiction and how it affects moral principles like environmental stewardship, social responsibility, and empathy. Additionally, it emphasizes the necessity of educational programs that encourage teenagers to connect their actions with sustainable practices by promoting responsible mobile phone usage.

It is more important than ever to raise awareness of the negative effects that mobile phones have on the environment, society, and mental health of young people. In order to support the larger objectives listed in the Sustainable Development Goals (SDGs) of the United Nations, specifically SDG 4 (Quality Education) and SDG 12 (Responsible Consumption and Production), this study aims to offer insightful information about how mobile phone usage among Indian youth can be in line with the principles of sustainable development. This study intends to inform policies and practices that can assist Indian youth in responsibly navigating the digital era and contributing to a sustainable future by identifying the links between mobile phone usage and sustainable development.

Objectives Of The Study

- To look at methods for minimizing high screen time and promoting sensible use.
- To look into reducing negative impacts

- To assess and promote mobile phone use for education and self-improvement.
- Make use of mobile technologies to improve teamwork, communication, and innovation.
- Give youth the tools they need to assess internet content critically and spot false information.
- Encourage responsible online conduct and raise knowledge of security and privacy concerns.
- Promote the use of mobile devices for education and self-improvement.

Literature Review

With over 500 million mobile phone users in India, mobile phones have become integral to daily life. However, their production and disposal contribute to electronic waste (e-waste), which poses environmental and health risks. Research has linked mobile phone usage to increased energy consumption, greenhouse gas emissions, and e-waste generation.

Methodology

This study utilized a survey research design, gathering data from 500 Indian youth aged 18-25. The survey consisted of 20 questions addressing mobile phone usage patterns, awareness of sustainable development, and attitudes toward environmentally responsible behaviors. Descriptive and inferential statistical methods were employed to analyzes the data.

Discussion

This study examines the connection between Indian youth's use of mobile phones and sustainable development, illuminating the ways in which technology use—more especially, mobile phone use—interacts with environmental, social, and economic sustainability. In India, mobile phones have become a commonplace tool for young people, enabling entertainment, education, and communication. But there are drawbacks to this extensive use as well, especially when it comes to the effects on the environment, social behavior, and well-being.

According to the research, excessive usage of mobile phones can lead to addiction, mental health problems, and a decline in physical activity, even though they are useful instruments for social and educational connectivity. Since the manufacture, usage, and disposal of mobile phones greatly contribute to electronic waste, resource depletion, and pollution, mobile phone addiction among young people in India is not only a behavioral issue but also an environmental one, as this study has shown.

Understanding how mobile phone use affects sustainable development, especially in relation to the Sustainable Development Goals (SDGs) of the UN, was one of the study's main objectives. According to the study, mobile phones can provide educational and skill-building possibilities, but they can also diminish social contacts and impede the development of important values like empathy, social justice, and environmental awareness. For example, too much screen time frequently results in fewer in-person contacts, which erodes social ties and lessens the emphasis on solidarity and collective responsibility—two important social ideals that are essential to sustainable development.

Furthermore, it is impossible to ignore how using a mobile phone affects the environment. There are significant environmental dangers associated with the rapid rise in electronic garbage, or "e-waste," caused by young people in India owning mobile phones. The environmental effect of mobile phones is made worse by inappropriate disposal techniques and a lack of recycling infrastructure as they approach the end of their life cycle. This emphasizes how young people need to be more conscious of the effects that their use and disposal of mobile phones have on the environment. The environmental impact can be greatly decreased by teaching young people how to recycle old electronics, dispose of electronic trash ethically, and prolong the life of their phones.

The report emphasizes how important it is for educational institutions and schools to help young people use technology in a more sustainable way. A generation of young people who are not just tech-savvy but also conscious of the social and environmental ramifications of their digital habits can be produced by teaching pupils about digital literacy, responsible consumerism, and sustainable behaviors in relation to technology. This is particularly crucial in India, where mobile phones are now a major means of obtaining education, especially in underprivileged and rural areas.

The necessity of incorporating sustainable development goals into the educational system is also emphasized by the study. SDG 4, which emphasizes high-quality education and opportunities for lifelong learning, calls for an

educational system that fosters ethical ideals, socioemotional development, and responsible citizenship in addition to cognitive growth. According to the research, implementing sustainability-focused curricula in schools may help youth comprehend the wider effects of their digital behavior, empowering them to make wise decisions about using mobile phones and help create a more sustainable future.

Results

The findings showed that Indian youth spend an average of 4-6 hours per day on mobile phones, with 80% of respondents using them for social media, gaming, and entertainment. However, only 30% were aware of the environmental consequences of mobile phone use. These results underscore the need for educational programs to raise awareness about the environmental impacts of mobile phone usage and promote more sustainable habits among young people.

While mobile phones offer benefits, excessive use, particularly among children and adolescents, has led to negative effects on academic performance, mental health, and overall well-being. For example, 52.5% of Indian teenagers say they show characteristics of mobile phone dependence, which has an impact on their academic performance and general well-being. Teaching kids how to use technology appropriately must be a top priority for schools given the gravity of these problems.

Conclusion

In conclusion, mobile phones offer a lot of chances to improve education and communication among young Indians, but they also pose serious risks to environmental sustainability and personal well-being. This study emphasizes how crucial it is to encourage ethical mobile phone use through awareness campaigns, education, and the inclusion of sustainability principles in school curricula. India's youth can be encouraged to make thoughtful decisions that support sustainable development by cultivating a greater awareness of the social and environmental effects of mobile phone use. The study's conclusions are a call to action for stakeholders, educators, and legislators to collaborate in encouraging responsible technology usage and making sure that cell phones enhance rather than diminish the long-term sustainability of the environment and society.

Recommendations

- Education and awareness initiatives should be introduced to encourage sustainable mobile phone usage among Indian youth.
- Mobile phone manufacturers need to implement eco-friendly production and disposal methods.
- Government policies should be established to regulate e-waste and foster environmentally responsible behaviors.

Limitations

A small sample size and a restricted geographic reach are two of this study's shortcomings. Future studies ought to focus on resolving these issues and offering a more comprehensive comprehension of the connection between mobile phone use and sustainable development.

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LITERATURE REVIEW-FOOD SECURITY AND SUSTAINABLE AGRICULTURE

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Abstract:

Food security and sustainability are interrelated worldwide issues that demand immediate attention to guarantee that everyone has access to enough food that is safe, nourishing, and sufficient while maintaining environmental health and promoting socioeconomic equality. The relationship between food security and sustainability is examined in this literature review, with particular attention paid to important topics including climate change, soil erosion, water scarcity, food waste, and unequal distribution. It emphasizes how crucial it is to enhance regional food systems, reduce food waste, and implement sustainable agricultural methods.

Keywords: Food security, sustainability, climate change, agricultural conservation, pest management.

Introduction:

India, the second most populous country in the world with a population of over 1.4 billion, depends largely on agriculture for both livelihoods and food security. Unsustainable farming methods, however have put food production at risk by causing deteriorating soil health, water scarcity and heightened susceptibility to climate change. Agro ecology, organic farming, water efficient irrigation, and agro forestry are examples of sustainable farming methods that have been found to be essential for improving food security and maintaining environmental sustainability.

1. Concept of Food Security and Sustainable Farming

Food Security is a state in which everyone, everywhere, has physical, social and financial access to enough wholesome food to sustain an active and healthy life. A method of agricultural production known as "sustainable farming" aims to satisfy present food demands without endangering the capacity of future generations to satisfy their own. It encompasses actions that support social justice, economic viability, and environmental preservation.

The goals of sustainable farming methods are to:

- ❖ Preserve water and lessen reliance on external inputs like fertilizers and pesticides.
- ❖ Encourage biodiversity via the use of diversified cropping systems.
- ❖ Maintain soil fertility through less reliance on chemical inputs.

2. The Role of Sustainable Agriculture in Ensuring Food Security

A. Agro ecology- Agro ecology creates resilient, sustainable farming systems by fusing ecological concepts with conventional agricultural methods. Numerous studies show that agro ecological methods boost farm productivity and environmental sustainability; which in turn increases food security.

- **Food Security and Agro ecology:** According to Altieri & Nicholls (2013), agro ecology improves biodiversity, increases resilience to pests and climate change, and lessens dependency on outside inputs, all of which contribute to increased food security. Research has demonstrated that agro ecological systems can lower environmental effects such as soil erosion and water pollution while producing consistent harvests. (Gliessman, 2015).
- **Water and Soil Fertility Management:** Agroecology emphasizes crop rotation, mulching, and composting as ways to improve soil health. These techniques enhance soil structure, improve water retention, and lessen reliance on irrigation, all of which raise agricultural output and food security, according to research by Pretty & Bharucha (2014).

B. The use of forest products.

By combining trees with crops or animals, agroforestry produces a robust and varied agricultural system. Agroforestry methods improve soil health retain more water, and provide a variety of goods, from timber to fruits, all of which contribute to increased food security.

- Agroforestry and Food Security: Milder et al. (2019) found that by increasing agricultural biodiversity and offering economic diversification through the sale of forest products, agroforestry systems can increase food security, especially in tropical countries. Additionally, agroforestry has been demonstrated to boost crop production and act as a buffer against climate variability.
- Biodiversity and Resilience: Crop failure and pest risk are significantly decreased by agroforestry systems, which integrate trees with agricultural crops to enhance biodiversity (Schroth et al., 2015). Food security is enhanced and farming systems become more resilient as a result of this diversity, particularly in regions with erratic weather patterns.

C. Agricultural Conservation:

Minimal soil disturbance, permanent soil cover, and crop rotation are the main tenets of conservation agriculture (CA). These methods have been associated with improved food security, more efficient use of water, and healthier soil.

- Research by Garnett & Godfray (2012) shows that CA can improve food security by lowering the requirement for chemical inputs, enhancing soil health and water retention, and producing steady yields despite climatic change. Research from Latin America and Africa indicates that CA techniques preserve ecological balance while increasing crop yields (Hobbs & Govaerts, 2010)
- Enhanced Soil Health and Productivity: Research indicates that CA promotes food security by enhancing soil fertility and agricultural productivity over time. For instance, Thierfelder et al. (2013) discovered that, especially in regions that are prone to drought, CA systems in Zambia greatly increased corn yields when compared to conventional farming.

D. IPM stands for Integrated Pest Management.

Utilizing biological, cultural, mechanical, and chemical approaches to pest control is known as integrated pest management, or IPM. IPM helps to preserve biodiversity and encourage environmental sustainability by reducing the use of chemical pesticides, both of which support long-term food security.

IPM and Food Security: Kouadio et al.(2019) demonstrated that integrated pest management practices, including the use od biological control agents and crop rotation, enhance food security by minimizing crop losses from pests while preserving ecological balance. IPM enables farmers to avoid the detrimental environmental impacts of pesticides, thereby ensuring the long-term availability of food.

Challenges in implementing Sustainable Farming for Food Security:

Although sustainable farming methods offer significant promise for enhancing food security, various challenges obstruct their broader implementation, particularly in developing nations:

a. Economic Barriers:

- **High Initial Expenses:** Many sustainable farming methods demand upfront investments in tools, knowledge, and occasionally infrastructure. For small holder farmers, especially in developing nations, the upfront expenses can be too high.
- **Limited access to financing:** Small holder farmers frequently face challenges in assessing credit and financial assistance, which may hinder their ability to implement new sustainable methods (Kassie et al., 2025).

b. Knowledge and Education Deficiencies:

- **Inadequate Access to Extension Services:** The success of sustainable farming often relies on the presence of agricultural extension services that offer training and support. In numerous regions, these services are either underfunded or not readily available (Sass, 2015).
- **Insufficient Knowledge**: Farmers might not fully understand the long term advantage of sustainable agricultural practices, particularly when immediate financial pressures lead them to adopt conventional methods that harm soil health or increase reliance on external resources (Bharucha & Pretty, 2010)

C. Policy and Institutional Challenges:

- **Inadequate Policy Support:** Embracing sustainable farming often necessitates supportive policies such as subsidies, incentives, and access to markets. However, in numerous areas, agricultural policies generally favor conventional farming approaches over sustainable alternatives (Beddington et al, 2012)
- **Market Accessibility:** Farmers may encounter difficulties in reaching markets for goods produced sustainably, which can diminish the profitability of sustainable agriculture (Pretty et al., 2011).
- **Impact of Climate Change:** The Impact of Climate Change on food security is Substantial, especially in areas that are particularly susceptible to droughts, floods, and extreme weather conditions. To address these changing circumstances, sustainable farming methods are crucial for assisting farmers in adapting.

Climate- Smart Agriculture (CSA), as defined by Lipper e al, (2014), is an approach aimed at boosting productivity, improving resilience, and lowering greenhouse gas emissions. CSA incorporates sustainable farming techniques such as agroforestry, conservation agriculture, and integrated pest management to strengthen resilience against climate-related challenges while securing food availability.

According to research, sustainable farming systems are better equipped to withstand the effects of climate change, such as unpredictable rainfall, droughts, and extreme weather events. In order to preserve productivity during drought circumstances, for instance, Cairns et al (2013) discovered that agro ecological and organic farming systems performed better than conventional farming.

Conclusions

Increasing agricultural production, supporting environmental sustainability, and boosting climate change resilience are all ways that sustainable farming methods can increase food security. Agro forestry, conservation agriculture, integrated pest control, and agro ecology have all shown promise in enhancing food security while protecting ecosystems. However, in order to expand these techniques globally, important obstacles like financial constraints, knowledge gaps, and legislative restrictions must be overcome. For food systems to be robust, productive, and able to satisfy the demands of future generations, sustainable farming practices are essential.

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ROLE OF INVESTMENT AND FINANCE IN PROMOTING SUSTAINABILITY

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Abstract: Sustainability has captured critical focus in the modern world, as the need is felt amongst researchers to address environmental challenges.

Finance and investment are effective tools to promote sustainability and inculcate positive change in corporate behaviour, encouraging green innovation and ensuring long-term economic stability. This research explores the key facets highlighting the principles, strategies and challenges of how finance and investment can contribute to sustainability providing a broad roadmap for stakeholders and shareholders aiming to align financial objectives with environmental and social goals. The United Nations SDGs provide a framework on aligning investment with global priorities in modern day such as clean water, affordable sources of energy and climate change. Environmental, Social, and Governance (ESG) Criteria is effective tool to facilitate as indicator of sustainable finance, enabling investors to appraise companies based on their environmental practices, Corporate social responsibility and governance structures. Financial incentives and subsidies from government such as lower interest rates for green projects in form of soft loans can promote corporate environmental initiatives. This research will also touch upon how public private partnership can go a long way in funding large-scale sustainable infrastructure projects.

Green financing is to increase level of financial flows (from banking, micro-credit, insurance and investment) from the public, private and not-for-profit sectors to sustainable development priorities. A key part of this is to better manage environmental and social risks, take up opportunities that bring both a decent rate of return and environmental benefit and deliver greater accountability.

Keywords: Keywords: Green Financing, Micro Credit, Corporate social Responsibility,ESG

Introduction:UN Environment has been working with countries, financial regulators and finance sector to align financial systems to the 2030 sustainable development agenda – to direct financial flows to support the delivery of the Sustainable Development Goals. At the core of today's globalized economy are financial markets through which banks and investors allocate capital to die rent sectors. The capital allocated today will shape ecosystems and the production and consumption patterns of tomorrow.

The main areas for the current work on green financing are:

- Supporting public sector on creating enabling environment
- Promoting public-private partnerships on financing mechanisms such as green bonds
- Capacity building of community enterprises on micro-credit

Literature Review:

https://www.climatepolicyinitiative.org/publication/landscape-of-green-finance-in-india-2024/

1. Coordinated action to scale up green finance at a faster pace
2. Enhancing finance for adaptation
3. Furthering policy and regulatory measures to mobilize green finance across all sectors, by: Developing and operationalizing a green/climate finance taxonomy. Introducing national and sub national level legislation and regulations for adaptation.
4. Making coordinated efforts across data collection, reporting, and access

- Standardizing and mandating disclosures.
- Increasing availability and accessibility of climate finance data.
- Putting in place an integrated domestic measurement, reporting, and verification (MRV) system.India needs to urgently scale green finance to enable low-carbon and climate-resilient development. Based on this report's findings, CPI proposes the following priorities:

https://energy.economictimes.indiatimes.com/amp/news/renewable/apollo-green-energy-plans-to-launch-ipo-by-q4-cy25/117471798

International Commitments On Climate Finance: The Developments

Lack of access to adequate and affordable financial resources remains a significant constraint for developing countries in implementing their climate commitments. The Standing Committee on Finance (a body under the UNFCCC) has estimated that resources from USD 5.8 trillion to USD 11.5 trillion are required till 2030 to meet the targets set by developing countries in their NDCs and other communications. The 2023 UN Adaptation Gap Report estimated adaptation costs in developing countries to be 10 to 18 times greater than current international adaptation finance flows of USD 21.3 billion. The UNFCCC and its Paris Agreement mandate that developed countries provide financial resources on a grant or concessional basis and provide access to technologies to developing countries to enable their climate actions. The first GST outcome also underscored the current needs of developing countries and the criticality of new and additional, grant-based, highly concessional finance and non-debt instruments in supporting developing countries. The finance flows to developing countries from developed nations have been very meagre. Currently, most of the international finance available for developing countries is in the form of loans rather than grants.

Available, accessibile and affordable financial resources are essential to meet the needs of developing countries. UNFCCC and its Paris Agreement mandate that developed countries provide the resources and take the lead in mobilising finance through various sources. Given the scale of financial requirements, the ability of private capital to meet the needs even partially remains debatable. Further, the cost of such capital would have implications on the macroeconomic stability of the developing countries While recognising the importance of private capital, a working paper by the Centre for Social and Economic Progress identifies various challenges for developing countries in attracting such as limited depth of their financial markets and vulnerable debt profiles. There is further evidence to suggest that even MDBs mobilised less than a dollar from the private sector for every dollar of committed finance by MDBs for climate action. As reflected in an article the Financial Times- There's too much to do, and given the urgency and the need to get the solution right, this isn't a task for.... favourite ESG-focused portfolio manager... The sheer scale of the physical infrastructure that must be revamped, demolished or replaced is beyond comprehension. Governments, ..., will have to lead.... The Western nations that did so much of the damage will have to finance the transition in the developing world-it is astonishing that this idea is still debated.

https://energy.economictimes.indiatimes.com/news/renewable/budget-2025-a-missed-opportunity-for-decarbonisation-green-finance-and-esg-reform/117886610

Budget 2025: A Missed opportunity for decarbonisation, green finance, and ESG reforms

The Budget 2025 has primarily focused on economic growth but has failed to align with a broader decarbonization strategy. While the renewable energy sector is hoped to help us transition from fossil-fuel based electricity generation, it is not the sole contributor to the decarbonization of an economy. the Union budget 2025 needed to take a decisive stance on gaps, allowing corporations to continue their business as usual approach without meaningful consequences, India's transition finance ecosystem remains weak, climate policies are not integrated into economic planning, and regulatory framework lacks accountability.

finally to conclude if india truly is to become a global leader in sustainability, it must take a stronger stance on ESG enforcement ,carbon market and financing mechanism. otherwise the climate will remain fragmented ,leaving both investors and planet vulnerable to long term risk.

Problem statement:

1. This study is to investigate the impact of sustainable investment on the financial performance.
2. The present study is expected to contribute academically to the established banking, finance, and sustainability literature.
3. The study's results can provide valuable insights to potential investors regarding the correlation connection environmentally responsible actions and economic results, facilitating informed investment decisions.

Objectives of the Study:

1. To investigate the relationship between sustainable development and financial inclusion.
2. To ascertain whether financial management can promote the expansion and adoption of sustainable business practices.
3. To enable the use of finance in research methodologies for sustainable development is essential.

Hypothesis:

H0:Effective investment and finance mechanisms like green bonds and carbon trading facilitate market incentives for reducing carbon footprints and promote resource conservation for sustainable development .

H1 There is no relationship between financial or investment mechanisms and resource conservation for sustainable development

Research methodology

Universe of study: The focus of this descriptive study is on

The Population of the study : Population in Thane district , Mumbai suburbs and navi mumbai were targeted .

Sample size:81 respondents.

The sampling method adopted :Random sampling.

Research design: Study was analytical and descriptive in nature

Method of data collection:

A)Primary Data:

A survey with a group of structured questions with multiple choice questions and Checkboxes was provided to respondents through Whatsapp and emails on random basis to facilitate non probability sampling. It was designed to collect data on demographic facets like age and location, their qualifications and their domain knowledge and awareness on the subject and recommendations on use of Green Finance and investment options learning along with challenges perceived in its implementation.

Structured (closed ended questionnaire) was used to collect data from respondents who were basically teachers and academicians from various educational institutions .Respondents were requested to forward the questionnaire to forward the questionnaire within their teaching community to enhance the horizon of study

B)Secondary Data: The references were taken from the past Published reports and survey, reference books like **Economic survey** by Ministry of finance and E articles on the subject. Search tools like Google scholar were also referred in order to provide conceptual clarity sustainability tools.

Significance of study:

Scope:

Limitations of study:

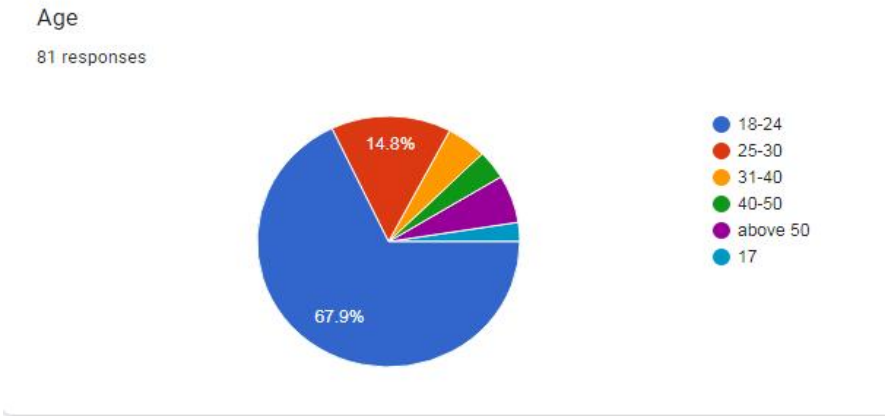
1) Study was confined to limited group of respondents comprising of faculties in domain of accounting and finance from Thane district and Mumbai Suburbs.

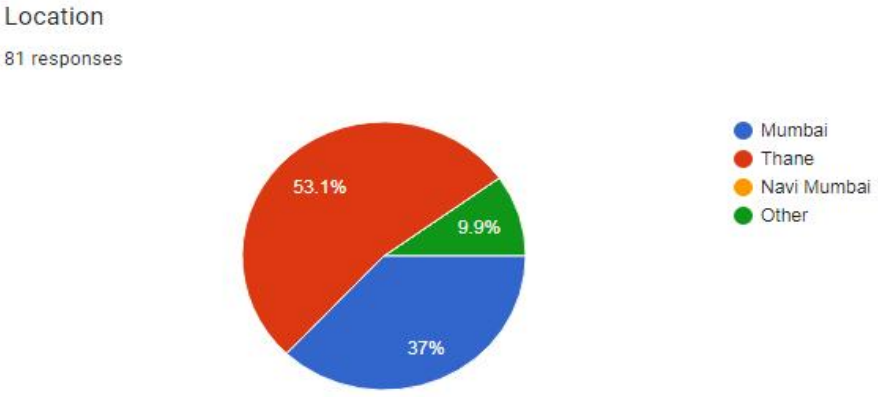
2) Respondents in other states of the country may have different opinions and perceptions on Mechanisms to promote sustainability.

The fact remains that responses will vary taking into account their qualifications and age and responses may not be authentically correct as subjective influences cannot be done away with .

Awareness about environmental sustainability is increasing and future changes in technology and its impact on financial management in Indian scenario is difficult to manifest asthe study is only based on present scenario.

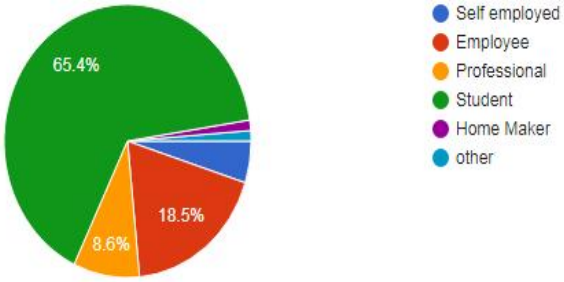
Data Analysis & Interpretation:





Occupation

81 responses



1. How can banks or financial institutions promote sustainability through their investment products?

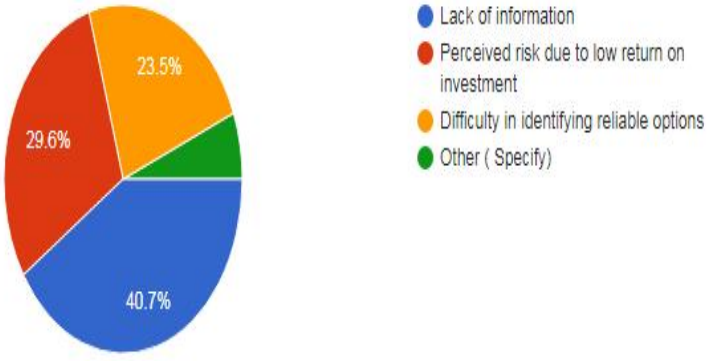
Copy chart

81 responses

2. What are the challenges imposed when trying to invest in sustainable assets?

Copy c

81 responses



3. Which of the following investment strategies are most effective in promoting sustainability?

81 responses

4.What is the most important action banks and financial institutions should take to enhance their role in supporting sustainability?

81 responses

5.Which of the following green financing options are you aware of?

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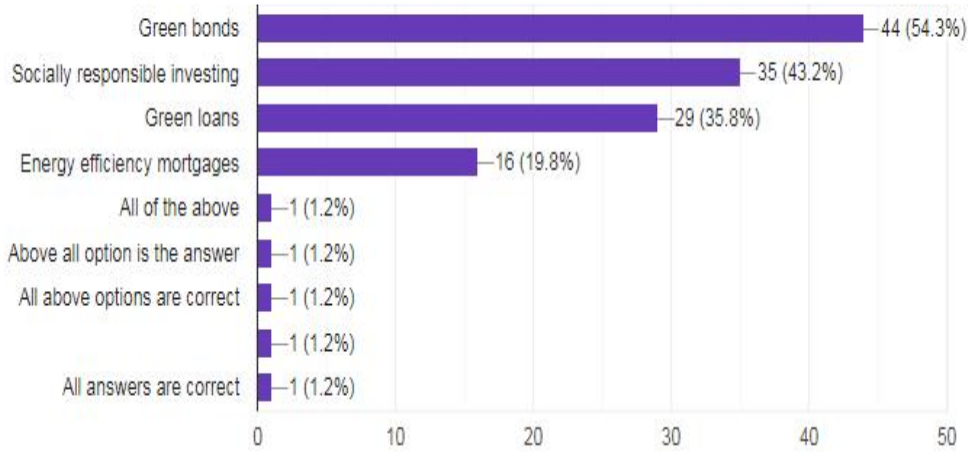

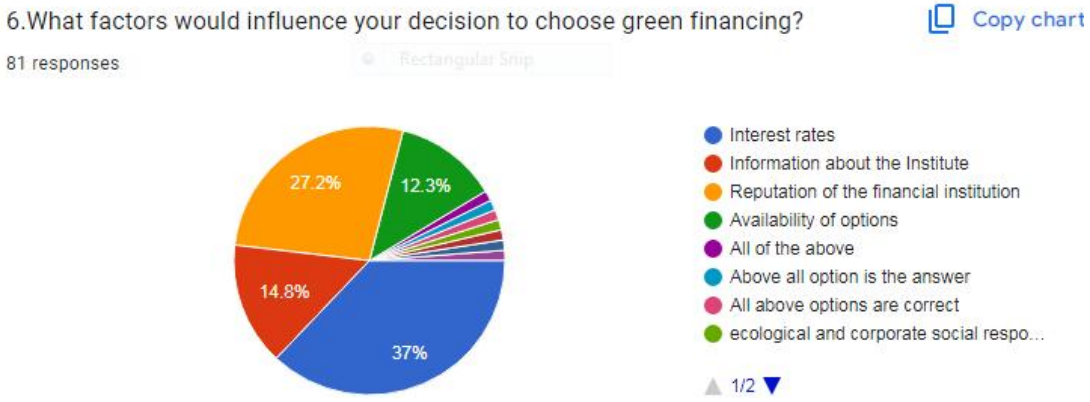

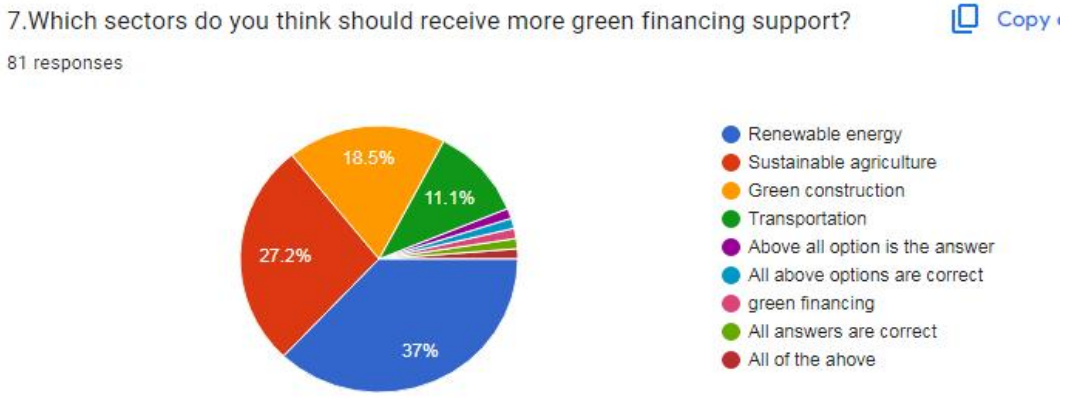

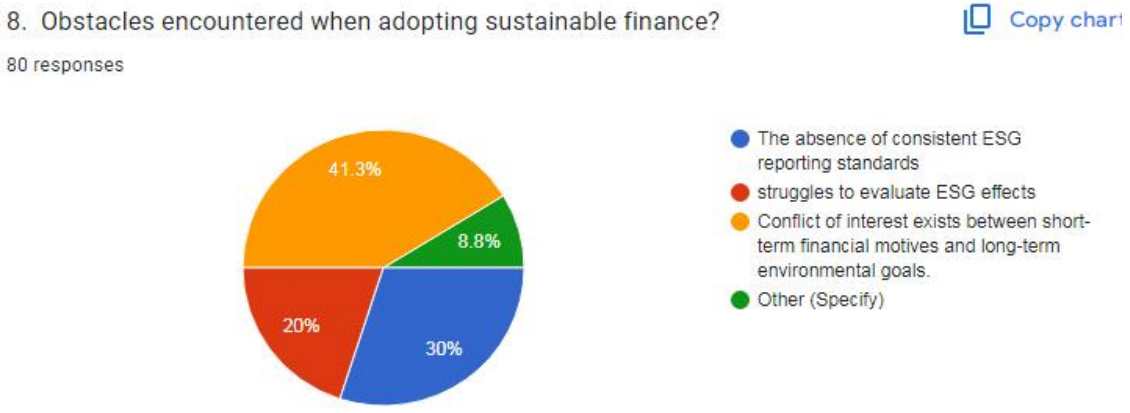

Findings of study:

1. Majority of respondents feel that lack of information or inability to identify possible options and also low return perceived on investment in sustainable assets is biggest challenge for success of sustainable investment in India.

2. Respondents were in favour of point that banks can provide education on investment in sustainable assets or can help people identify various green investment options.

3. Few respondents favour divestment from non sustainable investment whereas majority of responses preferred promoting investment in companies having promising technology to achieve sustainable goals as strategy to augment the investment in right direction.

4. Banks need to act as active partners in aligning their business model in tune with global sustainable goals and emphasis to be placed on sustainable reporting .

5. Green bonds is most viable options to bring in funds towards sustainable goals as investors will like investing funds provided they provide conducive interest rates.

6. Green construction, sustainable agriculture and renewable energy are promising areas where more funds will be attracted .

7. Respondents feel that biggest obstacle in adoption green financing is the conflict between profitability and long run socially desirable goals on environmental sustainability.

Suggestions: Environment sustainability is gearing up momentum in financial spectrum of India and requires radical change in financial planning ,Budgeting and Investment tools and it also calls for revolutionary changes in regulatory framework of the country as well as the political will in order to implement the methodologies suggested in our research paper for achieving SDG.

Conclusion :It remains a fact that transition to a sustainable economy faces challenges in form of resistance to change including the need for regulatory frameworks, transparent reporting and greater collaboration between government private sector. Bridging the finance gap requires innovative instruments like green bonds supportive government policies, and increased stakeholder commitment. sustainable finance is not just an ethical concept but a future necessity for prosperity. By aligning financial flows with sustainable development, we can create inclusive, resilient, and environmentally responsible Society.

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ROLE OF AI IN ENHANCING HOTEL SERVICE QUALITY

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Abstract

The rapid evolution of the hotel industry, driven by increased competition and shifting consumer expectations, necessitates innovative service strategies. Generative Artificial Intelligence (Gen AI) has emerged as a transformative force, enabling hotels to enhance service quality, improve operational efficiency, and personalize guest experiences. This paper explores the various applications of AI in hospitality, focusing on key technologies such as Generative AI, Predictive Analytics, Natural Language Processing (NLP), Robotic Process Automation (RPA), and AI-driven revenue management.

AI-driven automation streamlines housekeeping, predictive maintenance, and marketing, ensuring seamless operations. However, the implementation of AI presents challenges, including data privacy concerns, high adoption costs, workforce resistance, and ethical considerations. Balancing technological advancements with human-centric hospitality remains critical to AI's success in the industry.

The paper concludes that while AI offers unprecedented opportunities to redefine service quality, its true potential lies in harmonizing automation with personalized human interactions. Hotels that strategically integrate AI while preserving the essence of hospitality will set new benchmarks for service excellence and guest satisfaction in the digital age.

Keywords: Artificial Intelligence, Generative AI, Hotel Industry, Service Quality, Hospitality Innovation, Customer Experience

1. Introduction

The booming travel and tourism sector is driving a surge in demand for the hotel industry, prompting major players to expand their geographical footprint, engage in aggressive branding strategies, and establish strategic partnerships to capitalize on the growing market. Service innovation has become essential, with hotel operators embracing new ideas and leveraging technology-driven marketing strategies to stay competitive. Social media platforms and digital tools have empowered potential customers with abundant information and diverse options, significantly influencing their decision-making process.

In this evolving landscape, managing customer experiences has taken center stage. Delivering superior service quality not only drives customer satisfaction but also fosters loyalty, leading to repeat visits and positive word-of-mouth.

In an era where technological innovation is reshaping industries globally, the advent of Generative Artificial Intelligence (Gen AI) has emerged as a transformative force. With its ability to analyze vast datasets, simulate human-like interactions, and generate tailored solutions, Generative AI is redefining traditional service paradigms in hospitality. From automating routine tasks to offering AI-generated recommendations and virtual assistance, the technology is bridging gaps in service delivery while driving innovation. This article explores the multifaceted role of Generative AI in enhancing service quality within the hotel industry. By harnessing the potential of Generative AI, hotels can not only meet but exceed customer expectations, setting new benchmarks in service excellence.

2. Types of Artificial Intelligence useful for Hotel Industry

The integration of various AI types in the hotel industry enhances operational efficiency, elevates service quality, and creates a competitive edge. By leveraging these technologies, hoteliers can provide personalized, seamless, and memorable guest experiences while optimizing their resources and revenue strategies.

1. **Generative AI:** Generative AI utilizes advanced algorithms such as machine learning and neural networks to create new content and insights, making it a powerful tool for personalized guest interactions. It enables AI-powered chatbots and virtual assistants, like ChatGPT, to answer guest queries, manage bookings, and provide

concierge services efficiently. Additionally, it supports content creation by generating tailored travel itineraries, promotional materials, and personalized customer communications, enhancing the overall guest experience and operational efficiency.

2. **Predictive Analytics AI:** Predictive AI leverages historical data to anticipate future trends and behaviors, offering valuable applications in the hotel industry. It aids in demand forecasting by predicting occupancy rates and customer preferences, enabling hotels to optimize pricing and inventory management. Additionally, it facilitates customer behavior analysis, identifying trends in guest preferences to refine offerings and enhance service delivery, ultimately improving overall guest satisfaction and operational efficiency.
3. **Natural Language Processing (NLP):** NLP enables machines to understand and process human language, crucial for analyzing guest reviews to gauge satisfaction levels and areas for improvement. Offering hands-free assistance for guests, such as controlling room amenities or seeking hotel information.
4. **Robotic Process Automation (RPA):** RPA automates repetitive tasks, saving time and reducing errors. Examples include: Automated kiosks for a seamless guest experience and streamlining administrative tasks like billing and inventory management.
5. **Computer Vision AI:** AI-enabled surveillance systems for monitoring hotel premises. Facial recognition for personalized room settings or contactless access.
6. **Recommendation Systems:** These AI systems analyze guest preferences and suggest services or products, such as giving personalized offers like tailored dining or spa packages based on guest history or upselling opportunities like suggesting room upgrades or additional services during booking or stay.
7. **AI for Revenue Management:** AI-driven dynamic pricing tools adjust room rates based on factors like market demand, competitor pricing, and seasonality, ensuring maximum profitability.
8. **Augmented and Virtual Reality (AR/VR):** While not AI in itself, when paired with AI, AR/VR creates immersive guest experiences such as virtual tours of the property or destination guides powered by AI-generated insights.

3. Role of Generative AI in Enhancing Service Quality in the Hotel Industry

Generative AI (Gen AI) is transforming the hotel industry by providing innovative solutions to improve service quality, operational efficiency, and guest satisfaction. Here are key roles and benefits of Gen AI in the hotel industry:

1. Personalization of Guest Experiences

- **Dynamic Itineraries:** AI can analyze guest preferences and create tailored itineraries, including room preferences, dining options, and local activities.
- **Personalized Communication:** Chatbots powered by Gen AI can engage guests in natural conversations, addressing their unique queries and requests in real-time.
- **Loyalty Programs:** AI can recommend customized rewards and offers based on a guest's past behavior and preferences.
- **24/7 Virtual Concierge Services:** AI chatbots can handle a wide range of guest inquiries, such as room service orders, reservation changes, or travel guidance.
- **Multilingual Support:** Gen AI tools can bridge language barriers by translating and communicating effectively in multiple languages.
- **Complaint Resolution:** AI can detect sentiment in guest feedback and address complaints proactively, ensuring a positive experience.

2. Operational Efficiency

- **Predictive Maintenance:** AI can analyze data from IoT devices to predict equipment failures, ensuring smooth operations.
- **Automated Housekeeping Requests:** AI-enabled systems can streamline housekeeping services based on occupancy rates and guest schedules.

3. Intelligent Marketing and Sales

- **Content Creation:** Gen AI can generate engaging and personalized marketing content, including emails, social media posts, and promotional materials.
- **Dynamic Pricing Strategies:** AI can optimize room rates by analyzing market trends, competitor pricing, and demand patterns.
- **Upselling Opportunities:** AI algorithms can identify and recommend upgrades, such as premium rooms or exclusive packages, to potential customers.

4. Data-Driven Insights

- **Demand Forecasting:** Hotels can leverage AI to predict future demand and plan resources accordingly.
- **Competitive Analysis:** AI tools can track competitors' offerings and suggest strategies to maintain a competitive edge.

5. Virtual and Augmented Reality Experiences

- **Virtual Room Tours:** AI-generated VR content allows guests to explore hotel rooms and amenities before booking.
- **Interactive Training Modules:** AI can create immersive AR/VR training programs for hotel staff to enhance skills and service delivery.

6. Sustainability and Green Practices

- **Smart Resource Allocation:** AI can recommend sustainable practices, such as reducing water and energy usage based on guest behavior.
- **Waste Management:** Gen AI can analyze food and material usage to minimize waste and promote eco-friendly initiatives.

4. Challenges in using Gen AI for enhancement of Service Quality

While Gen AI offers transformative potential, there are significant challenges that hoteliers must navigate to implement and leverage this technology effectively. Here is a detailed overview of the challenges:

1. Privacy and Data Security Concerns

Hotels collect and store guest data, including personal preferences, payment details, and travel itineraries. Integrating AI increases the risk of data breaches or misuse. Adhering to global data protection laws like GDPR, CCPA, and others can be complex, especially when using AI systems that process large datasets. Guests may feel uneasy about the level of personal data AI requires for personalization, impacting trust and satisfaction.

2. High Implementation Costs

Developing and deploying AI systems involve substantial upfront costs for software, hardware, and customization. AI systems require regular updates, troubleshooting, and optimization, which adds to operational expenses. Smaller hotels or budget chains may struggle to afford the sophisticated AI tools required to match larger competitors.

3. Integration with Existing Systems

Many hotels operate on outdated property management systems (PMS) that may not integrate seamlessly with AI technology. Transitioning to AI-powered systems can cause temporary disruptions in operations, impacting service quality. Ensuring compatibility across multiple AI tools and hotel systems (e.g., booking engines, CRM, POS) can be a technical hurdle.

4. Workforce Resistance and Training

Staff may perceive AI as a threat to job security, leading to resistance to its implementation. Employees need training to effectively use AI tools, which requires time and additional resources. Over-reliance on AI can reduce personal interaction, which remains a critical aspect of hospitality.

5. Over-Personalization Risks

Excessive personalization can make guests feel uncomfortable or intruded upon, especially if AI predictions about their preferences seem too precise. Incorrect data or algorithms can lead to inaccurate recommendations or services, frustrating guests. AI might prioritize efficiency over creativity, making guest experiences predictable and less unique.

6. Dependence on Data Quality

AI's effectiveness relies on high-quality, accurate, and up-to-date data. Incorrect or incomplete data can lead to flawed outputs. Historical biases in datasets can result in unfair or discriminatory recommendations, harming a hotel's reputation. Continuously gathering comprehensive data without violating privacy laws is a delicate balance.

7. Ethical and Cultural Considerations

AI systems may unintentionally perpetuate cultural, racial, or gender biases present in training data. AI algorithms might not fully understand or adapt to cultural nuances in hospitality practices or guest preferences. Guests might question decisions made by AI systems, especially if they lack transparency about how recommendations are generated.

8. Technical Limitations

AI systems might struggle with unique or unforeseen situations, resulting in suboptimal service. Many AI applications require constant internet access, which can be unreliable in remote locations. While AI excels at pattern recognition, it might fail in providing creative solutions for complex guest needs.

9. Guest Adaptability

Not all guests are comfortable interacting with AI systems or using digital tools for hospitality services. Certain guests may value personal interactions over AI-driven solutions, especially in luxury or boutique hotels. Guests might not be fully aware of AI capabilities, reducing their willingness to use AI-driven services.

5. Conclusion

The integration of Generative AI into the hotel industry represents a transformative leap toward enhancing service quality and guest satisfaction. However, the journey toward its adoption is not without challenges. The readiness of the hotel industry to embrace Gen AI depends on its ability to balance technological innovation with the core principles of hospitality—human connection and empathy. Hotels must evaluate their current technological infrastructure and willingness to invest in AI systems while ensuring seamless integration with other AI tools, such as machine learning algorithms, predictive analytics, and IoT devices, to create a cohesive ecosystem.

Equally important is the training of human resources. Hotel staff need to be equipped with the skills to collaborate effectively with AI systems, ensuring a balance between automated efficiency and the irreplaceable warmth of human interaction. As AI tools become more prevalent, hotels must guide guests in understanding and adopting these technologies, ensuring that AI-driven solutions feel intuitive and beneficial rather than intrusive or impersonal. Clear communication about the purpose and benefits of AI services can help bridge this gap.

Ultimately, the success of AI in the hospitality industry lies in maintaining the delicate balance between innovation and the human touch. Technology should serve as a tool to amplify empathy, not replace it. By using Generative AI to handle repetitive tasks and enhance personalization, hotel staff can focus on building authentic relationships with guests—creating memorable experiences rooted in genuine care and attention. The future of AI in the hotel industry is promising, but its true potential will only be realized when innovation and humanity walk hand in hand.

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ROLE OF IOT IN DISASTER RESPONSE

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Abstract:

Technologies such as sensors, satellites, and weather forecasting models provide early warnings for natural disasters like hurricanes, tsunamis, and floods. These systems allow authorized persons to issue timely alerts and evacuate populations at risk. Internet of Things (IoT) devices and sensor networks provide real-time monitoring of climatic conditions (like air quality or seismic activity) and infrastructure health (such as bridges and buildings). IoT devices can help with disaster response in many ways, such as Assessing damage, providing real-time information, monitoring vital signs, locating vulnerable people, sharing real-time data, predicting floods, and Improving preparation and response. Integrating technology into disaster management frameworks enhances preparedness, improves response coordination, facilitates rapid assessment and decision-making, and supports long-term recovery efforts. By leveraging technological advancements, stakeholders can better protect lives, reduce economic losses, and build more resilient communities in the face of disasters. With IoT technology, It is possible to provide quick response, collect critical data related to earthquake activity, and provide fast response in affected areas, including seismic wave patterns and ground vibrations. The objective of the paper is to study the IoT-based fast disaster recovery and it discusses the key enabling technologies for IoT and provides insight into IoT-based post-disaster response and recovery.[1]

Keywords:

Analytics, Coordination, Disaster Response, IOT, Predictive, Sensor, Social Media, Resilient.

Introduction:

In the new days, progress of India towards smart cities and digitalization is noticeable. It is impossible to exaggerate India's historical vulnerability. Approximately 57% of the terrain is susceptible to earthquakes, 12% of the land is susceptible to severe earthquakes, 68% to drought, 12% to floods, and 8% to cyclones. Many Indian cities are particularly susceptible to industrial, chemical, and man-made disasters. The process of dealing with an incident that could significantly damage the community's social cohesion is known as disaster management. Although we cannot totally prevent the harm through disaster management, we can reduce the danger by using early warning. Man-made and natural are the two categories of disaster. Natural disasters include earthquakes, landslides, floods, river erosion, cyclones, tsunami, forest fire etc. Artificial disasters include nuclear, chemical, mine, and biological disasters.[2]

Objective:

This research paper aims to support prompt decision-making and ensure a swift response to disasters. IoT connects devices and objects to the internet, allowing them to collect and share information. It helps in collecting real time data using IoT-enabled devices like sensors, cameras, and drones that can collect data on the intensity of a disaster and its impact on affected areas and triggering alerts. In the recovery stage, the focus shifts to helping affected areas return to normalcy and rebuilding infrastructure.[7] IoT can accelerate this process through efficient damage assessment and by aiding in the coordination of efforts. IoT-enabled building sensors can assess structural damages and transmit data to central systems that prioritize recovery operations.[4] Smart grids and IoT systems can also restore and manage energy distribution in affected areas, ensuring a quicker return to stability. [5][6]

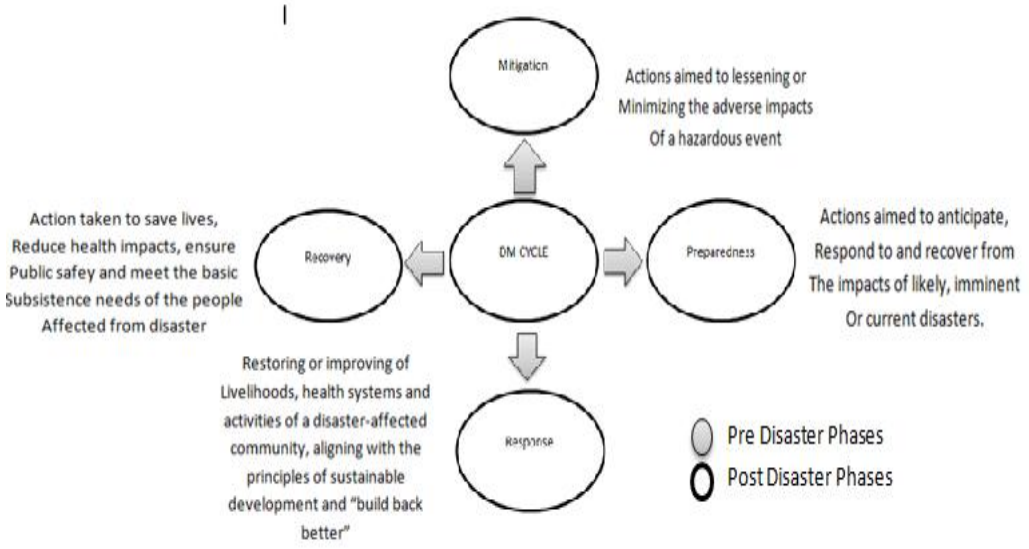

Figure 1

Disaster Risk Management Cycle

Literature Survey

Technology	Application (Response)	Benefits	Limitations	Reference
Sensors	Response	Enables real-time monitoring and improves situational awareness	Limited operational range and sensitivity to environmental factors	[4][6]
Drones (UAVs)	Response	Offers aerial surveillance, rapid deployment, and access to hard-to-reach areas	Affected by weather conditions, regulatory restrictions, and short battery life	[3][7]
AI and Machine Learning	Response	Enhances decision-making through predictive analytics and rapid data processing	Requires high computational power and raises data privacy concerns	[2]
Mobile Communication Devices	Response	Supports emergency communication and coordination, easy to carry	Relies on network coverage and has battery life limitations	[7][9]
Geographic Information System (GIS)	Response	Provides accurate disaster mapping, resource allocation, and spatial analysis	Needs frequent data updates and skilled personnel for operation	[8][10]
Wearable	Response	Tracks responder	Raises privacy issues and	[12]

Devices		health and location, enhancing safety and efficiency	depends on strong network connectivity	

Case Studies of IoT in Recent Disasters

Disaster Event	Year	IOT Solution Used	Outcome	Key Learnings	Reference
Hurricane Katerina	2005	Mobile Communication Devices	Facilitated rescue operations and coordination	Importance of robust communication networks	[7] [8]
Tohoku Earthquake	2011	Sensors, Drones	Quick assessment of damage, aided in rescue efforts	Effective in rapid damage assessment	[9] [10]
Nepal Earthquake	2015	Drones, Mobile Communication devices	Aided in delivering aid and assessing structural damage	Demonstrated value in post-disaster recovery and aid distribution	[5] [11]
California Wildfires	2020	Drones, GIS	Real-time tracking of fire spread	Critical for dynamic disaster response	[4] [5]
Cyclone Amphan	2020	Mobile communication devices, Sensors	Enhanced early warning systems, improved evacuation strategies	Showcased need for early warning and rapid response systems	[12] [13]

Role of Technology in Disaster Response

Technology plays a crucial role in Disaster Risk Management (DRM) by enhancing early warnings, improving communication, and strengthening response efforts. Integrating advanced tools helps mitigate risks, ensure timely interventions, and support recovery processes.[2] In disaster management, technology serves a crucial function by facilitating real-time monitoring, streamlined communication, and optimized resource distribution. Hazard tracking and high-risk area identification are made possible through Remote sensing and Geographic Information Systems (GIS).[5] Timely warning dissemination and smooth coordination among response units are ensured via mobile alerts and emergency networks. For damage evaluation, drones and satellite imagery provide essential information, enabling efficient relief operations. Furthermore, digital platforms and simulations improve community readiness and response capabilities.[9] The strategic incorporation of these technological tools enhances disaster resilience and expedites recovery processes. For technology to be most effective in disaster management, it must be accompanied by adequate training, involvement of local communities, and appropriate regulations to ensure it is both accessible and efficient. Although technological solutions can improve response times, a comprehensive strategy that incorporates these elements enhances overall resilience, boosts preparedness, and speeds up recovery processes.[10] This holistic approach results in a more effective and inclusive disaster management system.

6.1 Internet of Things (IoT)

IoT or the Internet of Things, is essentially the concept of connecting physical objects or devices to the internet and to each other. These devices are equipped with embedded sensors, software and sometimes actuators (which enable them to interact with the environment).[13] The Internet of Things (IoT) connects a diverse range of physical objects, from household appliances and wearable devices to industrial machinery and infrastructure components. These objects are embedded with sensors and software that gather data on various parameters such as temperature, pressure, location, and motion. The collected data is then processed and transmitted over networks, enabling real-time monitoring and prompt responses to changes. IoT devices communicate with each other and centralized systems, facilitating advanced functionalities like predictive maintenance, automated control, and data analytics. By

leveraging connectivity and real-time data, IoT enhances efficiency, safety, and convenience across both consumer and industrial applications.[14]

6.2 Location finding in disaster management from IOT

Location finding in disaster management is a critical application of IoT (Internet of Things) technology, leveraging various devices and sensors to enhance emergency response efforts.[3] IoT-based location tracking plays a crucial role in disaster response by delivering real-time, precise location data through GPS-enabled wearables, vehicles, and equipment. Wearable sensors on responders and survivors provide continuous tracking, improving rescue coordination. Infrastructure-based remote monitoring systems assess structural integrity, aiding in evacuation planning. Drones equipped with IoT sensors capture aerial imagery and geospatial data for damage assessment and survivor identification.[15] Mobile applications allow survivors to send distress signals with exact coordinates while guiding responders to affected areas. Integrated command centers aggregate data from multiple IoT sources, offering a comprehensive disaster overview for emergency teams. By leveraging GIS and analytics, responders can visualize location-specific insights for optimal resource distribution and route planning. Additionally, resilient IoT-powered communication networks ensure uninterrupted connectivity, enabling seamless coordination between response teams and command centers, even in challenging disaster conditions. In summary, IoT technologies play a crucial role in disaster management by enhancing location finding capabilities through real-time data collection, GPS tracking, remote monitoring, and integrated communication systems. These capabilities improve response times, coordination among responders, and ultimately, the effectiveness of disaster relief efforts.[14]

Conclusion:

The Internet of Things (IoT) has emerged as a crucial component of modern life, linking the global community and facilitating smooth communication. In specific applications, IoT can be potentially life-saving, especially in managing disasters where widespread disruptions and fatalities occur owing to natural or human-induced calamities. IoT-enabled disaster management systems enhance early warning capabilities through sophisticated data analysis and computational tools by enabling interconnectivity between various devices. This review examines primary research challenges in IoT-based disaster management and emphasizes the significant role IoT devices play in reducing the impact of disasters. It offers a comparative evaluation of current IoT solutions for disaster response, demonstrating their efficacy. Furthermore, this study explores real-world applications of IoT, such as early warning systems for detecting fires and earthquakes, elaborating on their implementation, IoT architecture, and significance in examining various types of disasters.[8-12]

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SAVING WATER INDOORS AND OUTDOORS IN SCHOOLS: A PATH TOWARDS SUSTAINABLE DEVELOPMENT

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Abstract

Water is an essential component for humans as well as animals. Thus, it is important to save water for the future. Rapid Global warming is drastically changing weather patterns around the world and affecting the quantity as well as the quality of water resources. Pollution, population explosion and urbanization are the other major factors that are putting trace on the available freshwater resources. The treatment of dirty water consumes huge amounts of energy in the form of electricity and fuel. By conserving and using fresh water efficiently, humans would save a lot of energy that is utilised for water treatment and transportation. Also, they would be able to avoid potential water crisis in the future when the demand for water wood exceeds its supply considerably. [1] The consumption of freshwater has increased ten times in 1990, whereas its supply is gradually decreasing due to global warming. If water isn't conserved in the present we may have to face a severe water crisis in the future.

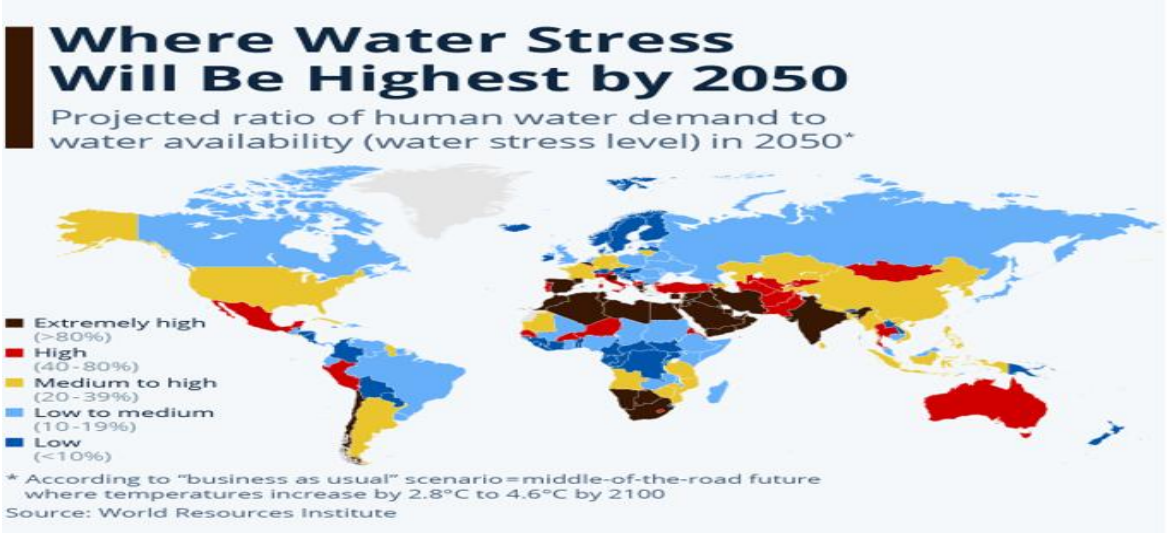
This paper explores strategies to conserve water indoors and outdoors in school environments as a pathway to sustainable development. It highlights innovative practices, technological interventions, and behavioural changes necessary to address water scarcity and promote environmental stewardship among students and educators.

Keywords

Water conservation, indoor and outdoor water use Saving in school, sustainable development, environmental education.

Introduction

Only marginal quantity of the total water available on Earth is drinkable or usable for agriculture, industrial and domestic purposes. When the water demand of an area exceeds the availability, it indicates a water crisis. Many reasons are presently suffering from water crisis even though the earth has enough fresh water to meet the global requirement. When the annual water supply for a person in an area goes below 1700 m^3, it is called water stress; and when it drops down to 1,000 m^3 per person, it is called water scarcity. By 2025, about two third of the global population would be living in water stressed regions if water is not conserved. Following Image project, the area where the ratio of human water demand to water availability that is water stress level in the end of the year 2050.



Source: World Resources Institute

At present more than 1.3 billion people in the word are leaving in area where there is a physical shortage of water. It is estimated that by 2025, 1.8 billion people will live in areas with water scarcity.

Water usage in schools can be broadly categorized into indoor and outdoor consumption. Common areas of indoor water use are Toilets and Urinals these account for a significant portion of water use in schools, particularly in institutions with older plumbing systems. Hand washing and general hygiene lead to substantial water usage, especially in high-traffic areas. Water fountains and hydration stations are essential for students and staff, contributing to indoor water consumption. Washing fruits, vegetables, and other ingredients. Cleaning utensils, trays, and other kitchenware can use large amounts of water. Following table describe the indicators for water consumption for schools worldwide

Water consumption indicators for schools worldwide

Category	Value	Unit	Locality
Daytime school[a]	15 to 25	L/person/day	UNICEF
School – boarding school[a]	35 to 60	L/person/day	UNICEF
Primary schools[a]	11 to 18	L/student/day	UK
Secondary schools[a]	14 to 21	L/student/day	UK
Daytime school[a]	45	L/person/day	India
School – boarding school[a]	135	L/person/day	India
Daytime school[a]	20	L/student/day	USA
School – boarding school[a]	25	L/student/day	USA
Pre-school buildings	30 to 70	L/student/day	Italy
Elementary schools	10 to 30	L/student/day	Italy
Primary schools	30	L/person/day	Taiwan
School – semi-boarding[a]	50	L/student/day	Brazil
School – boarding school[a]	150	L/student/day	Brazil
State public schools	25	L/student/day	São Paulo
Early childhood education	18.85 to 55.60	L/student/day	Campinas/SP
Elementary school	21.33	L/student/day	Campinas/SP
High schools	10.68	L/student/day	Campinas/SP
State schools from 1st and 2nd degrees	4.5 to 81.1	L/student/day	São Paulo
State elementary and high schools	6.42 to 62.82	L/student/day	Triângulo Mineiro/MG
State elementary and high schools	3.9	L/student/day	Recife/PE
State elementary schools	4.9	L/student/day	Recife/PE
State elementary and high schools	3.9 to 16.9	L/student/day	Recife/PE
Elementary and high schools	3 to 9	L/student/day	Sydney/Australia

Source: adapted from Nunes (2018).

Science experiments and other academic activities can require water, especially in high schools with dedicated lab facilities. Water is used for cleaning floors, windows, and general sanitation in classrooms, hallways, and offices. Outdoor water usage typically involves maintaining the school's external environment. Key areas include. Watering lawns, gardens, and athletic fields often constitutes the largest portion of outdoor water use. Shrubs, flowerbeds, and trees may require regular watering, especially in regions with dry climates. Grass-covered fields for sports like football or soccer often need extensive irrigation, especially during peak seasons. While generally requiring less water, some areas may still need periodic cleaning or maintenance.

Washing sidewalks, parking lots, and outdoor seating areas can contribute to outdoor water consumption. Schools with swimming pools require significant water for filling, maintenance, and evaporation control. Given the extensive water use in both indoor and outdoor settings, schools can adopt measures to conserve water:

By monitoring and managing water use both indoors and outdoors, schools can significantly reduce their environmental footprint, lower utility bills, and instill a culture of sustainability among students and staff.

The objective of the paper, **"Saving Water Indoors and Outdoors in Schools: A Path towards Sustainable Development,"** is to emphasize the importance of water conservation in educational institutions as a crucial step toward achieving sustainable development goals. The paper aims to Raise Awareness about Water Usage in Schools, Promote Sustainable Water Management Practices.

By aligning water-saving practices with educational objectives, the paper underscores the role of schools as catalysts for environmental change and their contribution to a sustainable future.

Literature Review

Here are some noteworthy case studies of water-saving initiatives in schools worldwide, showcasing innovative approaches to water conservation and education:

Sr.	Country	schools	Initiative	Impact	Educational Value
1	**Australia**	**Rainwater Harvesting at Blackwood High School**	Blackwood High School in South Australia installed a rainwater harvesting system to reduce reliance on municipal water. The collected water is used for irrigating school gardens and flushing toilets.	The school saved thousands of liters of water annually and significantly reduced its water bills.	The initiative was incorporated into the school curriculum, where students learned about water cycles, rainwater harvesting, and sustainable practices.
2	**India**	**Jal Shakti Abhiyan in Government Schools**	As part of the government-led Jal Shakti Abhiyan, schools across India implemented water-saving techniques such as rainwater harvesting, groundwater recharge pits, and awareness campaigns.	Many schools reported an increase in groundwater levels and decreased dependence on external water sources.	Students actively participated in water conservation drives, spreading awareness within their communities.
3	**United States**	**Water Audit Program in California Schools**	The City of Santa Monica worked with local schools to conduct water audits, identifying leaks, inefficient fixtures, and areas for conservation.	Schools replaced old plumbing with water-efficient fixtures, leading to a reduction in water usage by up to 30%.	Students participated in the audits, learning how to track water use and identify waste, empowering them to apply these skills at home.

4	**Kenya**	**Solar-Powered Water Pumps at Kithoka Primary School**	In water-scarce regions like Kenya, schools such as Kithoka Primary installed solar-powered water pumps to access clean water efficiently.	The pumps provided water for drinking, sanitation, and irrigation of school gardens, reducing the need for external water sources.	Students learned about renewable energy and sustainable water management through hands-on projects.
5	**United Kingdom**	**Greywater Recycling at Bedales School**	Bedales School in Hampshire introduced a greywater recycling system, reusing water from sinks and showers for flushing toilets.	The system significantly reduced the school's water consumption, lowering its environmental impact.	The initiative became a key component of the school's environmental science program, inspiring students to explore innovative sustainability solutions.
6	**South Africa**	**Eco-Schools Water Projects**	Under the international Eco-Schools program, schools in South Africa implemented water-saving projects such as installing water-efficient taps, repairing leaks, and creating water-wise gardens.	Schools reduced water consumption while teaching students about drought resilience and conservation.	These projects empowered students to address water scarcity issues in their communities.
7	**Japan**	**Water-Conserving Infrastructure at Fujimigaoka High School**	Fujimigaoka High School in Tokyo installed dual-flush toilets, automatic faucets, and a rainwater harvesting system to optimize water use.	The school achieved significant water savings while reducing maintenance costs.	Students studied the technical aspects of water-saving systems as part of their science and technology curriculum.

8	**Brazil**	**Sustainable School Gardens in São Paulo**	Schools in São Paulo created sustainable gardens watered using rainwater	The gardens provided food for school cafeterias while promoting water conservation.	Students participated in garden maintenance, learning about sustainable agriculture and resource management. These case studies illustrate that water-saving initiatives in schools not only reduce resource consumption but also serve as powerful educational tools, fostering a culture of sustainability among students and their communities.

Source: Secondary data

Methodology

To write this research paper, I have used secondary data, for which I have referred to schools in India and abroad.

Indoor Water Conservation Strategies

Upgrade to Water-Efficient Fixtures

- Install low-flow or dual-flush toilets and waterless urinals.
- Use Sensor-Activated Faucets.
- Aerators on Faucets

Leak Detection and Repairs

- Regular Inspections: Conduct routine checks of plumbing systems.
- Monitoring Systems: Use water monitoring systems to detect unusual spikes in water usage for likage.

Behavioral Interventions

- Awareness Campaigns: Educate students and staff on the importance of turning off taps, reporting leaks, and conserving water.

Optimize Kitchen

- Install energy- and water-efficient dishwashers and kitchen appliances.
- Reduce Rinse Water Use: Train kitchen staff to use minimal water when rinsing fruits, vegetables, and dishes.

Drinking Water Stations

- Replace traditional water Bottle Filling Stations
- Encourage Reusable Bottles among students and staff.
- Use mops and cleaning equipment that require minimal water.
- Dry Cleaning Alternatives: such as microfiber cloths, for non-critical cleaning tasks.

Incorporate Technology

- Install smart water meters to monitor water consumption in real time and identify areas of inefficiency.
- Timed Water Flow Systems: Use timed or automated systems for water dispensers and restrooms.

Educational Initiatives

- **Student Involvement:** Engage students in water conservation projects, like water audits and awareness campaigns.
- **Incorporate Conservation in Curriculum:** Teach water-saving techniques as part of science, geography, or environmental education.

Outdoor Water Conservation Strategies. -

- **Smart Irrigation Controllers:** Use weather-based or soil moisture sensors to ensure watering only occurs when needed.
- **Drip Irrigation:** Install drip irrigation systems for gardens and landscaped areas to deliver water directly to the roots, minimizing evaporation.
- **Time Watering Efficiently:** Schedule irrigation during early mornings or late evenings to reduce water loss from evaporation.

Replace Water-Intensive Landscaping

- **Drought-Resistant Plants:** Use native or drought-tolerant plants in school gardens and landscapes to reduce water needs.
- **Mulching:** Apply mulch to garden beds to retain soil moisture and reduce evaporation.
- **Artificial Turf or Low-Water Ground Covers:** Replace grass in non-essential areas with artificial turf or low-maintenance ground covers.

Rainwater Harvesting

- **Rain Barrels and Storage Tanks:** Install rain barrels or tanks to collect and store rainwater from rooftops for outdoor uses such as irrigation or cleaning.
- **Bioswales and Permeable Surfaces:** Use permeable materials in parking lots or walkways to direct rainwater into the soil or collection systems.

Maintain Outdoor Areas Efficiently

- **Prevent Overwatering:** Train maintenance staff to monitor and adjust watering schedules based on seasonal needs.
- **Repair Leaks:** Regularly inspect outdoor plumbing, sprinklers, and irrigation systems for leaks or inefficient spray patterns.
- **Pressure Washing Alternatives:** Use brooms or blowers for cleaning hard surfaces instead of washing them down with water.

Water-Efficient Sports and Recreation Areas

- **Efficient Grass Management:** Aerate soil and fertilize appropriately to reduce water needs on grass-covered sports fields.
- **Designated Practice Areas:** Restrict high-maintenance grass fields to official games while using lower-maintenance areas for practice.

Educational and Community Programs

- **Water-Wise Gardening Projects:** Engage students in creating and maintaining sustainable school gardens, teaching them the value of water conservation.
- **Community Workshops:** Host water conservation workshops for parents and the local community to extend the impact beyond the school.
- **Competitions and Challenges:** Organize inter-class or inter-school challenges focused on reducing outdoor water consumption.

Use Recycled and Non-Potable Water

- **Greywater Systems:** Use treated greywater from sinks or kitchens for irrigation and other non-drinking purposes.
- **Municipal Recycled Water:** Partner with local governments to access recycled water for outdoor uses.
- **Incorporate Technology**
- **Smart Monitoring Systems:** Use outdoor water meters to track water usage and identify areas for improvement.
- **Leak Detection Sensors:** Install sensors in outdoor pipelines and sprinkler systems to quickly detect and address leaks.
- **Water-Wise Features:** Incorporate rock gardens, rain gardens, or xeriscaping (landscaping designed for minimal water use) into school grounds.
- **Shade Structures:** Use trees or structures to reduce water evaporation from gardens and lawns by providing shade.

By implementing these indoor and outdoor water conservation strategies, schools can significantly reduce their water footprint, create cost savings, and instill sustainable habits in students and staff and set a strong example for environmental stewardship while creating opportunities for student involvement in sustainability initiatives**.**

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SMART AGRICULTURE USING IOT

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Abstract

Agriculture, which began over 12,000 years ago during the Neolithic era, has been central to the development of human civilization. In India, agriculture continues to play a crucial role, with most farming practices depending on rainfall, soil quality, and environmental factors. While traditional methods persist, advancements in technology's, such as the "Internet of Things" (IoT), offer promising solutions to modernize farming and increase crop yields. IoT systems are already successfully used in various global industries, and it is time for India to adopt smart agricultural practices. These systems integrate data from sensors, actuators, and advanced electronics, allowing farmers to monitor their fields remotely. Smart agriculture can predict weather patterns, regulate irrigation, and optimize resource usage. Through sensors connected to platforms like Arduino-UNO, farmers can control systems remotely via networking technologies. The combination of research in smart agriculture and Artificial Intelligence (AI) can enable better resource optimization and pest control, ultimately leading to higher crop yields.

Keywords: Smart Agriculture, IoT, Precision Farming, Sensors, Arduino, Wireless Sensor Networks, Artificial Intelligence

Introduction

Smart farming techniques have the potential to significantly enhance traditional agriculture, which has long relied on labor-intensive methods and rudimentary tools. Technologies such as "precision farming, efficient water management, and soil moisture" monitoring can help increase yields while reducing waste. Precision farming reduces the overuse of fertilizers and pesticides by tailoring their application based on soil quality, benefiting both the environment and farmers. With water resources rapidly depleting due to increased agricultural and industrial demand, it is crucial to adopt more sustainable farming practices. Additionally, many migrants returning to rural areas after the COVID-19 pandemic have shown interest in farming, providing an opportunity to introduce them to modern, efficient farming methods.

Existing Agricultural Practices

In Village areas, farming remains the primary livelihood for many, with farming techniques passed down through generations. However, most small-scale farmers rely on traditional methods that are often inadequate for maximizing crop yields. These farmers typically rely on rainfall and canal irrigation systems for water, and pest control is done using locally available materials. The lack of modern tools and weather forecasting systems leaves farmers vulnerable to crop failure due to unpredictable environmental conditions. In contrast, large-scale corporate farms have been able to implement smart agriculture systems, which has led to higher productivity and profits. The goal is to transition from labor-intensive, risk-prone farming to more sustainable, efficient practices that increase yields and profits.

Proposed Systems

To address the challenges faced by traditional farming, the proposed system focuses on integrating IoT-based technologies into agricultural practices. For instance, a smart irrigation system can increase water utilization by automating the irrigation process based on current weather and soil moisture data. Farmers can constantly track and regulate their crops by utilizing "IoT sensors", which can provide complete data on environmental elements like temperature, humidity, and soil moisture. This system can help small farmers achieve better yields and profitability by optimizing water usage, pest control, and overall crop management.

Methodology

- **Wireless Sensor Networking**: The system uses a "wireless sensor network (WSN)" to continuously monitor environmental factors like temperature, humidity, and soil moisture. Data from various sensors is

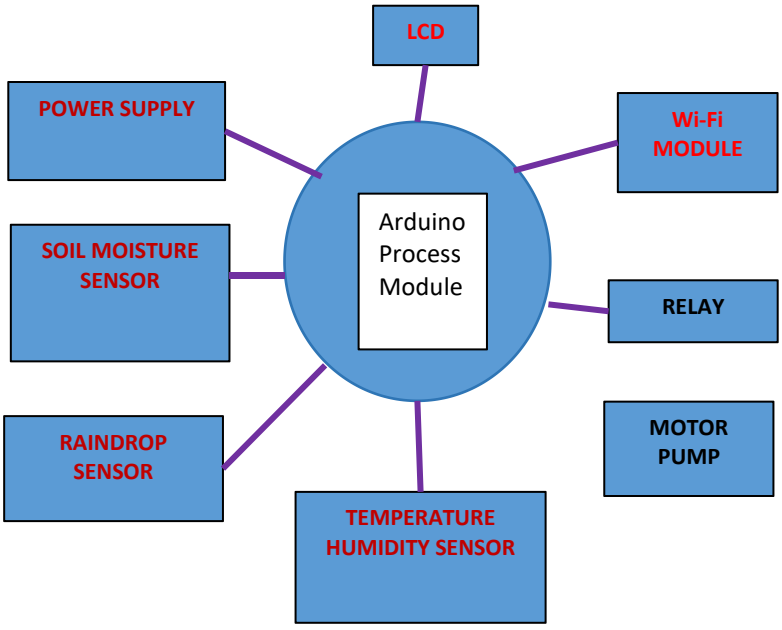
collected and processed to provide real-time insights for farmers. This system can also control agricultural machinery, such as irrigation pumps, based on the data received from the sensors.

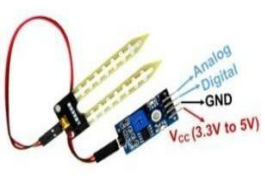
- **Irrigation Control**: Soil moisture sensors are embedded in the field to measure moisture levels. If moisture levels fall below the threshold, the system automatically activates the irrigation pump. Temperature sensors and rain sensors are also integrated to provide comprehensive environmental data.
- **Remote Monitoring**: The system allows farmers to monitor their crops and control irrigation systems remotely through a smartphone or computer. This increases convenience and ensures that farmers can take immediate action when needed.

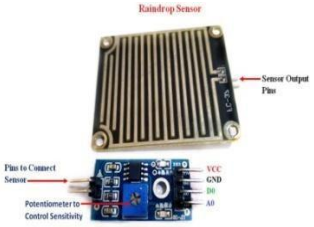
Literature Survey

Several studies have examined the application of IoT in agriculture. One such study focused on an irrigation system that utilizes soil moisture data to regulate water usage efficiently. However, some systems, such as those based on Bluetooth, have limitations in range and device compatibility. Another study focused on improving energy efficiency in sensor networks. Researchers have also explored the use of Zigbee technology for environmental monitoring, although power consumption remains a concern. Despite these challenges, IoT-based systems offer significant benefits for monitoring crop conditions and improving farm management.

Block Diagram







"Figure-2 Soil Moisture sensor Figure – 3 Raindrop sensor Figure-4 Temperature & Humidity sensor"

"Soil Moisture Sensor": Measures the volumetric water content in the soil and provides moisture level readings. This helps determine when irrigation is needed.

"Raindrop Sensor": Detects rainfall by measuring the change in resistance caused by water droplets falling on the sensor's surface.

"Temperature & Humidity Sensor": Monitors temperature and humidity levels, which are crucial for crop health.

"Arduino UNO": Arduino is an open-source electronic platform designed for prototyping with an emphasis on ease of use, both in hardware and software. It allows users to interface with sensors to collect input and control outputs like motors and actuators. The platform is particularly user-friendly for individuals familiar with basic electronics and C programming. Arduino consists primarily of a hardware board, commonly the Arduino Uno, and the Arduino Integrated Development Environment (IDE) for writing code.

"The Arduino Uno is a microcontrollers board built around the ATmega328P chip. It has 14 digitals input/output pins, including 6 that support PWM output, along with 6 analog inputs. The board also includes a 16 MHz quartz crystal, a USB port, a power jack, an ICSP header, and a reset button. It can be powered through either a USB connection or an external AC-to-DC adapter, making it highly accessible. With its straightforward "plug and play" design, users can easily connect it to a computer or battery and start working on their projects with minimal risk of damage."

The Arduino IDE is a multi-platform software compatible with Windows, macOS, and Linux, built using Java. It provides a straightforward way for users to write code and uploads it to Arduino boards, simplifying the development of electronic projects. Its ease of use makes it suitable for both beginners and experienced developers in electronics and programming.

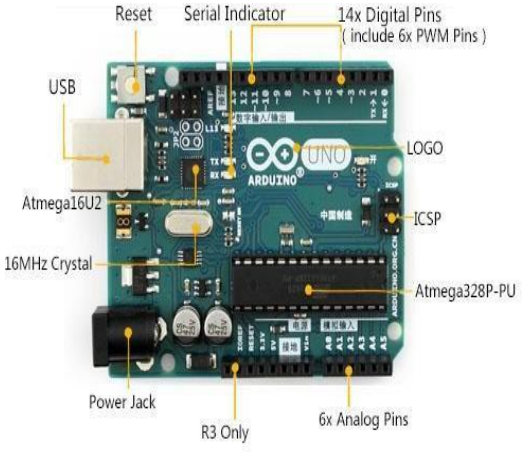


Fig. No.5 Arduino UNO board

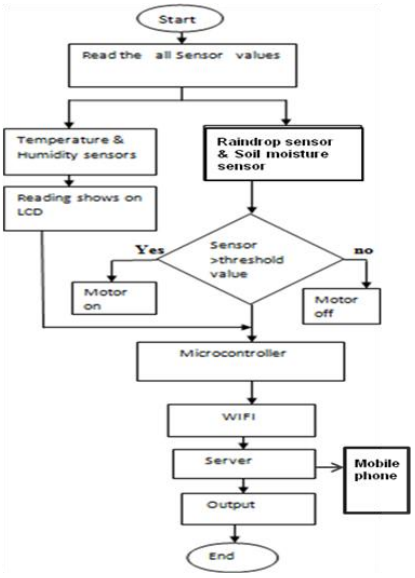


Fig. No. 6 Flow Chart

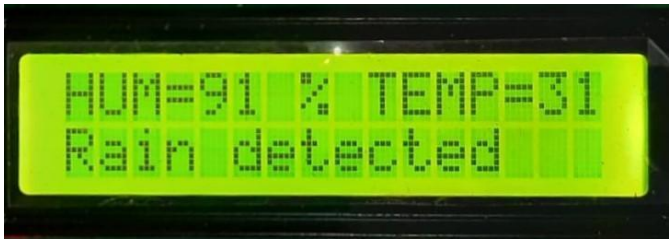


Fig. No. 7 LCD data

Performance and Operability

The system's performance was assessed using the Thing Speak platform, which facilitated the monitoring of key parameters, including “temperature, humidity, rainfall, and soil moisture.” The data gathered through this platform enabled the evaluation of the smart irrigation project's efficiency and functionality, as demonstrated in the corresponding figure.

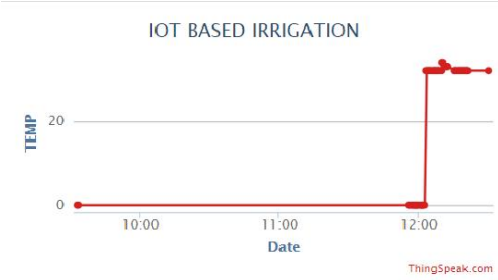


Fig. No. 8 Temperature Data

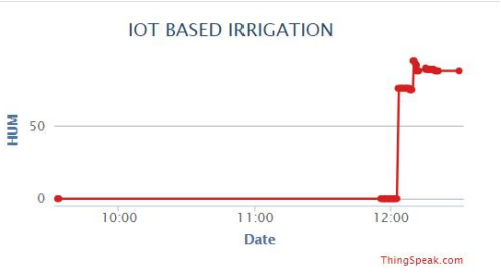


Fig. No. 9 Humidity Data

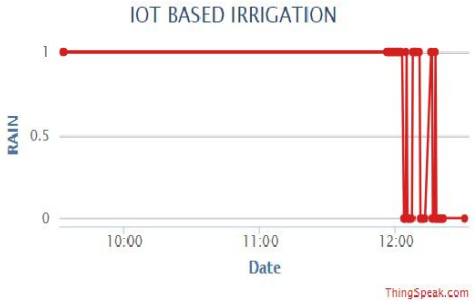


Fig. No. 10 Rain Data

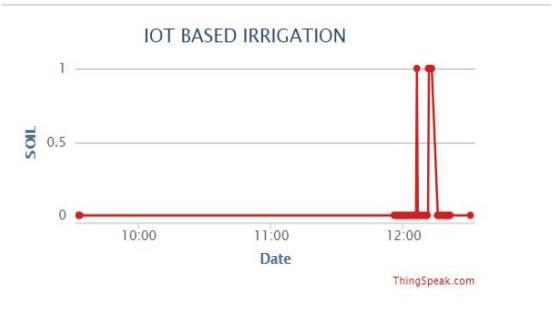


Fig. No. 11 Soil Data

Conclusion

By incorporating IoT and wireless sensor networks into agriculture, farmers can improve crop management, reduce resource waste, and increase overall productivity. These systems offer a cost-effective way to automate irrigation, monitor soil and climate conditions, and control farming equipment remotely. As IoT technology continues to evolve, it holds great potential for transforming agriculture in India, improving food production, and addressing environmental challenges.

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SOCIAL MEDIA INFLUENCE ON SUSTAINABLE SHOPPING TRENDS

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Abstract

This study looks at how social media might help customers adopt more environmentally friendly purchasing habits. The study illustrates how digital interactions impact the transition toward eco-friendly purchasing patterns through an examination of various social media platforms, influencer involvement, and consumer engagement strategies. The results highlight important trends and provide useful advice for marketers and companies looking to take advantage of the rising demand for eco-friendly goods.

Keywords

sustainability, social media, consumer behavior, sustainable brands, green marketing, digital communication, influencer marketing, greenwashing.

Introduction

Consumer behavior has changed significantly in recent years, especially in regards to sustainability. Customers are increasingly choosing eco-friendly products as environmental issues like plastic litter and climate change continue to dominate international conversation. The trend of sustainable purchasing, which includes the desire for goods that are created ethically, with little ecological impact, and with little environmental damage, has emerged as a result of this change. The widespread impact of social media platforms has exacerbated this shift in consumer behavior.

With billions of users using sites like Facebook, Instagram, Pinterest, and TikTok, social media has become an integral part of everyday life. In addition to revolutionizing communication and interaction, these platforms have developed into effective instruments for influencing the tastes and actions of customers. Because of this, social media has a special power to affect consumer choices, especially when it comes to encouraging environmentally friendly purchases. A wider audience can now see and understand sustainability because to social media's use of visual storytelling, peer pressure, and influencer endorsements. (Mangold & Faulds, 2009). Furthermore, user-generated content such as product reviews, sustainability advice, and brand advocacy has increased the legitimacy of environmentally friendly products and increased their appeal to consumers who care about social issues. (Cheung & Thadani, 2012).

Platforms that emphasize visual content and brief films, such as Instagram and TikTok, have proven especially successful in encouraging sustainable lifestyles. By showcasing the beauty of eco-friendly products, zero-waste lifestyles, and sustainable fashion, these platforms have made it possible for sustainable enterprises to flourish and connect with a worldwide consumer base. (Niinimäki, 2020). Influencers, who are crucial in establishing trends, frequently utilize their platforms to promote sustainability, which raises awareness and eventually modifies the buying patterns of consumers. (Schouten et al., 2020).

The purpose of this article is to examine the ways in which social media platforms impact trends in sustainable shopping. This study will investigate how social media influences consumer attitudes toward sustainability and encourages eco-friendly buying habits by examining the roles of influencers, user-generated material, and peer recommendations. The difficulties that emerge in this field will also be covered in the paper, such as problems like disinformation and greenwashing that might call into question the veracity of sustainability claims. In the end, this study aims to provide light on how consumers, marketers, and brands can more effectively traverse the changing terrain of sustainable buying in the digital era.

Literature Review

- **Social Media and Consumer Behavior:** Research suggests that social media influences consumer choices through peer recommendations, influencer endorsements, and exposure to marketed material. (Mangold & Faulds, 2009)
- **Sustainability and Consumer Trends**: The rise of eco-conscious consumers and the increasing demand for sustainable products, particularly in the fashion, food, and beauty industries. (Niinimäki, 2020)
- **Influencers and Social Proof**: How influencers and user-generated content shape purchasing behavior and perceptions of sustainability. (Schouten et al., 2020)

The Role of Social Media in Promoting Sustainable Shopping

- **Platform Influence**: Platforms like Instagram, Pinterest, and TikTok allow brands to reach consumers visually and interactively, making sustainability more accessible and desirable. (Woods et al., 2016).
- **Peer Recommendations and User-Generated Content**: The influence of consumer testimonials, internet reviews, and displays of environmentally friendly products on buying decisions. (Cheung & Thadani, 2012).
- **Brand Marketing for Sustainability**: Brands influence consumer choices and brand loyalty by using social media to promote their eco-friendly products and sustainable business practices. (Kaplan & Haenlein, 2010).

The Influence of Social Media Influencers

- **Influencers as Key Drivers**: By sharing their own stories, social media influencers aid in the promotion of sustainable products and are therefore regarded as reliable resources by environmentally concerned customers. (Freberg et al., 2011)
- **Building Trust through Authenticity**: Influencers who focus on transparency and authenticity in promoting sustainable lifestyles can build trust and influence purchasing decisions (Eisenberg et al., 2020).

The Role of Social Media in Shaping Consumer Awareness

- **Increased Awareness of Environmental Issues:** An examination of the ways in which social media has increased public awareness of issues pertaining to the environment, including plastic waste, climate change, and ethical fashion.
- **Educational Campaigns by Brands:** Examples of how companies use social media to inform customers about ethical production, eco-friendly products, and sustainable sourcing.

Social Media Campaigns Promoting Sustainable Shopping

- **Case Studies of Successful Campaigns:** Evaluation of initiatives like Lush's sustainability-focused Instagram and TikTok campaigns or Patagonia's #BetterThanNew (Palmer, 2020)
- **The Role of Hashtags and Viral Trends:** Hashtags such as #ZeroWaste and #SustainableFashion inspire people to live more sustainably and promote viral trends related to eco-friendly shopping. (Dholakia & Zhao, 2018).

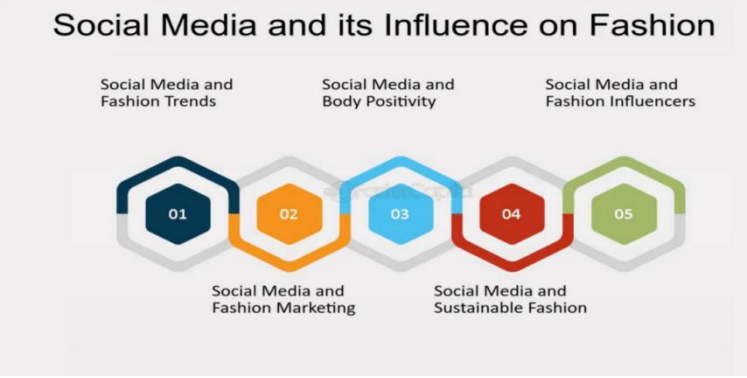

Figure 1- Social Media and its Influence on Fashion

Challenges in Social Media-Driven Sustainable Shopping

- **Greenwashing Concerns**: The risk that businesses will overstate their sustainability efforts in an effort to attract eco-aware clients, especially on social media platforms like Instagram where visibility is important. (Lyon & Montgomery, 2015)
- **Misinformation and Consumer Trust**: The spread of misleading information about sustainable products and the need for regulation to ensure that eco-friendly claims are true. (Borgerson et al., 2018)

Findings

- **Social Media's Role**: Sustainable buying is greatly aided by social media sites like Facebook, Instagram, and TikTok. These tools make it easier to share information and create communities centered around sustainability.
- **Consumer Engagement**: Customers can share ideas, advice, and product suggestions in sustainability-focused online communities and social media groups.
- **Brand Strategies**: Influencer partnerships and user-generated content are being used by brands more and more to communicate their sustainability pledges. This tactic increases customer trust in addition to improving brand image.

Discussion

Social media's incorporation into sustainable product marketing methods has increased consumer participation and awareness. Greenwashing, the practice of companies falsely representing their goods as ecologically beneficial, is still common, nonetheless.The market is oversaturated with both authentic and fraudulent sustainability promises, and customer opinions vary widely.

Conclusion

Social media has a complex role in advancing sustainable shopping trends, influenced by peer pressure, visual storytelling, and the growing number of digital influencers. The main ways that social media platforms encourage the adoption of environmentally friendly consumer practices are examined in this section, along with the difficulties that result from this change.

1. Social Media as a Platform for Raising Sustainability Awareness

Social media platforms, which provide a forum for people, organizations, and activists to exchange knowledge, resources, and up-to-date information on environmental issues, have demonstrated efficacy in increasing awareness of sustainability. According to Mangold and Faulds (2009), social media's strength is in its capacity to spread messages via peer networks and reliable sources. Given that consumers are increasingly trying to make ethical, well-informed decisions, this is especially pertinent when it comes to sustainable buying. With their visually stimulating material, social media sites like Instagram and Pinterest have produced a potent platform for promoting sustainable movements, eco-friendly goods, and green lifestyles.

The increasing popularity of "sustainable fashion" on Instagram, where eco-aware companies use influencers, artists, and environmental activists to market their goods, is one such example. Younger, socially conscious generations now find sustainability more visually appealing and approachable thanks to these platforms' captivating visuals and hashtag movements like #SustainableFashion and #SlowFashion (Niinimäki, 2020). Users can quickly recognize and relate to products that reflect their values thanks to this visual focus, whether they are from the culinary, beauty, or fashion industries.

2. The Role of Influencers in Shaping Sustainable Consumption

Influencers are crucial in influencing social media user behavior, especially when it comes to promoting eco-friendly goods. Influencers directly affect followers' perceptions of brands and products since they are regarded as trustworthy individuals. Because their support is frequently regarded as genuine and trustworthy, influencers who promote sustainability have the power to dramatically alter consumer behavior. By offering relatable examples of

how sustainable practices can be integrated into everyday life, influencers can close the gap between consumer awareness and action (Schouten et al., 2020).

3. User-Generated Content and Peer Influence

User-generated content is another important factor influencing sustainable purchasing trends (UGC). Users can share their own experiences with sustainable practices, eco-friendly items, and brands that reflect their beliefs on social networking networks. According to study, electronic word-of-mouth, like this content, has a big influence on people's decisions to buy (Cheung & Thadani, 2012). Peer recommendations are frequently more trusted by consumers than traditional advertising, and when people talk about their great experiences using sustainable products, it can encourage others to do the same.

Peer recommendations have an impact that goes beyond product reviews. On TikTok, for instance, hashtags like #ZeroWaste and #EcoTok highlight a burgeoning user base that exchanges experiences, advice, and suggestions about sustainable living.

4. Challenges in the Social Media Landscape for Sustainable Shopping

Social media's impact on environmentally friendly purchasing is not without its difficulties, despite its potential. The problem of greenwashing is among the most important issues. Many firms may be tempted to exaggerate their environmental efforts or mislead consumers about the sustainability of their products as sustainability gains importance as a consumer priority. According to Lyon and Montgomery (2015), greenwashing is the practice of companies making exaggerated claims to be environmentally friendly in an effort to take advantage of the rising demand for sustainable goods. Customers may become skeptical of sustainability promises as a result, which can erode their trust in businesses and make it more difficult for them to distinguish between products that are truly sustainable and those that are just promoted as such.

5. The Future of Social Media and Sustainable Shopping

Social media will probably keep being a major factor in the development of sustainable purchasing trends in the future. For customers looking for sustainable solutions, emerging technologies like augmented reality (AR) and artificial intelligence (AI) may provide even more personalized and interactive experiences as digital platforms develop. As governments and organizations start to crack down on deceptive marketing techniques, brands and influencers will also need to negotiate regulatory changes pertaining to sustainability claims and transparency.

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THE STAMPEDE PHENOMENON IN RELIGIOUS GATHERINGS IN INDIA: A STUDY OF CAUSES, CONSEQUENCES, AND PREVENTION

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Abstract

Stampedes at religious gatherings in India either it including the Kumbh Mela, Vaishno Devi pilgrimage, and Sabarimala temple festival, have led to tragic loss of life due to irresponsible behaviour and management overcrowding, inadequate infrastructure, and poor crowd management. These events attract millions of devotees, making crowd control and safety a significant problems. Key causes of stampedes include overcrowded spaces, narrow paths, inadequate barriers, ineffective crowd management strategies, and panic induced by religious intent . Poor communication and lack of emergency preparedness exacerbate these situations which often leading to fatal results.

Case studies and review on such as the Kumbh Mela stampedes in 1954, 1986, and 2008, and the 2013 Ratnagarh and Vaishno Devi incidents highlight recurring patterns of overcrowding, sudden surges, and ineffective planning. These tragedies are often caused by overcrowding, lack of clear information, and poor infrastructure that limits crowd movement and emergency response.

The consequences of these stampedes go beyond the loss of life. They also affect local economies dependent on religious tourism , image of state, decrease public confidence in the safety of such events, and leave lasting emotional and psychological scars on survivors and families.

To prevent future stampedes, authorities must implement better crowd management strategies, improve infrastructure, and technology such as AI-based crowd prediction models and drones for real-time monitoring. Enhanced communication systems and trained personnel are also essential. With improved planning, these religious gatherings can be safer while maintaining their spiritual significance etc.

Keywords: Religious Stampede, Crowd Management, Infrastructure safety, Emergency Preparedness and AI - Based Monitoring.

Introduction

India, known for its diverse culture and religions, hosts some of the world's largest religious gatherings. Events such as the Kumbh Mela, the Vaishno Devi pilgrimage, and the yearly Navratri festivities attract millions of devotees who engage in sacred rituals and celebrations. While these occasions offer spiritual satisfaction and foster community bonds, they also pose significant logistical challenges due to their vast attendance.

Unfortunately, overcrowding at these events has led to tragic occurrences, particularly stampedes, where panic can sweep through tightly packed crowds, resulting in injuries and even deaths. These stampedes are not isolated incidents; rather, they are recurring events that heighten concerns regarding the safety and preparedness of event organizers, local governments, and religious bodies.

Objective :

This research paper aims to examine the reasons and ramifications of stampedes at religious events in India, concentrating on major pilgrimages and festivals. Additionally, it evaluates possible preventive measures and investigates how technological innovations, infrastructure enhancements, and improved crowd management practices can help avert such disasters in the future.

Literature Review

Religious assemblies in India have existed for centuries, but the level of participation has significantly surged in recent decades. Pilgrimages such as the Kumbh Mela, held every 12 years, have experienced remarkable growth, increasing from a few hundred thousand attendees in the early 20th century to over 120 million in recent times. As the number of participants grows, the challenges associated with managing such vast crowds also amplifies.

Numerous researchers and organizations have examined crowd dynamics and the elements that lead to stampedes during large events. A 2013 report from the National Disaster Management Authority (NDMA) highlighted that inadequate infrastructure design, lack of effective crowd management strategies, and poor emergency response systems are key factors contributing to the incidents of stampedes. Investigations conducted by the Indian Institute of Technology (IIT) Bombay regarding crowd behaviour further underline the significance of grasping crowd psychology and behaviour patterns, along with the necessity for a proactive stance on crowd management.

Analysis of stampedes throughout India indicates that most incidents could be prevented with improved planning. For example, research on the 2011 Kumbh Mela stampede in Allahabad identified overcrowding, sudden panic, and ineffective communication as major causes, where the absence of clear information regarding crowd conditions led to disorder.

In spite of these findings, minimal action has been taken to enforce large-scale safety reforms at all religious gatherings, and many of the problems remain unresolved, resulting in persistent incidents.

Factors Contributing to Stampedes in Religious Gatherings

Crowd Density and Inadequate Planning

The foremost reason for stampedes is the excessive density of the crowd. Large religious events like the Kumbh Mela, Vaishno Devi pilgrimage, and the Sabarimala temple festival attract millions within a brief period. Often, the physical space needed for such sizable groups is lacking, and the crowd control measures, including barriers and pathways, fall short.

Crowds can be unpredictable, particularly during sudden movements. In these situations, the combination of overcrowding and insufficient planning leads to a highly dangerous environment. The 2013 Ratnagiri temple stampede exemplifies how congestion in a restricted area caused chaos. With poor barricades and congested pathways, the surge of devotees at the temple entrance created a bottleneck that sparked a disastrous sequence of events.

Insufficient Infrastructure

Many of India’s religious sites, some of which date back centuries, were not built to handle the vast numbers that now converge upon them during significant religious gatherings. Narrow paths, limited access and exit points, along with inadequate emergency evacuation routes, pose considerable risks.

For instance, during the Vaishno Devi pilgrimage, worshippers navigate narrow, winding trails. These routes, originally designed for smaller groups, have become overcrowded during peak pilgrimage times. In certain circumstances, these pathways lack sufficient lighting, safety barriers, or clear directional signs, all of which can lead to accidents and chaos during emergencies.

Passionate Religious Sentiment and Panic

The psychological factor of religious enthusiasm should not be overlooked. For numerous devotees, participating in a pilgrimage or religious event may be a once-in-a-lifetime opportunity, amplifying their urgency to reach the sacred site. When individuals are swept up in the fervour, their sense of danger can become distorted, resulting in irrational actions, particularly when panic arises.

A sudden jolt, an imagined threat, or a moment of confusion can trigger widespread panic, as witnessed in the 2014 Vaishno Devi stampede. The intensity of devotees' beliefs often drives them to neglect their safety as they strive to reach their goal, increasing the likelihood of stampedes.

Ineffective Crowd Management Measures

Even though many religious events garner significant attendance and receive sufficient attention from local authorities, crowd management strategies frequently fall short of addressing the enormity of the gathering. Inadequate barricades, insufficient personnel to regulate the crowd, and delayed reactions in emergencies worsen the situation. For example, during the 2013 Ratnagiri temple stampede, deficiencies in crowd control measures and a failure to execute timely interventions resulted in over 100 fatalities.

Authorities often misjudge the unpredictability of crowds, and the absence of thorough risk evaluations and crowd-flow forecasting during these events leads to tragic outcomes. This dilemma becomes even more pressing when there is an inadequate number of trained personnel available to manage such large crowds.

Ineffective Communication

In any significant event, particularly one as tumultuous as a religious gathering, effective communication is crucial for ensuring safety. Insufficient communication systems—such as inadequate signage, vague instructions, and delayed distribution of emergency alerts—can lead to anxiety and chaos. This issue is intensified during a stampede when timely access to real-time information is limited.

During the 2014 Vaishno Devi stampede, there were accounts of ineffective communication among the temple officials, local law enforcement, and emergency responders. This lack of collaboration contributed to a sluggish response, exacerbating the crisis.

Case Study : Kumbh Mela 1954

The Kumbh Mela of 1954, the first held after India's independence, was a historic and tragic event. On 3 February, during Mauni Amavasya, millions of devotees gathered at the confluence of the Ganges, Yamuna, and Sarasvati rivers in Allahabad (now Prayagraj) to take a holy dip. In the rush, a stampede broke out, leading to the deaths of nearly 800 people, either trampled or drowned. The tragedy highlighted the dangers of overcrowding and poor crowd management at such large-scale events. It remains a sombre reminder of the need for better organization at future Kumbh Melas, though it continues to be a major spiritual occasion for millions.

Case Study 1: Kumbh Mela 1986

The 1986 Kumbh Mela in Haridwar was marked by another devastating tragedy. On the day of the event, a stampede broke out, claiming at least 200 lives. The chaos began when Uttar Pradesh Chief Minister Veer Bahadur Singh, accompanied by other state leaders and Members of Parliament, arrived in Haridwar. As security personnel attempted to restrict public access to the riverbanks to accommodate the VIPs, tensions rose. The growing frustration of the crowd, compounded by the lack of space and poor management, led to a deadly stampede. This tragic incident underscored the need for better crowd control and security measures at large-scale religious events.

Case Study 2: Kumbh Mela 2008

The Kumbh Mela, held every 12 years in Allahabad (now Prayagraj), is the largest religious gathering in the world. The 2008 Kumbh Mela stampede, which resulted in over 40 deaths, occurred when a large number of devotees surged towards the riverbanks to perform a ritual bath. The event was poorly managed in terms of crowd control, and rumours of gate closures led to panic. The lack of clear signage and inadequate barriers further escalated the situation.

The aftermath of the tragedy sparked widespread criticism of the event's organization, with many pointing out the inadequate infrastructure and poor planning, which contributed to the overcrowding and chaos.

Case Study 3: **: Ratnagarh Temple Stampede (2013)**

During the Navratri festival in 2013, a stampede at the Ratangarh temple in Madhya Pradesh resulted in over 100 deaths and hundreds of injuries

Around 9 a.m. on Sunday, October 13, 2013, approx. 25,000 individuals were on the bridge at when a portion of the railing collapsed. Word spread that the bridge might collapse, leading to panic as the crowd attempted to push their way off. Many people lost their lives or sustained injuries in the resulting crush, and others drowned after leaping into the rising river. The majority of the casualties were women and children.

There were differing accounts regarding the reasons for the stampede. One account suggested that the panic was triggered by the broken railing, while another claimed that a tractor had struck the bridge prior to the chaos. Others reported that a group of pilgrims deliberately circulated the rumour in order to break the long queue. Some eyewitnesses indicated that the stampede was ignited when police charged into the crowd swinging batons, though this claim was refuted by police authorities.

Case Study 4: Kumbh Mela 2013 Allahabad (Prayagraj), Uttar Pradesh

Date: February 10, 2013

Initial reports suggest that the stampede occurred after a railing on a footbridge at Allahabad railway station collapsed. However, eyewitnesses claim that the chaos was triggered when railway police

used wooden sticks to charge at the crowd in an attempt to control the overwhelming rush at the station. The tragedy claimed the lives of 42 people, including 29 women, 12 men, and an eight-year-old girl who passed away after waiting for nearly two hours for assistance. At least 45 others were injured in the incidents

Case no 5: Hathras Uttaroradesh July 2024 (Satsang)

On July 2, a large crowd, mainly consisting of people from disadvantaged communities, gathered in Hatteras to hear a 'godman' deliver a sermon. As the event came to an end and the godman was leaving, the crowd rushed forward to get a last look at him. Many people knelt down to collect the mud from the ground where he had walked, believing it to be sacred. In the chaos that followed, a stampede broke out, resulting in the deaths of 121 people, the majority of whom were women.

Case Study 6: Maha Kumbh 2025 (Prayagraj)

At least 30 people have lost their lives and 60 others have been injured in the stampede at the Maha Kumbh venue in Prayagraj …….

Here are some more religious stampedes that have occurred in India:

1. 2011 Kumbh Mela Stampede (Allahabad January 14, death: 36 approx.)
2. 2008 Mandhata Stampede (Mandhata Madhya Pradesh, October 3, death: 220 approx.)
3. 2006 NainaDevi Temple Stampede (NainaDevi Temple, Himachal Pradesh, August 3, Deaths:
4. 145 approx.)
5. 2004 Vrindavan Stampede (Vrindavan, Uttar Pradesh, March 4, Deaths: 29 approx.)
6. 2003 Chamunda Devi Temple Stampede (Jodhpur, Rajasthan April 25, Deaths: 258 approx.)
7. 2001 Kumbh Mela Stampede (Allahabad (Prayagraj), Uttar Pradesh January 14, Deaths: 40 approx.)
8. 1997 Ujjain Stampede (October 22, Ujjain, Madhya Pradesh Deaths: 50 approx.)
9. 1991 Mahavir Jayanti Stampede (April 7, Patna, Bihar, Deaths: 104 approx.)
10. 2013 Ratnagiri Temple Stampede (September 13, Ratnagiri Temple, Madhya Pradesh, Deaths: 115 approx.)
11. 2010 Sabarimala Temple Stampede (January 14, Sabarimala, Kerala, Deaths: 102 approx.)
12. 2000 Sabarimala Stampede (December 14, Sabarimala, Kerala, Deaths: 51 approx.
13. 1998 Varanasi Stampede (October 13, Varanasi, Uttar Pradesh, Deaths: 60 approx
14. 1987 Bhavnagar Temple Stampede (October 10, Bhavnagar, Gujarat, Deaths: 50 approx.)
15. 1986 Kumbh Mela Stampede (February 1, Allahabad (Prayagraj), Uttar Pradesh, Death :100 approx.)
16. 1985 Baidyanath Temple Stampede (: September 14, Baidyanath Temple, Deoghar, Jharkhand Deaths: 50+ approx.)
17. 1983 Badrinath Temple Stampede (September, Badrinath, Uttarakhand, Deaths: 25 approx.)
18. 2006 Eid-ul-Fitr Stampede in India (November 1, Mecca Masjid, Hyderabad, India
19. 2001 Eid-ul-Fitr Stampede in India (January 1, Delhi, India Deaths: 35 approx.) and etc

Consequences of Stampedes

- **Human Cost:** The immediate toll of stampedes on human life is catastrophic. Lives are lost, and many survivors endure both physical injuries and psychological trauma. The families of those who perish often grapple with a lack of closure, while the emotional scars for survivors can persist indefinitely. Children and the elderly tend to be particularly at-risk during stampedes, resulting in lasting ramifications for affected families.

- **Social and Economic Consequences:** The repercussions of stampedes go beyond the moment they occur. Religious tourism, a vital element of the local economy, suffers when potential attendees view religious events as hazardous. Businesses reliant on pilgrim traffic, such as vendors, hotels, and transportation services, face substantial financial setbacks when stampedes occur. Additionally, the media portrayal of these incidents frequently influences public perceptions of the events, leading to decreased participation in future gatherings.

- **Religious Consequences:** Stampedes can create a significant impact on the spiritual and religious experiences of participants. What is intended to be a holy pilgrimage often transforms into a tragedy, jeopardizing the faith of survivors and deterring others from attending such events. The anxiety and trauma linked to stampedes can result in devotees being reluctant to revisit these locations, influencing the religious importance and spiritual satisfaction they gain from these gatherings.

6. Prevention Measures and Solutions

Crowd Management Strategies

To avert stampedes, it is essential to implement a thorough crowd management strategy. This strategy should involve analysing crowd behaviour and designing pathways that facilitate the smooth movement of worshippers. Sufficient barriers, clear visual directions, and multiple entry and exit points are crucial for regulating the flow of large groups. Furthermore, designated rest areas and first aid stations should be strategically positioned to avoid overcrowding in important locations.

Technological Solutions

Technological measures can greatly improve safety during large gatherings. AI-based crowd prediction models can assist authorities in foreseeing potential dangers and taking precautionary steps before situations become unmanageable. Drones fitted with cameras can observe crowd density from the sky, offering real-time feedback to security staff. Furthermore, mobile applications that monitor crowds and supply updates on crowd density can help direct individuals away from overcrowded locations.

Improved Infrastructure

Investing in enhanced infrastructure at religious sites serves as a long-term approach to avoid stampedes. This encompasses widening narrow paths, adding more entry and exit points, and upgrading lighting and signage. At key junctions, digital displays showing live crowd movement data can assist in directing people and preventing congestion.

Public Awareness and Communication

Clear communication is vital during large-scale events. Authorities should utilize various channels, including loudspeakers, mobile applications, and social media, to share important information. Emergency procedures should be publicized in advance, and volunteers should be trained to safely guide individuals during emergencies.

Training Authorities

Security personnel and volunteers must receive ongoing training in crowd management and emergency response. They should be provided with equipment such as walkie-talkies and GPS devices to effectively coordinate actions in emergencies. Additionally, simulations and drills can prepare them for handling unexpected challenges during peak events.

Conclusion

Stampedes at religious gatherings in India are a recurring issue caused by overcrowding, poor infrastructure, ineffective crowd management, and lack of communication. These incidents result in tragic loss of life and long-term social and economic impacts. To prevent future disasters, authorities must implement better crowd control strategies, leverage technology, improve infrastructure, and enhance public awareness. With coordinated efforts from organizers, officials, and religious institutions, these gatherings can be made safer while preserving their spiritual significance.

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"SUSTAINABILITY IN RELATION WITH ARTIFICIAL INTELLIGENCE"

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Abstract: Artificial intelligence has grown rapidly in recent years, impacting many industries like media, healthcare, transportation, agriculture, and energy. While AI offers great potential, there are also concerns about issues like high energy consumption and ethical challenges. This paper looks at AI sustainability from economic, social, and environmental perspectives. It organizes existing research into two main areas: "Sustainability of AI" and "AI for Sustainability," providing a balanced view of the topic. Since 2019, there has been a noticeable rise in studies and real-world applications, showing that the field is becoming more developed. Future research will focus on understanding the role of stakeholders, aligning AI with the United Nations' Sustainable Development Goals (SDGs), and exploring lesser-known aspects of the topic.

Keywords: systematic mapping study, sustainability, artificial intelligence, or AI

Introduction

Significant progress in the field of artificial intelligence (AI) has been made in recent decades. Unexpected change might result from AI's capacity to revolutionize a number of sectors and industries. Health care, transportation, agriculture, energy, and the media have all witnessed significant changes brought about by A systems. There is a noticeable hesitancy despite the general excitement, which stems from worries about possible drawbacks as well as proof of AI's effectiveness. [1]

For example, training a state-of-the-art model, particularly one that uses Natural Language Processing (NLP), necessitates a significant amount of processing power, incurring significant energy costs as well as related financial and environmental implications. [2], [3]

Additionally, new ethical and societal issues for the economy and society were brought about by the development of AI. These issues include worries about the spread of fake news, societal injustice brought on by discriminatory AI systems, and stagnant actual pay for workers. As a result, scholars are becoming more eager to investigate their effects on sustainability. [1]Understanding AI's impact and revolutionary potential, particularly with regard to sustainability, necessitates a critical examination of the subject.

The three components of sustainability—economic, social, and environmental—can be examined in depth. Additionally, research is frequently separated into two categories when examining the current corpus of literature on AI sustainability: the influence of AI on sustainability and AI as a tool for accomplishing sustainable goals. [1]

Current research on this subject, however, frequently focuses on a single aspect, which may oversimplify the problem and provide a limited understanding of what AI sustainability actually means. The main goal of this paper is to develop a Systematic Mapping Study (SMS) that will enable the compilation and analysis of the existing literature on the subject, [3]bringing together both perspectives across all three dimensions of sustainability, given the current non-holistic state of the research described above. This work aims to fill in these knowledge gaps and stimulate further research. Additionally, our SMS will give businesses, governments, and researchers a succinct summary of the most recent studies in the field.[1]

Analytics 2024, 3141 for each of the three sustainability aspects. This work aims to fill in these knowledge gaps and stimulate further research. Additionally, our SMS will give businesses, policymakers, and searchers a succinct summary of the most recent research in the field.[1]

The format of this document is as follows: Our first literature review, which is presented in Section 2, introduces the basic ideas and recent analyses of AI sustainability research. By going over the primary steps of our SMS, Section 3 provides further detail on the paper's methodological approach. Our primary research topics are examined and addressed in Section 4, which also includes data-set-based visuals. Our study's limitations are covered in Section 5, and the conclusion is given in Section 6.[1]

Literature Review

"The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages," is how the Oxford Dictionary describes artificial intelligence. This is when artificial intelligence (AI) starts to show itself as a system that can behave like a person. AI is "the science and engineering of making intelligent machines, especially intelligent computer programs," according to John McCarthy, who is regarded as one of the founding fathers of the field. AI does not have to limit itself to techniques that are biologically observable, yet it is tied to the related job of utilizing computers to study human intellect. Although the concept of human-like behavior is included in McCarthy's definition, he goes one step farther by pushing the boundaries of AI's potential. [1]

Distinguishing it from human intelligence and emphasizing that biology does not define its bounds.
We can observe a development of the idea in the context of sustainability. Sustainability was first described as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" by the United Nations Brundtland Commission in 1987. Since then, authors have developed the idea further and divided it into three pillars or dimensions: social, economic, and environmental.[1][4]

Concerns regarding the environmental and societal sustainability of AI have been raised by its explosive expansion, according to existing research. [2]Building confidence in AI applications, interdisciplinary cooperation, and AI governance and regulation are all necessary to overcome these problems. AI can help with resource and energy intensity reduction and environmental governance. However, there are drawbacks, including an excessive dependence on past data, unpredictable human behavior, and cybersecurity threats. These issues also indicate that multilevel perspectives, systems dynamics methodologies,[3] design thinking, psychological and sociological factors, and economic value considerations should all be taken into account in future research. We examined relevant prior literature studies by other researchers in this subject using the two previously mentioned characteristics in order to present the overall picture of AI sustainability.[1]

According to the study, AI can help create individual and organizational habits that are culturally appropriate and can successfully lessen the environmental impact of human activity. However, AI's real value is found in its potential to improve and foster environmental governance at a higher level rather than just in its ability to reduce the intensity of energy, water, and land use in society. [4]
[2]

On AI for sustainability that focuses on a variety of applications in industries such manufacturing, water management, transportation, healthcare, and agriculture. The methods, challenges, and barriers related to using AI for sustainable development are highlighted in the study.[1]

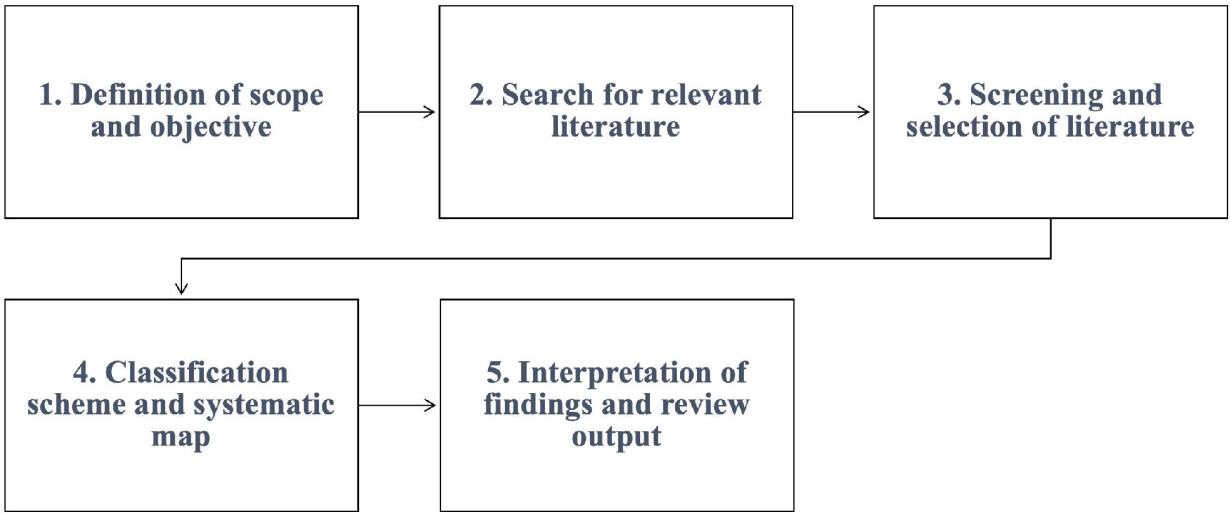
This literature outlines the several ways that artificial intelligence (AI) is being utilized to enhance sustainable practices on a small to big scale, as well as the different avenues for future research that academic researchers can pursue.[2] To put it briefly, cutting-edge research on AI for sustainability covers a broad range of subjects, such as biodiversity protection, resource management, energy efficiency, and climate change mitigation.[1]

Research Methodology

In order to investigate the subject of AI sustainability, our work used a Systematic Mapping Study (SMS) as the research approach. SMS adopts a more comprehensive approach, providing an all-encompassing picture of the literature in developing research fields, whereas Systematic Literature Reviews (SLR) go further into specific research concerns through empirical investigations. SMS addresses broad problems such as common research methodology and publication outlets by classifying and organizing literature studies along several parameters. In contrast to SLR, SMS offers a broad overview of developing disciplines and frequently uses visual aids such as graphs and concise data summaries to improve understanding. Although each methodology has its own merits, SMS offers academics and practitioners clear benefits in our study of AI sustainability, a relatively new research topic, enabling thorough comprehension of developing research fields.

We adhered to Levy and J. Ellis's "input–processing–output" method, which outlines the three steps of a successful literature review procedure. Figure 1 illustrates how these phases were further broken down into five segments. In order to provide the groundwork for the following stages, the first emphasis was on establishing the goals and

scope. A thorough search for pertinent literature was then conducted, guaranteeing a full examination of the body of knowledge within the specified constraints. [1]The third phase entailed a thorough screening and selection of the literature, with careful consideration given to quality and relevance. As we entered the processing phase, the fourth stage involved creating a systematic map and categorization scheme to help organize and synthesize the information that had been acquired. Lastly, at the output stage, The findings and review output were interpreted, resulting in a logical and perceptive analysis that is prepared for distribution and use in the pertinent field. We sought to guarantee systematic and exacting execution with this organized strategy, which would ultimately result in significant additions to the corpus of current knowledge.[1]



Scope and Objective

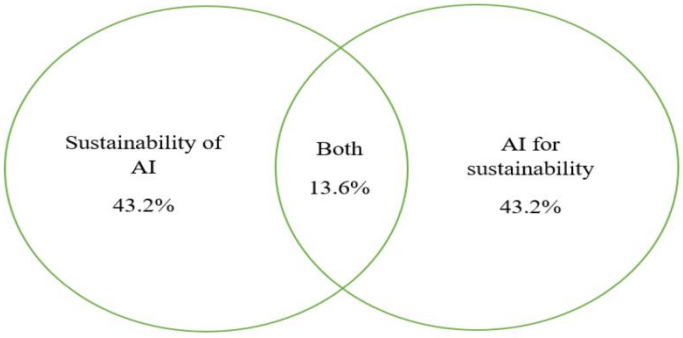
RQ1: How is AI sustainability portrayed in the literature now in publication? This goal is to provide readers a thorough grasp of how the idea of AI sustainability is addressed in the corpus of existing work. We can find important themes, patterns, and gaps in the current body of research by carrying out a systematic review, which will set the groundwork for more investigation and analysis. We therefore seek to examine in our paper two essential aspects of AI sustainability, namely, AI as a tool to achieve sustainability and the sustainability concerns of AI itself, in response to Heilinger et al. whose paper examines the goals and methods of "sustainable AI" in social and environmental contexts. We look more closely at the environmental, social, and economic aspects of each.

RQ2: How developed is the field of AI sustainability research? This goal aims to assess the scope and depth of research in the area of AI sustainability, taking into account the amount of publications, the degree of interest in the issue, and the way that research themes have changed over time. Knowing the maturity level makes it easier to assess progress, define areas of strength, and uncover new trends or areas that need more research. Therefore, the purpose of this research topic is to assess the various methods used in the body of current literature. How much empirical support is there in the body of current literature? Still assessing the related issues are most research papers on this subject? Are there any remedies being adopted for the problems at hand?

RQ3: What is the research plan for AI sustainability going forward? Based on the knowledge gathered from our analysis and evaluation of the status of the field, this objective seeks to suggest future research directions. Here, we note any research gaps in the body of current literature and suggest a prospective future roadmap. We want to provide some insights to help practitioners and scholars make more contributions to this subject by providing answers to this topic.

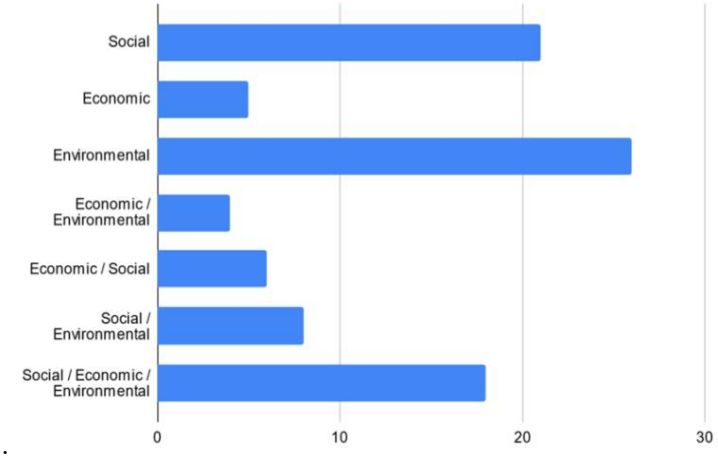
Results and Visualization

Figure 1



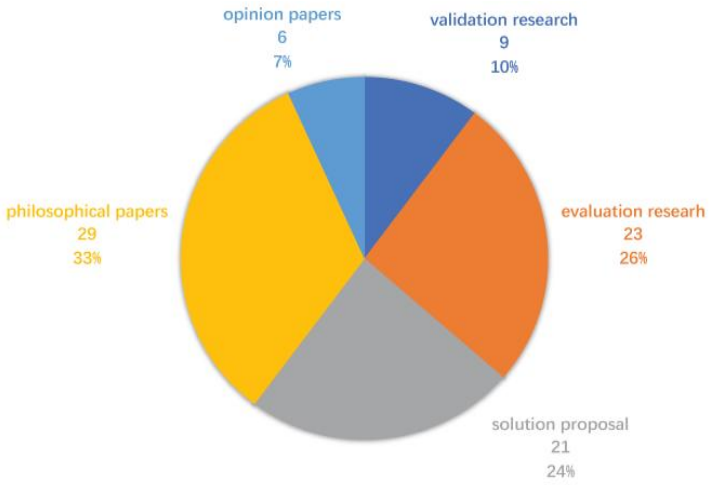
Different categories that offer a detailed knowledge of the complex subject of AI sustainability were identified as a result of the literature study. One significant classification results from different definitions of AI sustainability; some writers concentrate primarily on evaluating and reducing the effects of AI on sustainability, while others investigate the ways in which current AI technologies might support sustainable development. Inspired by Van Wynsberghe, this categorization divides the 88 mapped articles into two main groups: AI for Sustainability (43.2%) and Sustainability of AI (43.2%). A smaller subset (13.6%) takes a more comprehensive approach, addressing both aspects at the same time, as seen in Under the direction of, the analysis of sustainability dimensions further categorized the literature according to particular subfields or features within each dimension. While some articles addressed two or three dimensions, others concentrated on just one specialized subject or particular element.

Figure 2



The papers are broken down by category in The Environmental component, which includes research that explore how AI interacts with the environment, including energy usage optimization, carbon emission assessment, and the energy costs of operating big ML models, was notably the most prominent. The social component, which examines ethical issues, educational ramifications, and equity concerns pertaining to AI, comes next. Despite being the smallest, the economic dimension is covered by papers that look at new company models, labor market dynamics, and economic growth

Figure 3



Our analysis indicates that assessment research, solution proposals, and philosophical writings make up the majority of the literature currently available on AI sustainability. The most common category among the 88 papers reviewed in this review is philosophical papers, with 29 entries, followed by evaluation study with 23 entries and solution suggestion with 21 entries, as shown in Figure 3.

Discussion and Limitations

Paper quality: The caliber and breadth of the scholarly works chosen and examined are significant factors in this work. Since AI sustainability is a relatively new discipline, we found that there weren't many research articles in this area prior to 2019. Due to this feature, our research was limited in its ability to capture a whole historical perspective on the evolution of this subject. It also made long-term trend analysis challenging. Furthermore, compared to the overall amount of research publications, we found a comparatively lower proportion of empirical research papers. This element made it more difficult for us to record a wide variety of study techniques. Furthermore, a selective focus on less empirical research may offer biased interpretations and disproportionately reflect particular viewpoints. As a result, several important components of the research might not be thoroughly examined or analyzed.

Depth of review: Our approach to SMS may offer a more high-level summary without going thoroughly into each research, in contrast to SLR, which entails a more thorough review of each included article, including quality evaluation and synthesis of findings. This might imply that our examination of each particular piece may be less thorough even if it covers a wider range of literature.

Conclusions

The research aimed to create a Systematic Mapping Study (SMS) to analyze AI sustainability, focusing on environmental, social, and economic dimensions. The study found a dynamic landscape with rapid maturation and a promising research agenda. The field has grown significantly since 2019, with a surge in publications and diverse contribution types. The findings highlight a balanced perspective, with equal weighting between AI sustainability and AI for sustainability.

Recent papers have started to incorporate multiple dimensions, but the economic dimension remains under-explored. Future research should explore this dimension, aligning with the United Nations' Sustainable Development Goals (SDGs), and address concerns about stakeholders' influence on AI development. Safeguarding consumers' interests and safety is crucial, especially in tracking problematic AI decisions and accessing evidence for affected individuals. As AI research matures, collaboration, diversity in authorship, and commitment to sustainability will propel AI research towards a more inclusive, impactful, and sustainable future.

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SUSTAINABLE ENERGY SOLUTIONS: THE IMPACT OF RENEWABLE RESOURCES ON ENVIRONMENTAL AND ECONOMIC GROWTH

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Abstract:

The growing global demand for energy, coupled with the depletion of fossil fuels and their environmental impact, has necessitated a shift towards renewable energy sources. Solar energy, in particular, has emerged as a key solution due to its abundance, sustainability, and minimal environmental footprint. Countries worldwide are increasingly investing in solar energy infrastructure, with China, the United States, and India leading in installed capacity. The transition to renewable energy enhances energy security by reducing dependence on imported fuels and mitigating geopolitical risks. Additionally, it fosters economic growth, job creation, and technological innovation in the clean energy sector. Statistical data from India's energy sector highlights the gradual decline in energy shortages, reflecting improvements in energy availability and the integration of renewable sources. While fossil fuels still dominate electricity generation, non-fossil fuel contributions, including solar and wind energy, are steadily increasing. India's state-wise analysis of solar capacity illustrates significant growth, particularly in Rajasthan, Gujarat, and Karnataka, reinforcing the country's commitment to clean energy. Despite advancements in wind and hydroelectric power, solar energy remains the most promising due to its cost-effectiveness, scalability, and widespread applicability. This research underscores the importance of transitioning towards renewable energy to achieve carbon neutrality and sustainability goals. By leveraging solar power and other clean energy alternatives, nations can mitigate climate change, reduce pollution, and ensure a reliable energy future. The data-driven insights presented in this study emphasize the urgency of adopting sustainable energy solutions for long-term environmental and economic benefits.

Keywords: Carbon Neutrality, Energy Security, Fossil Fuels, Renewable Energy, Sustainability.

Introduction

The energy sector is rapidly evolving due to rising energy demands and the environmental impacts of fossil fuels.[1]. Renewable resources, including solar, wind, geothermal, and biomass, have emerged as essential alternatives to conventional energy sources [2]. These sustainable solutions offer a dual advantage: mitigating climate change through reduced greenhouse gas emissions and fostering economic development through job creation and energy independence [3].

Environmental degradation caused by fossil fuel consumption remains one of the most pressing global concerns. The Intergovernmental Panel on Climate Change (IPCC) has emphasized that transitioning to renewable energy could reduce global carbon emissions by up to 80% by 2050, making it a critical tool for achieving international climate goals such as those outlined in the Paris Agreement [4]. In response, many governments and organizations have introduced initiatives and policies to accelerate the adoption of green technologies [5].

The economic implications of renewable energy adoption are equally promising. Investments in renewable technologies create employment opportunities in manufacturing, installation, and maintenance sectors while reducing dependence on imported fossil fuels [6]. This transition not only enhances energy security but also contributes to long-term price stability in the energy market. According to IRENA, the global renewable energy sector employed over 13 million people in 2022, reflecting its growing significance in the global economy [6,7].

Despite these benefits, the integration of renewable energy systems faces challenges such as high initial costs, technological limitations, and the intermittent nature of certain energy sources [8,9]. However, ongoing advancements in energy storage technologies and smart grid systems are enhancing the reliability and efficiency of renewable solutions [9]. Renewable energy refers to energy derived from virtually inexhaustible and naturally replenishing sources, such as sunlight, wind, water, biomass, and geothermal heat. Unlike finite fossil fuels, renewable energy sources are sustainable and environmentally friendly, contributing to a cleaner and more sustainable energy future[8,9].

This paper will explore the impact of renewable energy on environmental sustainability and economic growth, highlighting technological advancements, policy frameworks, and successful regional case studies to emphasize the transformative role of renewable resources in creating a greener and more prosperous future.

Types of Renewable Energy Sources

1) Solar Energy

Solar energy, derived from the sun's radiation, is a renewable and sustainable power source. Photovoltaic cells, typically crafted from semiconductors like silicon, convert sunlight into electricity via the photovoltaic effect [10]. Solar thermal systems utilize sunlight to generate heat or electricity, offering versatile applications such as water heating or concentrated solar power plants. With improved efficiency and affordability, solar technologies are widely embraced, reducing greenhouse gas emissions and reliance on non-renewable resources. From residential rooftop panels to expansive solar farms, solar energy fosters energy independence and grid stability [10,11]. Governments worldwide incentivize solar adoption, accelerating the transition to cleaner energy practices and combating climate change.

Figure 1: Solar Panel

2) Wind Energy

Figure 2 : 229.5 MW Wind project in Gujarat under SECI Wind.

Wind energy, captured through wind turbines, transforms air kinetic energy into electricity. Turbines, featuring rotating blades driven by wind, power generators to produce electricity [11,12]. As a clean, renewable source, wind energy emits no greenhouse gases, bolstering global energy generation. Its output hinges on factors like wind speed and turbine efficiency, with wind farms strategically situated in windy locales like coasts or high elevations. Technological advancements have slashed wind energy costs, rendering it competitive with traditional sources [12]. Despite intermittency challenges, wind energy remains pivotal in diversifying energy portfolios and combating climate change by reducing fossil fuel reliance.

3) Hydropower energy

Hydropower, renewable energy source, harnesses flowing water's energy for electricity generation, tracing its roots to ancient waterwheel applications. In contemporary hydroelectric systems, water from rivers or dams propels turbines connected to generators, converting kinetic energy into electricity [11]. Emitting minimal greenhouse gases, hydropower stands as a clean and sustainable energy solution, offering reliability and quick responsiveness to demand fluctuations [13,14]. While its construction may impact local environments, advancements aim to mitigate such effects. Hydropower's adaptability spans from small-scale decentralized setups to large centralized projects, making significant contributions to global electricity generation and enhancing grid stability through water reservoirs for energy storage [13].

Figure 3: Manikdoh Dam in Junnar city, Dist- Pune.

4) Geothermal energy

Geothermal energy taps into the Earth's heat to generate power, sourced from natural radioactive decay and residual heat from planetary formation [15]. Utilizing the Earth's mantle, rich in molten rock, this renewable energy is harnessed via methods like geothermal power plants, extracting steam or hot water for electricity generation [14]. Offering reliability and sustainability, geothermal energy ensures a continuous power supply with minimal greenhouse gas emissions. Operating round-the-clock, it furnishes stable energy for various needs, including direct heating. Though reliant on location viability, ongoing technological advancements enhance its efficiency and accessibility, positioning geothermal energy as an increasingly integral part of the global energy landscape [16].

Figure 4: Geothermal energy plant in Dabhol Power Station in Maharashtra

5) Biomass energy

Biomass energy, sourced from organic matter like plants and forestry residues, is renewable and versatile, utilized through combustion, fermentation, and chemical reactions. Common sources include wood and crop residues, contributing to carbon-neutral energy when managed sustainably [15]. Serving heat production, electricity generation, and vehicle fuel, biomass reduces fossil fuel dependency and greenhouse gas emissions, aiding climate change mitigation. Additionally, biomass systems bolster economies by creating employment in agriculture and forestry. While abundant, responsible management is vital to prevent deforestation, with technological advancements enhancing biomass energy's viability amidst challenges like land competition and the need for sustainable policies in the transition to a greener energy future [11,17].

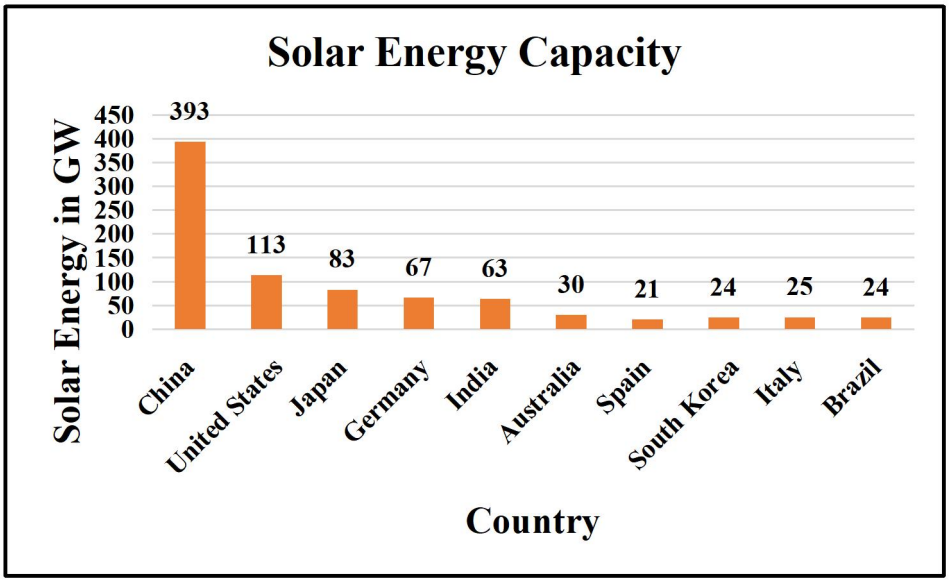
Figure 5: Biomass energy plant in India

Source: bioenergyconsult.com/energy-potential-bagasse

Need for Renewable energy sources

Renewable energy sources are essential for several reasons. Firstly, they offer a sustainable alternative to finite fossil fuels, reducing greenhouse gas emissions and mitigating climate change [15]. Secondly, they enhance energy security by diversifying the energy mix and reducing reliance on imported fuels, thus reducing vulnerability to geopolitical risks [11,14]. Additionally, renewable energy sources like solar and wind can be deployed locally, promoting decentralized energy generation and empowering communities. Moreover, investing in renewables fosters innovation, job creation, and economic growth in the clean energy sector. Lastly, transitioning to renewable energy sources aligns with global commitments to achieve carbon neutrality and create a cleaner, more sustainable future for generations to come [14].

Chart 1: Top 10 Countries for Solar Energy Capacity in GW.



Source: **Key World Energy Statistics, International Energy Agency, 2022**

The above chart shows the distribution of solar installed capacity across several key countries worldwide. China leads the global solar market with a significant installed capacity of 393.03 GW, showcasing its substantial investment in solar energy infrastructure. Following closely, the United States boasts a notable capacity of 113.02 GW, indicating a strong commitment to renewable energy adoption. Japan, India, and Germany also feature prominently, each with considerable installed capacities ranging from 63.19 GW to 83.06 GW, demonstrating their dedication to solar energy deployment. Additionally, Australia, with 29.68 GW of installed capacity, underscores its emergence as a major player in the solar energy landscape. Furthermore, Spain, South Korea, Italy, and Brazil exhibit significant strides in solar energy development, with installed capacities ranging from 20.52 GW to 25.08 GW, signaling a global trend towards embracing solar power as a crucial component of sustainable energy systems.

Table 1: The power supply position from 2014 onwards

Year	Energy Requirement (MU)	Energy Availability (MU)	Energy Shortage (MU)	Energy Shortage (%)
2014-15	1068923	1030785	38138	3.6
2015-16	1114408	1090850	23558	2.1
2016-17	1142929	1135334	7595	0.7
2017-18	1213326	1204697	8629	0.7
2018-19	1274595	1267526	7070	0.6
2019-20	1291010	1284444	6566	0.5
2020-21	1275534	1270663	4871	0.4
2021-22	1379812	1374024	5787	0.4
2022-23 (Upto Dec.)	1135192	1129139	6053	0.5

Source: **Annual Report Ministry of Power, Govt. of India 2022-23**

In 2014-15, the energy requirement stood at 1,068,923 MU, while the energy availability was slightly lower at 1,030,785 MU, resulting in an energy shortage of 38,138 MU, equivalent to 3.6% of the requirement. Moving to

2015-16, the energy requirement increased to 1,114,408 MU, with energy availability reaching 1,090,850 MU. This resulted in a smaller energy shortage of 23,558 MU, which accounted for 2.1% of the requirement. By 2016-17, both the energy requirement and availability saw further increases to 1,142,929 MU and 1,135,334 MU, respectively. Consequently, the energy shortage decreased to 7,595 MU, representing just 0.7% of the requirement. The trend continued in 2017-18, with the energy requirement reaching 1,213,326 MU and availability at 1,204,697 MU. This led to an energy shortage of 8,629 MU, also amounting to 0.7% of the requirement. In 2018-19, while the energy requirement continued to rise to 1,274,595 MU, the energy availability also increased to 1,267,526 MU. As a result, the energy shortage decreased further to 7,070 MU, equivalent to 0.6% of the requirement. Similarly, in 2019-20, despite a rising energy requirement of 1,291,010 MU, the energy availability also increased to 1,284,444 MU. This led to a reduced energy shortage of 6,566 MU, representing 0.5% of the requirement. In the fiscal year 2020-21, the energy requirement was recorded at 1,275,534 MU, while the energy availability improved to 1,270,663 MU. Consequently, the energy shortage decreased to 4,871 MU, accounting for 0.4% of the requirement. By 2021-22, the energy requirement surged to 1,379,812 MU, with energy availability reaching 1,374,024 MU. This resulted in a modest energy shortage of 5,787 MU, also equivalent to 0.4% of the requirement. Up to December 2022-23, the energy requirement stood at 1,135,192 MU, while the energy availability slightly dropped to 1,129,139 MU. This led to an energy shortage of 6,053 MU, amounting to 0.5% of the requirement.

Fossil fuels, derived from organic materials like coal, oil, and natural gas, have been primary energy sources for centuries due to their high energy density and availability. However, their combustion releases harmful pollutants, contributing to climate change and environmental degradation [18]. In contrast, non-fossil fuels, including solar, wind, and hydropower, are renewable and environmentally sustainable [19]. The global transition to clean energy is driven by the urgent need for climate-friendly and secure energy alternatives.

Table 2: Growth in Generation during from 2020-21 to 2022-23 (Upto April 2022-January 2023) [20].

Category-wise :	Year 2020-21		Year 2021-22		Year 2022-23 (April 2022-Jan. 2023)	
	Generation (BU)	% of Total Generation	Generation (BU)	% of Total Generation	Generation* (BU)	% of Total Generation
Generation from Fossil Fuel :						
Coal	950.938	68.8	1041.487	69.8	948.132	69.8
Gas	50.944	3.7	36.016	2.4	20.406	1.5
Lignite	30.506	2.2	37.094	2.5	29.875	2.2
Diesel	0.126	0	0.117	0	0.165	0
Total (Fossil Fuel):	**1032.514**	**74.7**	**1114.714**	**74.7**	**998.578**	**73.5**
Generation from Non-Fossil Fuel :						
Wind	60.15	4.4	68.64	4.6	64.57	4.8
Solar	60.402	4.4	73.476	4.9	81.498	6
BioPower & Others	26.695	1.9	28.796	1.9	23.736	1.7
Total:(Solar wind, BioPower & Others)	**147.248**	**10.7**	**170.912**	**11.5**	**169.804**	**12.5**
Hydro	150.3	10.9	151.627	10.2	146.117	10.8
Bhutan Import	8.766	0.6	7.493	0.5	6.71	0.5
Total RE Generation (Incl.	306.313	22.2	330.033	22.1	322.63	23.7

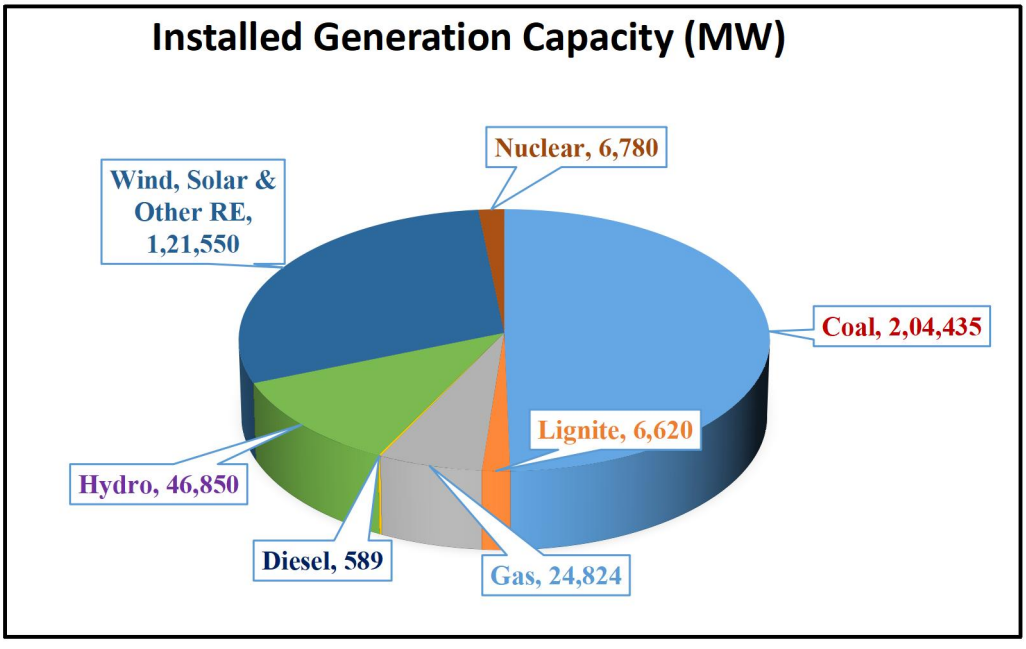
Hydro)						
Nuclear	43.029	3.1	47.112	3.2	38.008	2.8
Total (Non-Fossil Fuel):	**349.342**	**25.3**	**377.145**	**25.3**	**360.638**	**26.5**
Total Generation (Fossil Fuel & Non-Fossil Fuel)						
Total Generation:	**1,381.86**	**100**	**1,491.86**	**100**	**1,359.22**	**100**

***Provisional**

***Source:* Annual report 2022-23, Ministry of New and Renewable Energy, Govt of India.**

The provided table outlines the generation of electricity in India categorized by fossil fuel and non-fossil fuel sources for the years 2020-21, 2021-22, and April 2022 to January 2023. Fossil fuel-based generation, predominantly from coal, experienced a slight increase from 1032.514 BU in 2020-21 to 1114.714 BU in 2021-22 before decreasing to 998.578 BU in 2022-23. Conversely, non-fossil fuel-based generation, including wind, solar, bio-power, and others, exhibited steady growth over the same period, reaching 170.912 BU in 2021-22. Despite a decrease in 2022-23, it remained significant at 169.804 BU, representing 12.5% of total generation. Hydroelectric power generation remained relatively stable throughout the years, contributing around 10-11% of total generation. Nuclear power's contribution saw fluctuations, with a decrease to 38.008 BU in 2022-23. Overall, the data illustrates a gradual shift towards non-fossil fuel sources, emphasizing the country's commitment to renewable energy and reducing carbon emissions in its electricity generation sector [21].

Graph 3: Power Plants Commissioned during 2022-23 (upto December)



***Source:* Annual report 2022-23, Ministry of New and Renewable Energy, Govt of India.**

The above graph presents the installed generation capacity in megawatts (MW) for both fossil fuel and non-fossil fuel categories, highlighting the energy composition of the region. Fossil fuel sources, encompassing coal, lignite, gas, and diesel, collectively contribute 2,36,469 MW, constituting a significant portion of the total installed capacity. Conversely, non-fossil fuel sources, including hydro, wind, solar, biomass, waste to energy, small hydropower, and nuclear power, contribute 1,75,180 MW to the total capacity, showcasing a growing emphasis on renewable and clean energy technologies. Notably, solar energy boasts the highest installed capacity among non-

fossil fuel sources with 63,894 MW, followed closely by hydro and wind energy with 46,850 MW and 41,983 MW, respectively. Nuclear power also makes a substantial contribution, accounting for 6,780 MW of the total capacity.

Table 3: State-wise Cumulative Solar Installed Capacity in the country [22,23].

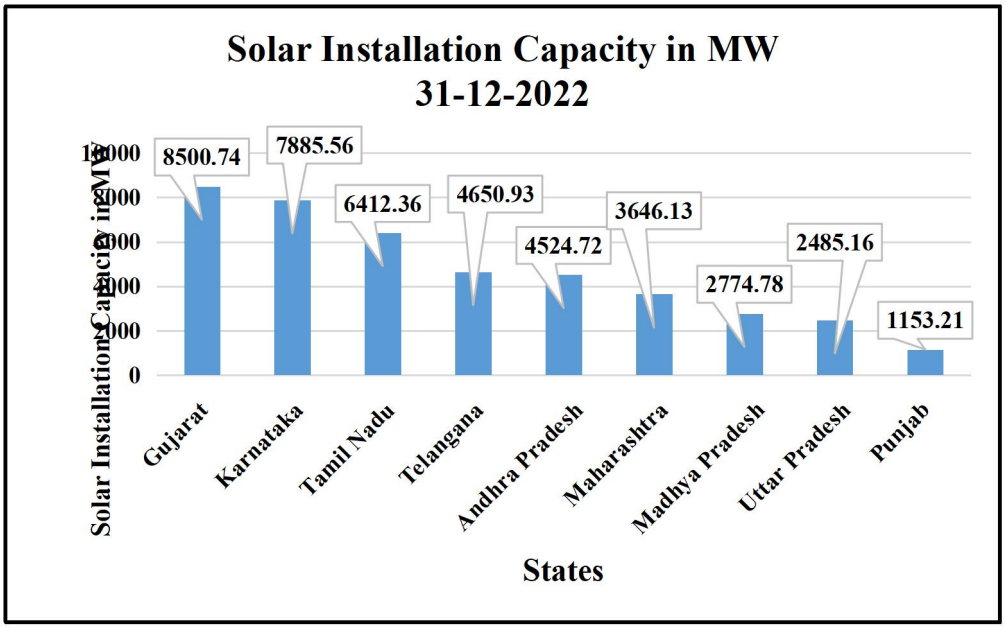
Sr. No	State/UT	2018	2019	2020	2021	2022
		Solar Installation Capacity in MW 31-03-2019	Solar Installation Capacity in MW 31-12-2019	Solar Installation Capacity in MW 31-12-2020	Solar Installation Capacity in MW 31-12-2021	Solar Installation Capacity in MW 31-12-2022
1	Andaman and Nicobar	11.73	12.19	29.22	29.22	29.91
2	Andhra Pradesh	3085.68	3559.02	3844.17	4292.37	4524.72
3	Arunachal Pradesh	5.39	5.61	5.61	5.61	11.52
4	Assam	22.4	41.23	42.99	59.15	147.93
5	Bihar	142.45	149.35	157.41	169.48	192.88
6	Chandigarh	34.71	36.99	45.16	52.64	58.69
7	Chhattisgarh	231.35	231.35	240	308.33	944.22
8	Dadra and Nagar Haveli	5.46	5.46	5.46	5.46	5.46
9	Daman and Diu	14.47	16.56	39.97	40.72	41.01
10	Delhi	126.89	156.12	176.46	209.66	211.48
11	Goa	3.89	4.78	4.78	18.37	26.4
12	Gujarat	2440.13	2763.55	3918.48	6206.34	8500.74
13	Haryana	224.52	249.27	262.42	593.3	990.67
14	Himachal Pradesh	22.68	32.57	42.73	45.04	87.39
15	Jammu and Kashmir	14.83	19.3	20.73	24.49	48.9
16	Jharkhand	34.95	38.4	39.06	53.56	94.9
17	Karnataka	6095.55	7274.92	7328.86	7496.8	7885.56
18	Kerala	138.59	141.75	146.92	306.3	688.34
19	Ladhakh	0	0	0	7.8	7.8
20	Lakshadweep	0.75	0.75	0.75	0.75	3.27
21	Madhya Pradesh	1840.16	2237.48	2440.14	2592.15	2774.78
22	Maharashtra	1633.54	1663.42	1895.82	2506.81	3646.13
23	Manipur	3.44	4.58	6.36	6.36	12.28
24	Meghalaya	0.12	0.12	0.12	0.19	4.15
25	Mizoram	0.5	1.52	1.53	1.53	8.02
26	Nagaland	1	1	1	1	3.04
27	Odisha	394.73	397.84	399.6	405.22	452.71

28	Puducherry	3.14	5.51	7.54	11.87	35.53
29	Punjab	905.62	947.1	947.1	1051.09	1153.21
30	Rajasthan	3226.79	4844.21	5389.48	9979.72	16340.5
31	Sikkim	0.01	0.07	0.07	2.76	4.69
32	Tamil Nadu	2575.22	3788.36	4315.78	4757.76	6412.36
33	Telangana	3592.06	3620.75	3936.36	4154.42	4650.93
34	Tripura	5.09	9.41	9.41	9.41	16.67
35	Uttar Pradesh	960.1	1045.1	1292.85	1990.28	2485.16
36	Uttarakhand	306.75	315.49	320.44	540.49	575.46
37	West Bengal	75.95	109.41	149.84	151	179.82
38	Others including NABARD	0	0	0	0	45.01
Total		**28180.64**	**33730.54**	**37464.62**	**48087.45**	**63302.24**

Source: **Annual report form 2028-19 to 2022-23, Ministry of New and Renewable Energy, Govt of India.**

The above table presents the solar installation capacities in megawatts (MW) for various states and union territories (UTs) in India over the years from 2019 to 2022 [24,25]. Notable increases in solar capacity are observed across several regions, indicating a significant push towards renewable energy. States like Gujarat, Karnataka, and Rajasthan have shown substantial growth in their solar installation capacities, reflecting their commitment to renewable energy initiatives [23,26,27]. Conversely, states like Kerala and Haryana have also made significant strides in expanding their solar capacities during this period. Overall, the data underscores the nationwide efforts to transition towards cleaner energy sources and reduce dependence on fossil fuels [23]. Additionally, it highlights the diverse landscape of solar adoption across different states and UTs, influenced by factors such as geographical location, policy incentives, and local resources . The total solar installation capacity in India has witnessed a remarkable increase from 28,180.64 MW in 2019 to 63,302.24 MW by the end of 2022, indicating a strong momentum towards achieving renewable energy targets.

Graph 3: **Top 10 Solar Installation States in India**



Source: **Annual report 2022-23, Ministry of New and Renewable Energy, Govt of India.**

The above chart 3 presents the solar installation capacities, measured in megawatts (MW), of various states and union territories (UTs) in India as of December 31, 2022. At the forefront, Rajasthan leads with an installed capacity, followed by Gujarat, Karnataka, Tamil Nadu, Telangana, Andhra Pradesh, Maharashtra, Madhya Pradesh, Uttar Pradesh, and Punjab. Gujarat and Karnataka hold significant capacities, exceeding 8,500 MW and 7,800 MW, respectively [26–29]. These states' substantial solar infrastructure underscores their commitment to renewable energy initiatives. Notably, Tamil Nadu and Telangana also demonstrate robust contributions, with capacities surpassing 6,400 MW and 4,650 MW, respectively. This data reflects the distributed nature of solar energy adoption across various regions in India, indicative of the nation's concerted efforts towards sustainable energy transitions.

The reason solar energy is the best other type of renewable energy source is because solar energy stands out as one of the best renewable energy sources due to its abundant availability and sustainability. It harnesses the power of the sun, a virtually limitless resource, offering clean and renewable electricity generation without emitting greenhouse gases or pollutants [14,30,31]. Unlike fossil fuels, solar energy is inexhaustible and can be harnessed locally, reducing dependence on centralized power grids. Additionally, advancements in solar technology have led to decreasing costs, making it increasingly affordable and accessible for both residential and commercial applications [31,32]. While other renewable energy sources such as wind, hydroelectric, and geothermal also offer significant benefits, solar energy's scalability, versatility, and minimal environmental impact position it as a leading contender in the transition towards a more sustainable energy future [33].

Conclusion

The transition to renewable energy is crucial in addressing the environmental, economic, and security challenges posed by fossil fuels. As countries strive to achieve carbon neutrality, renewable resources such as solar, wind, and hydropower are becoming essential components of sustainable energy strategies. India's progress in solar energy development, particularly in states like Rajasthan, Gujarat, and Karnataka, underscores the potential of clean energy solutions in fostering economic growth and enhancing energy security.

Solar energy’s scalability, widespread availability, and declining costs make it a cornerstone of the global clean energy transition. Continued investment and technological advancements will further enhance its role in decentralized power generation. This research emphasizes the importance of sustained innovation, collaboration, and supportive policies to accelerate the adoption of renewable energy and secure a cleaner, more sustainable energy future for generations to come.

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SUSTAINABLE GROWTH OF ACCOUNTING IN THE UK

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Abstract

Sustainability is at the forefront of the UK accounting profession's evolution in response to escalating economic, social, and environmental issues. This study looks at how Environmental, Social, and Governance (ESG) factors are included in contemporary accounting to promote accountability and transparency. Adoption of frameworks that promote thorough sustainability reporting, such as the International Financial Reporting Standards (IFRS) and the Global Reporting Initiative (GRI), is one of the major breakthroughs. The paper written by (Thomson, Grubnic, & Georgakopoulos, 2014) explains, Additional sustainability changes within these businesses and those they are responsible for overseeing have been hindered by a number of issues. Among these are the structural limitations of accounting-sustainability hybrids brought on by a comparatively inadequate local sustainability strategy and the urgent requirement to satisfy rising service delivery demands during a time of acute resource shortages.

Numerous problems have prevented these companies and those they are in charge of managing from making further sustainable adjustments. These include the need to meet growing service delivery demands in the face of severe resource shortages and the structural limitations of accounting-sustainability hybrids caused by a relatively insufficient local sustainability strategy (Gray, 1994).

In summary, attaining sustainable growth in the UK accounting industry necessitates a careful fusion of traditional accounting practices with progressive sustainability objectives. Even while there are clear obstacles, like a lack of funding and systemic inefficiencies, these problems can be solved with creativity, thoughtful policy, and teamwork. Finding a balance between environmental and financial responsibility is essential to bringing about significant change that eventually helps businesses and society as a whole.

Introduction

In order to assist businesses comprehend their wider perspective on society, it is now crucial for all organisations to concentrate on sustainable accounting, which includes analysing, gathering, and reporting on the environmental and social implications of their operations. In order to help new professionals learn and comprehend the significance of sustainability growth in accounting in the UK, educational institutions have even begun to provide programs that combine accounting with sustainability.

The function and objectives of accounting in fostering sustainable economic growth are also anticipated to be fulfilled by the UK government. In summary, the UK accounting industry is adopting a more comprehensive commitment to take accountability for economic expansion.

Literature Review

In teh research made by Bebbington (2017) at University of Birmingham, has explained their broader prospective via keynote speeches and interactions have seen the interest of the general public in the UK regarding sustainable economic growth. Bebbington (2017) have highlighted how this groth has happened. Starting from the education systems which plays the major roleto send the message across the new professionals and new generationto understand and apply that knowledge practically.

Next important topic is highlighted as doing the research will provide a chance to understand the experts review and how they have addressed the importance and also to focus on the root causes rather to address the symptoms. Doing the research will help the individual to practically engage in collaborations with the experts, understand policy manking and debates. The final highlight is to practically work in the organisations, internships or work in campuses to understand the applications and maintaining sustainable economic growth.

Sustainable development origins in much older debate concerns renewable resources (Sachs, 1992). In 1949, during United Nations conference was concerned on the urgent need for sustainable development and in 1970s it emerged as economic achievements (Bebbington, 2001).

The role of economic growth in driving economic activities and inconstraining oganisatio's flexibility which brings the concern for sustainability. As the companies focuses on the pursuit of profits and their growth, Gray and Bebbington (1996) identifies the requirement for the companies the need of sustainable development by keeping the rules of the companies same under which they operate (Bebbington, 2001).

Research on accounting practice and sustainability revealed issues, such as the danger of managerial capture, the promotion of the business as usual agenda, the incapacity to question neo-classical ideals, the legitimacy of businesses' purported belief in the sustainability of their operations, and the inability to challenge advanced liberal hegemony (Russell, 2009). We contend that concepts of "nature," "society," and "success" that are consistent with sustainable development principles must be incorporated into and represented by sustainable development indicators if they are to facilitate a shift towards sustainable development (Russell, 2009).

Methodology

The research for Sustainable Growth of Accounting in the UK is designed to identify future challenges and the growth of sustainability in the field of Accounting Over the years.

This research is done by a secondary data analysis by reviewing the literature and academic journals, books and reports and examining regulatory frameworks lis IFRS, GRI and UK Government policies.

Analysis

A company's social responsibility programs are now greatly influenced by accountants due to the increased focus on sustainability and ESG (Environmental, Social, and Governance) reporting (How Accounting in the UK Has Changed Over the Last Decade: Top 5 Transformations, 2025).

Accurate reporting on environmental impact, diversity, and governance measures is now required for UK corporations by frameworks like the Task Force on Climate-related Financial Disclosures (TCFD) and the Global Reporting Initiative (GRI). In order to make sure these reports meet investor expectations and legal requirements, accountants play a crucial role (How Accounting in the UK Has Changed Over the Last Decade: Top 5 Transformations, 2025).

The Global Forum for Sustainability at ACCA keeps an eye on trends and advancements in sustainability worldwide (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024). Through the forum, ACCA's global network can convene and develop the organization's official stance on a range of environmental issues. One noteworthy contribution was made in 2022 when ACCA introduced Accounting for a Better World, an action plan aimed at bringing the accounting profession together for the good of the public (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024). A variety of resources were included in the campaign to aid in the promotion of more environmentally friendly corporate practices (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024).

The UK's first significant professional organisation to declare carbon neutrality was ICAEW in 2020. The Institute is also a member of the UK Transition Plan Taskforce, established by HM Treasury in April 2022 with the goal of creating a "gold standard" for private sector climate transition plans and thwarting greenwashing (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024).

Along with the Economic Secretary to the Treasury and other top executives from the business, financial, and environmental sectors, Michael Izza, the Institute's Chief Executive, is a member of the Taskforce's Steering Group (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024). In addition, the Taskforce's delivery group includes Richard Spencer, the Institute's Director for Sustainability (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024). By taking part in this Taskforce, ICAEW hopes to highlight the crucial role that the accounting profession plays in integrating sustainability into business (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024).

The IFRS Foundation's Director of Strategic Affairs is Ravi Abeywardana, ACA. He is in charge of the IFRS Foundation's new International Sustainability Standards Board's (ISSB) capacity-building program (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024). In addition, he supports the creation and execution of the Institute's own sustainability strategy and policies as a member of the ICAEW Council and an

active member of the organization's Sustainability Committee. The IFRS Foundation's Director of Strategic Affairs is Ravi Abeywardana, ACA. He is in charge of the IFRS Foundation's new International Sustainability Standards Board's (ISSB) capacity-building program. In addition, he supports the creation and execution of the Institute's own sustainability strategy and policies as a member of the ICAEW Council and an active member of the organization's Sustainability Committee. Additionally, CCAB member organizations are emphasising sustainability more in their training and education. In order to help members and other finance professionals acquire the abilities and information necessary to confidently lead on sustainability challenges, ICAEW, ACCA, and Chartered Accountants Ireland have all introduced Sustainability Certificates (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024).

By adding a thorough introduction to sustainability and adjusting to the new terminology and ideas around ESG, ICAEW has integrated sustainability into the curriculum and content of its ACA certificate (THE ACCOUNTANCY PROFESSION IN THE UK AND IRELAND, 2024).

Conclusion

Important organisations that have actively contributed to the development of sustainability standards, the provision of skills to financial professionals, and the promotion of ethical corporate practices include ACCA, ICAEW, and the IFRS Foundation. The integration of standards such as the Task Force on Climate-related Financial Disclosures (TCFD), IFRS, and GRI has strengthened investor confidence in sustainable business practices and transparency.

The possibility of "greenwashing" and the difficulty of striking a balance between sustainability objectives and financial performance are among the remaining challenges, but the combined efforts of businesses, regulatory agencies, and educational institutions point to a positive future. In order to guarantee that sustainability becomes a fundamental accounting principle in the UK and eventually benefits companies, stakeholders, and society at large, it will be imperative to continue innovation, policy reform, and cooperation.

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SUSTAINABLE MOBILITY: CHALLENGES, STRATEGIES, AND INNOVATIONS IN GREEN TRANSPORTATION

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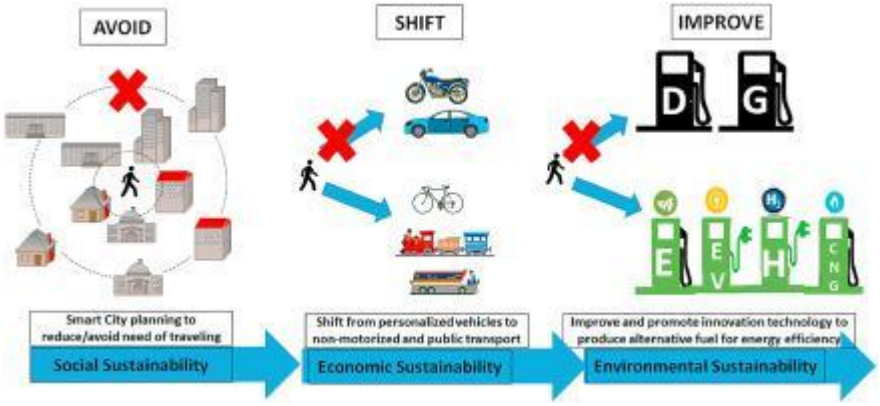
Abstract

Green transportation is a critical aspect of achieving global environmental and economic goals. This paper explores the principles of sustainable transport, current challenges, and potential solutions for a more environmentally friendly and efficient transport system. The study discusses alternative fuels, smart mobility solutions, urban planning strategies, and policy interventions aimed at reducing carbon emissions and improving energy efficiency. As seen by the steadily increasing air pollution concerns in large cities, the sustainability of a transportation system is a significant challenge for urbanization. Migration and population growth have ruined our global ecology, yet they have little control over the pervasive use of private and public automobiles. Thus, the expansion of the transportation system—also known as "green" or "sustainable" transportation—should be properly planned for global sustainability. This study presents a critical analysis of the issues that should be taken into account while adopting green transportation for global sustainability. First of all, obstacles and difficulties related to the demands of modern travel have been noted as impeding the adoption of green transportation. The so-called ASI strategy, or avoid, shift, and improve strategy. Finally, a few well-known ASI strategy success stories were shared, including the following: Avoid can reduce CO2 emissions by 146–312 kgCO2/y, Shift can reduce CO2 emissions by 0.27 kgCO2/revolution of vehicle use, and Improve can reduce CO2 emissions by 12.4%. This assessment serves as a reference for effective urban design using the green transportation system.



Keywords: Green transportation, sustainability, electric vehicles, policy strategies, innovative technologies, public transit, alternative fuels.

Introduction

Transport is an essential component of modern society, facilitating economic growth and social interactions. However, conventional transport systems contribute significantly to greenhouse gas emissions, air pollution, and resource depletion. Green transportation aims to balance economic, social, and environmental concerns by promoting energy-efficient and low-carbon mobility solutions. Society is significantly impacted by transportation on an economic, social, and environmental level . In order to accomplish sustainability goals in metropolitan settings, transportation should be prioritized. This may be done by controlling the various facets of travel demand (public transportation), automobile growth patterns, and efficient land-use patterns. The transportation service with a fewer negative impact on human health and the environment compared to existing transportation services" is the definition of "green transportation. GT can be viewed as a combinatorial technology that combines the best possible use of conventional fuels, the effective use of electric vehicle technologies, the use of biogas as a bus fuel, and improved public transit. An efficient GT system may result in.

- Reduced risk

- Reduced traffic congestion
- Enhanced energy and resource sustainability
- Reduced pollution and accident prevention
- Increased safety and security assurance
- Optimised travelling speed and traffic flow

Principles of Green Transportation

Green transportation is guided by key principles such as efficiency, accessibility, affordability, and environmental responsibility. It involves the use of clean energy, optimized public transportation networks, non-motorized transport options (such as cycling and walking), and smart mobility solutions.

Barriers to Green Transportation

The terms "barrier" and "challenges" describe things like laws, regulations, or policies that prohibit certain things from occurring as well as things that are challenging yet manageable. All stakeholders, including transportation operators, warehouse operators, infrastructure operators, cargo owners, environmental organizations, public officials, politicians, industries, R&D organizations, and universities, must be taken into account when analyzing the obstacles and challenges because their agendas and goals are all.Despite its benefits, the transition to green transportation faces several obstacles:

- **High Initial Costs**: Implementing green transport infrastructure requires significant investment in new technologies and urban redesign.
- **Technological Barriers**: Limited advancements in battery technology, hydrogen fuel cells, and charging infrastructure hinder widespread adoption.
- **Policy and Regulatory Issues**: Inconsistent policies, lack of incentives, and inadequate regulatory frameworks slow down the progress of green transportation initiatives.
- **Public Resistance**: Behavioral resistance to change and dependency on private vehicles pose challenges to green mobility solutions.

Formulation techniques for GT system construction

In order to construct new or extensive road infrastructure, the conventional method of addressing rising transportation demands requires more road space. Because of increasing traffic, greenhouse gas emissions, and the creation of additional externalities, this supply-side approach has not produced positive results. GIZ (German Service Provider) has recommended a new strategy called A-S-I (Avoid/Reduce, Shift/Maintain and Improve), which focuses on the demand side rather than the supply side.

Strategies and Opportunities

Several strategies can promote green transportation:

- **Alternative Fuels**: Adoption of electric vehicles (EVs), biofuels, and hydrogen fuel can significantly reduce emissions.
- **Public Transportation Enhancement**: Investing in efficient and affordable public transit systems can reduce traffic congestion and pollution.
- **Urban Planning and Smart Mobility**: Integrating mixed-use development, smart traffic management, and pedestrian-friendly infrastructure can support green transportation.
- **Policy Measures**: Governments can implement incentives such as tax benefits for EV purchases, congestion pricing, and stricter emissions regulations.
- **Technological Innovations**: Advances in AI-driven traffic management, vehicle automation, and shared mobility services can enhance sustainability.

Innovative Technologies in Green Transportation and integration management for environmentally friendly transportation

Transportation agencies are under a lot of pressure to adjust to new demands and declining income in the era of globalization and green edge. Although the consequences of transportation on the environment can vary, they are largely mitigated by transportation technologies. In the current situation, organizations look for innovative ways to increase the effectiveness of the resources at their disposal in order to provide the general public with a pleasurable travel experience. There are several technologies that allow GT.Technological advancements play a crucial role in sustainable transport :

- **Electric and Autonomous Vehicles**: Innovations in EV battery efficiency and self-driving technology improve sustainability.
- **Smart Traffic Management**: AI-driven solutions optimize traffic flow and reduce emissions.
- **Renewable Energy Integration**: Solar-powered charging stations and renewable energy-driven transport systems enhance sustainability.
- **Hydrogen Fuel Cell Technology**: Emerging hydrogen-based transport solutions provide alternative clean energy options.

Good Practice: Municipal Carsharing System in India

One of the notable examples of green transportation initiatives in India is the implementation of municipal carsharing systems in cities like Bengaluru and Delhi. These systems promote shared mobility, reducing congestion and carbon emissions. Key features include:

- **Electric Fleet**: Many municipal carsharing programs use electric vehicles (EVs) to minimize pollution.
- **Smart Booking Systems**: Mobile apps and digital platforms facilitate easy car rentals for urban commuters.
- **Public-Private Partnerships**: Collaborations between city governments and private companies enhance operational efficiency and accessibility.
- **Reduced Parking Congestion**: Encouraging shared mobility helps optimize urban parking space and reduce traffic congestion.

Research Methodology

This study employs a mixed-methods approach to analyze the current state of green transportation, identify key barriers, and evaluate potential strategies and technologies. The research methodology includes:

- **Literature Review**: A comprehensive review of existing academic papers, policy reports, and case studies on green transportation and sustainability.
- **Case Study Analysis**: Examination of successful green transportation initiatives in various cities and countries to extract best practices and lessons learned.
- **Data Collection**: Collection of data from government reports, industry publications, and surveys conducted in urban areas.
- **Comparative Analysis**: Assessment of different transportation strategies, technologies, and policies to determine their effectiveness and feasibility

Case Studies Examples from cities and countries leading in green transportation, such as Copenhagen's cycling infrastructure, Singapore’s smart mobility solutions, and Norway's EV policies, illustrate effective strategies and best practices.

Conclusion

Green transportation is crucial for addressing environmental concerns and fostering economic resilience. While challenges exist, technological advancements, policy reforms, and behavioral shifts can pave the way for a more sustainable and inclusive transport system.

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SUSTAINABLE TOURISM: BALANCING ECONOMY, ENVIRONMENT AND CULTURE

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Abstract

Sustainable tourism is all about finding the right balance between boosting the economy and protecting the environment. This paper explores the challenges and opportunities involved in making tourism beneficial for both people and the planet. It starts by breaking down the key ideas behind sustainable tourism, showing how economic, social, and environmental factors are all connected.

One major focus is the economic side of tourism—how it can support local communities without causing harm. The paper looks at the importance of involving local people, encouraging responsible business practices, and managing destinations wisely to ensure tourism brings long-term benefits rather than short-term gains.

At the same time, it examines the environmental impact of tourism, especially when large numbers of visitors put pressure on natural resources, wildlife, and fragile ecosystems. The paper discusses various ways to reduce this impact, such as conservation efforts, eco-friendly initiatives, and building more sustainable infrastructure.

Beyond the economy and environment, the paper also explores the social aspect of tourism. It highlights why it's important to respect and preserve local cultures, empower communities, and make sure tourism benefits are shared fairly. It also looks at how education, collaboration, and ethical tourism practices can help create a more sustainable future.

Finally, the paper showcases innovative ideas and real-world success stories in sustainable tourism, offering insights into how the industry can grow in a way that benefits both people and the environment for years to come.

Keywords: Sustainable Tourism, Economic Impact, Environmental Conservation, Community Environment and Responsible Travel.

Introduction

Tourism has historically been a fundamental element of the global economy, generating substantial revenue and creating employment opportunities for millions of individuals. Nevertheless, as the tourism sector expands, it encounters heightened scrutiny regarding its effects on the environment, local cultures, and economic stability. In response to these challenges, the concept of sustainable tourism has emerged, advocating for a model that seeks to harmonize economic advancement with environmental conservation and cultural preservation. Sustainable tourism promotes responsible travel practices that aim to reduce adverse effects, encourage conservation efforts, and improve the quality of life for local communities.

The significance of sustainable tourism has intensified in recent years, fueled by concerns related to climate change, loss of biodiversity, and the diminishing of cultural identities. While tourism plays a crucial role in the economic development of various destinations, it frequently results in resource depletion, pollution, and overcrowding. In numerous instances, local cultures and traditions are either marginalized or commercialized to cater to the demands of mass tourism. Thus, sustainable tourism poses a critical question: how can the economic advantages of tourism be maximized while safeguarding the environment and honoring the cultural heritage of host communities?

This paper delves into the fundamental principles of sustainable tourism and investigates the practical implementation of these principles. By analyzing case studies and evaluating the current landscape of tourism across different regions, this study seeks to identify effective strategies that balance the three pillars of sustainability—economic, environmental, and cultural—within the tourism sector. Ultimately, the objective is to propose frameworks that facilitate tourism development in a manner that benefits both the industry and the communities it serves, ensuring that tourism continues to be a viable and positive force for the future.

Literature Review

- **Economic Considerations in Sustainable Tourism:-** Economic contributions of tourism to local communities and countries. Highlight the positive impacts such as job creation, infrastructure development, and increased local business opportunities. Scholars such as Gössling et al. (2020) emphasize the need for a nuanced understanding of the economic drivers of tourism, identifying the delicate balance required to harness its benefits without compromising environmental integrity.
- **Environmental Impacts of Tourism**: The environmental repercussions of burgeoning tourism are well-documented in the literature. Studies by Higham et al. (2018) and Gössling and Scott (2012) highlight issues ranging from carbon emissions and biodiversity loss to habitat destruction. These adverse effects necessitate a paradigm shift in tourism development, emphasizing sustainable practices that minimize the ecological footprint of tourist activities.
- **Challenges in Achieving Sustainability:** While the concept of sustainable tourism development is widely acknowledged, its effective implementation faces numerous challenges. Insufficient regulatory frameworks, lax enforcement, and a lack of awareness among stakeholders contribute to the persistence of unsustainable practices (Hall, 2019; Weaver, 2008). Achieving a balance between economic growth and environmental conservation requires concerted efforts across governments, local communities, and the tourism industry.
- **Opportunities and Strategies:** Scholars and practitioners propose various opportunities and strategies for achieving sustainable tourism development. Gössling et al. (2012) advocate for destination management strategies that prioritize community engagement, cultural preservation, and environmental stewardship. The integration of technology, such as smart destination management systems, emerges as a promising avenue to monitor and optimize tourist flows, minimizing negative impacts (Sigala, 2020).
- **Community Involvement and Empowerment:** The role of local communities in sustainable tourism development cannot be overstated. Studies by Jamal and Stronza (2009) and Scheyvens (2011) underscore the importance of community involvement, empowerment, and benefit-sharing in fostering a sense of ownership and responsibility toward the sustainable management of tourism resources.

Research Methodology

Research design Research-Design is a process in which information is collected and analysed, to provide solutions for the problem. It is a method used to find solutions for questions asked in research.

There are 4-types of Research Design, namely:

1. Descriptive Research Methodology,
2. Correlational Research Methodology
3. Experimental Research Methodology.
4. Causal- Comparative Research Methodology.

Research Methodology is systematic method which is used to collect information about a particular topic and to do detailed study on that topic.

- **Data Collection:** Questionnaires is the primary data collection source and through articles, books and company website. The data collection in the research paper is thought primary data collection source which is questionnaires. Example:- Survey through google forms.
- **Research tool:** Research tool is an instrument or means through which the research is carried out. Example: - Surveys, Questionnaires, etc.

Research Design

Type of Research

- **Quantitative Research:** The survey is primarily quantitative as it involves structured questions, rating scales, and multiple-choice questions to gather measurable data on employee satisfaction.
- **Survey Methodology:** The survey is administered via Google Forms, which allows for efficient distribution and data collection. This platform is easily accessible to employees, ensuring a higher response rate.
- **Sampling:** Census Sampling or Random Sampling could be used. For example, if all employees are surveyed, it would be census sampling. If only a sample group is selected (e.g., employees from different departments or job roles), random sampling would ensure diverse responses.
- **Survey Design:** The survey includes a mix of closed-ended questions (e.g., multiple-choice, Likert scale ratings) and open-ended questions for more qualitative insights.

Categories covered in the survey may include:

- Job satisfaction
- Relationship with management
- Work-life balance
- Compensation and benefits
- Opportunities for growth and development
- Workplace environment and culture

Reseach Hypothesis

- Null Hypothesis (H_0): Implementing comprehensive HR practices has no significant impact on employee experience, job satisfaction, or retention rates.
- Alternate Hypothesis (H_1): Implementing comprehensive HR practices positively impacts employee experience, leading to higher job satisfaction and retention rates.

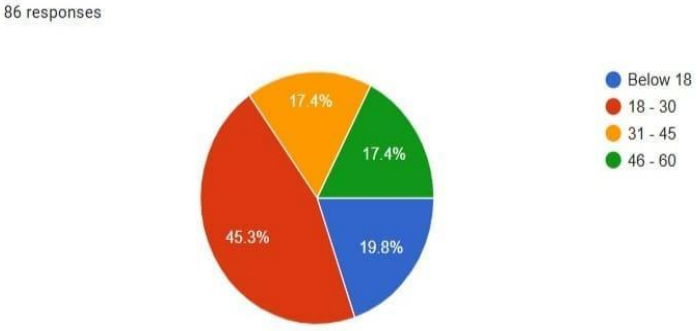
Data Analysis

- The data collected from the survey will be analysed using descriptive statistics to understand trends and general satisfaction levels. Responses to rating scale questions will be averaged or categorized, while open-ended responses will be reviewed for common themes.
- Tools like Google Sheets or Excel can be used to analyse the quantitative data (e.g., average satisfaction ratings), while qualitative responses can be categorized into themes or sentiments.

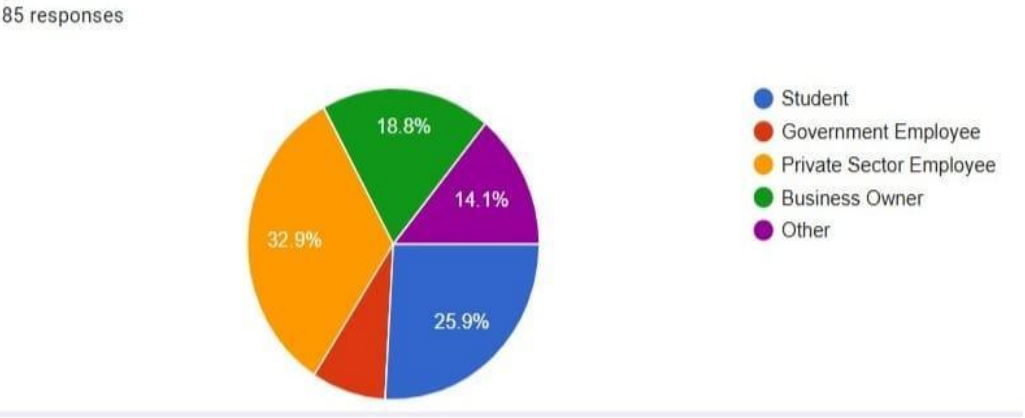
Sample Size

Sample Size is number of respondents or people selected from a population to collect data / samples for computing in the research. The sample size for this study is 100 respondents.

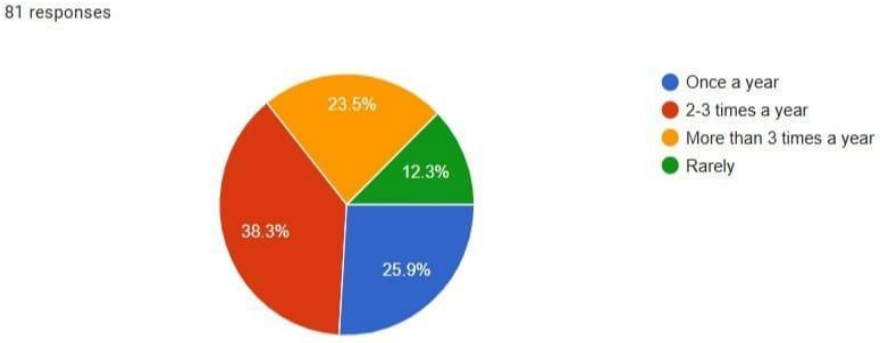
1. Name _____
2. Age Group & Gender



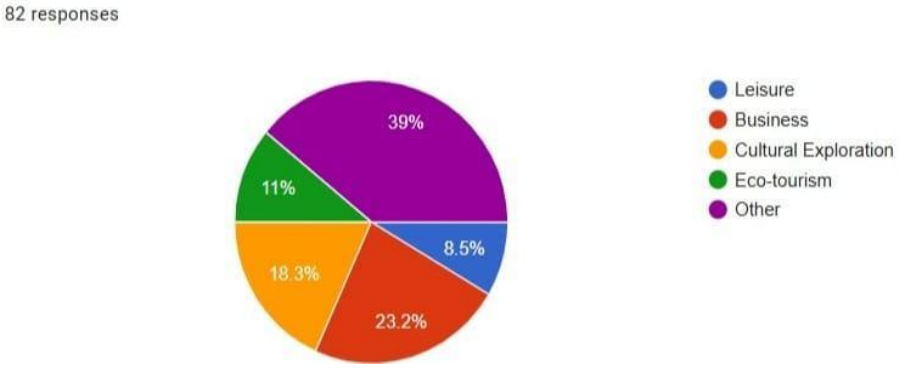
3. What is your occupation?



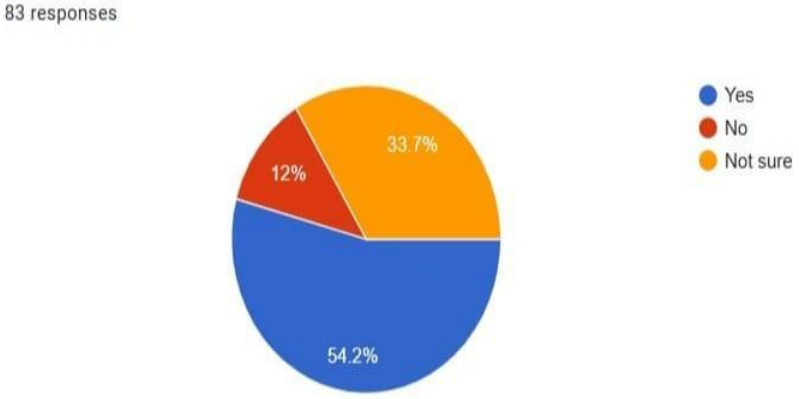
4. How frequently do you travel?



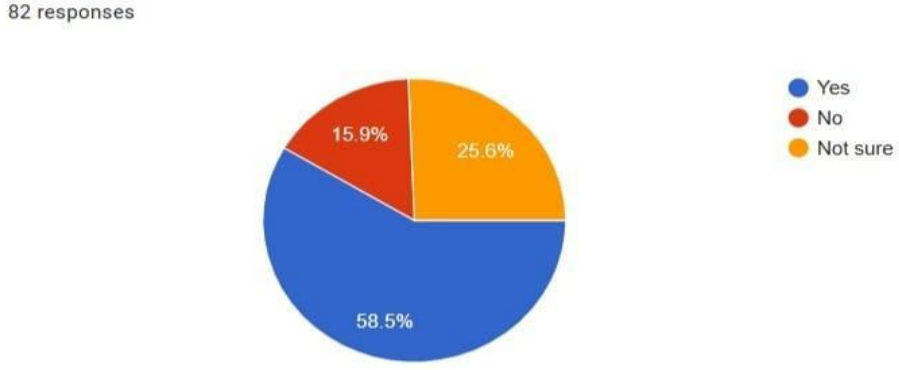
5. What is your primary reason for travelling?



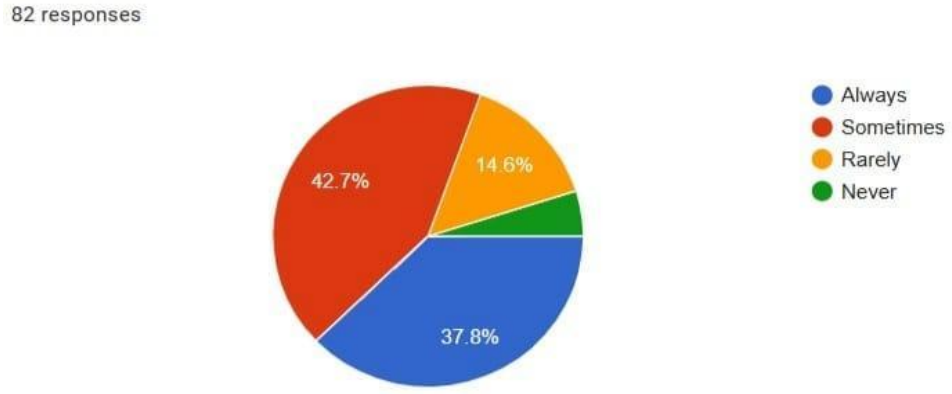
6. Do you believe tourism contributes significantly to local economic development?



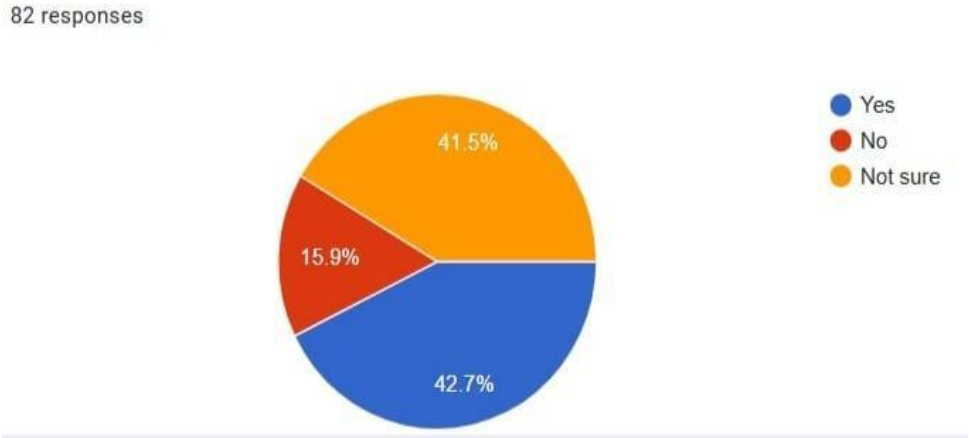
7. Have you observed negative environmental impacts in the tourism in the destinations you visit?



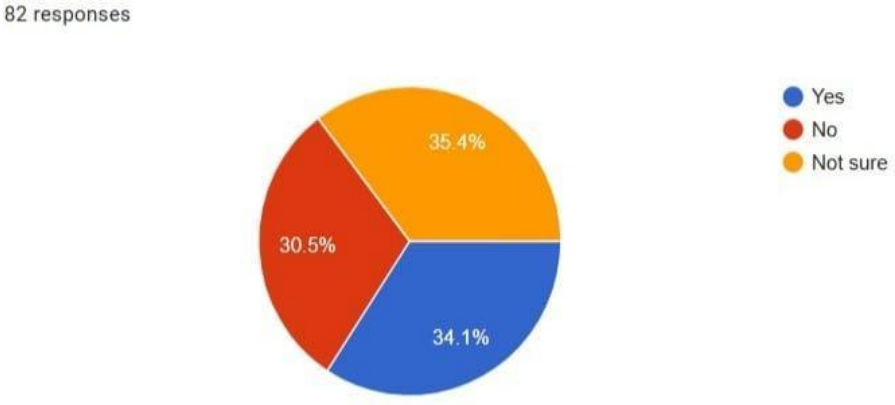
8. Do you actively choose eco-friendly or sustainable tourism options?



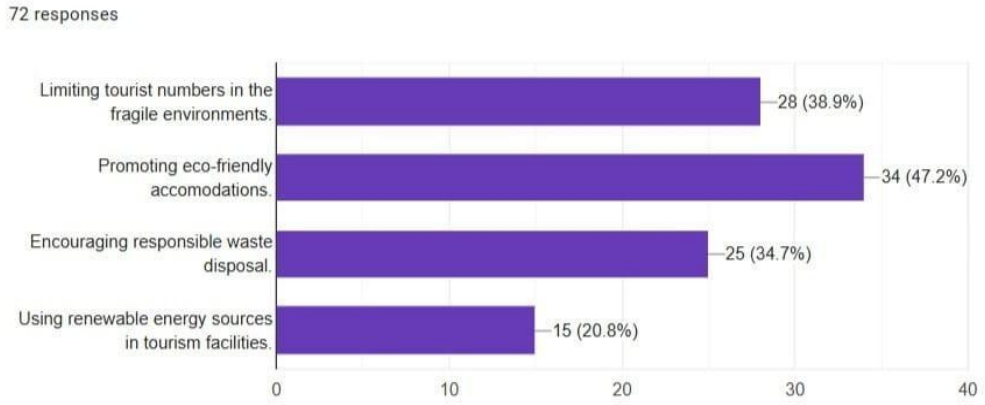
9. Do you think tourism helps to preserve local cultures and traditions?



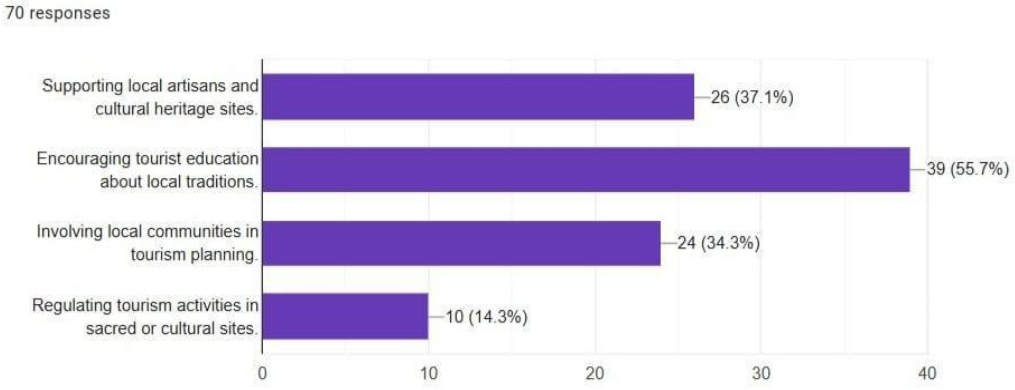
10. Do you believe government and tourism businesses are doing enough to promote sustainable tourism?



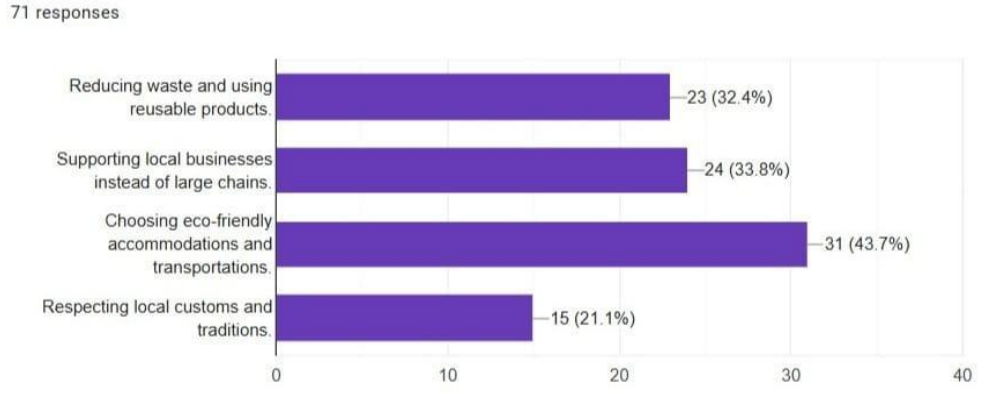
11.What sustainable practices do you think should be promoted in the tourism industry?



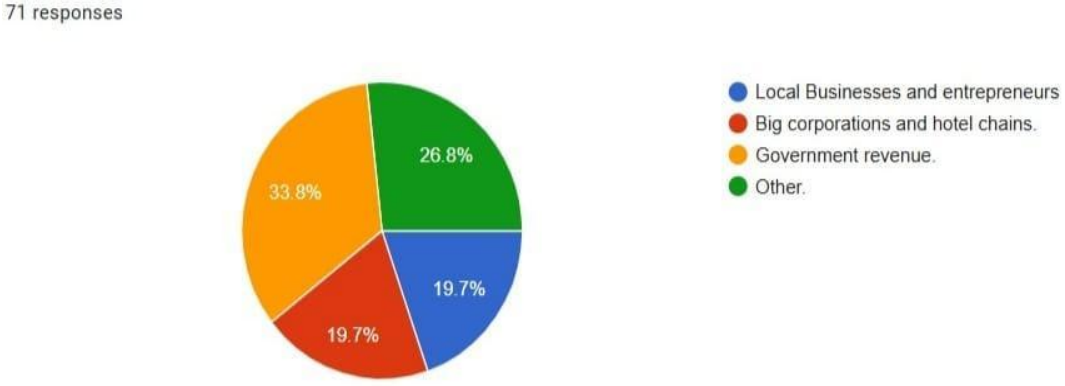
12. How can tourism promote cultural preservation?



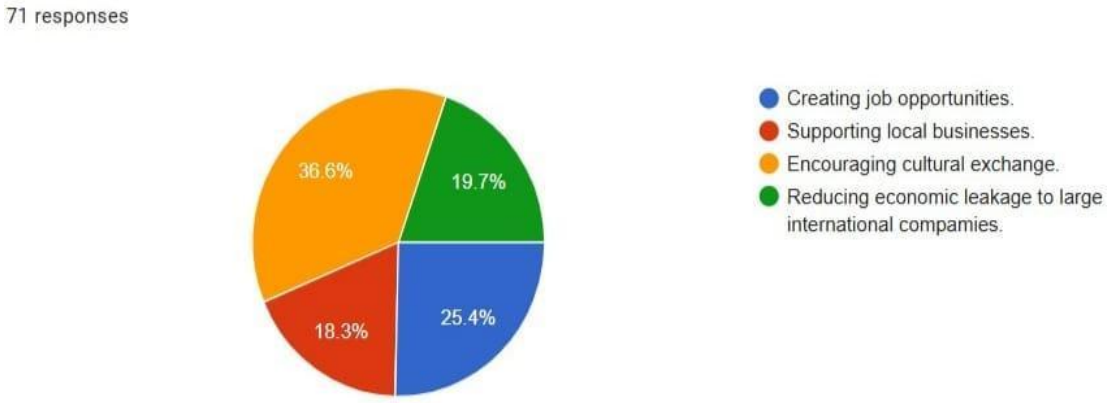
13. What steps do you personally take to ensure sustainable travelling?



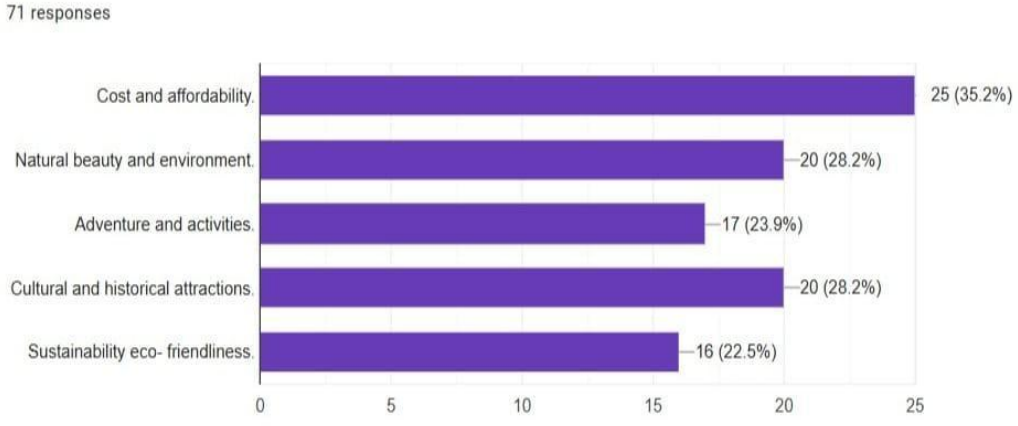
14. In your opinion which sector benefits the most from tourism?



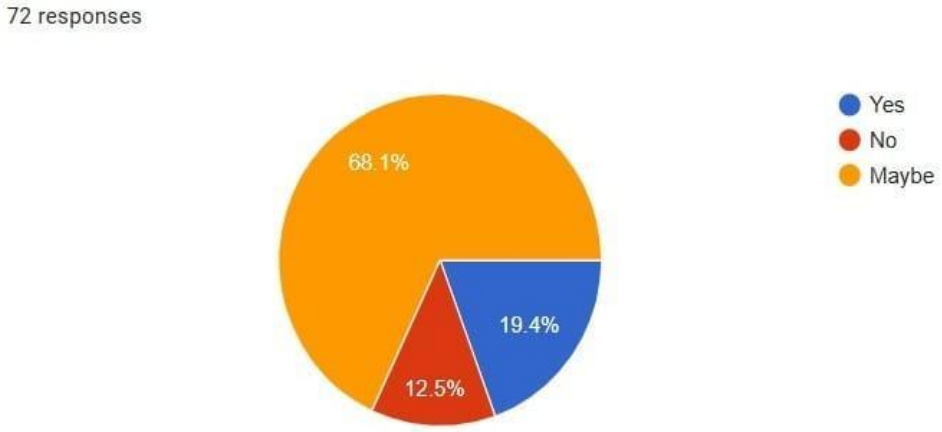
15. How do you think sustainable tourism can improve local economics?



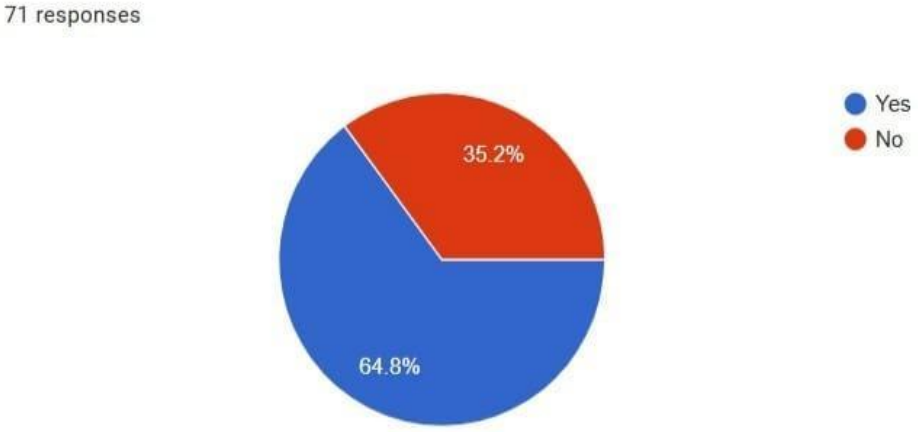
16. What is the most important factor when choosing a travel destination?



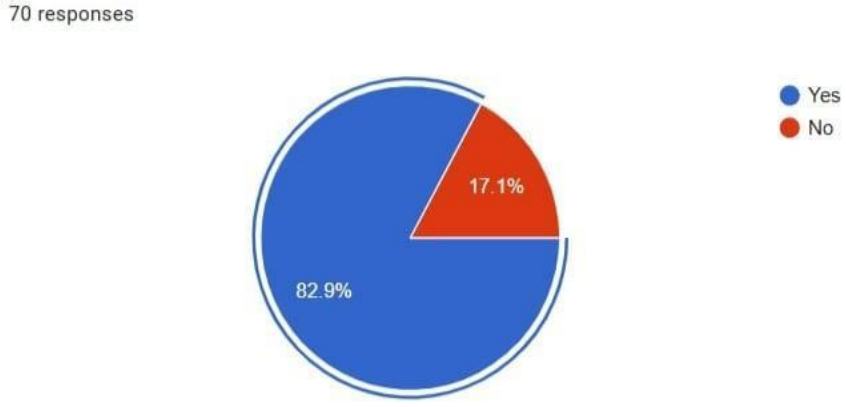
17. Do you feel that sustainable tourism will become a norm in the future?



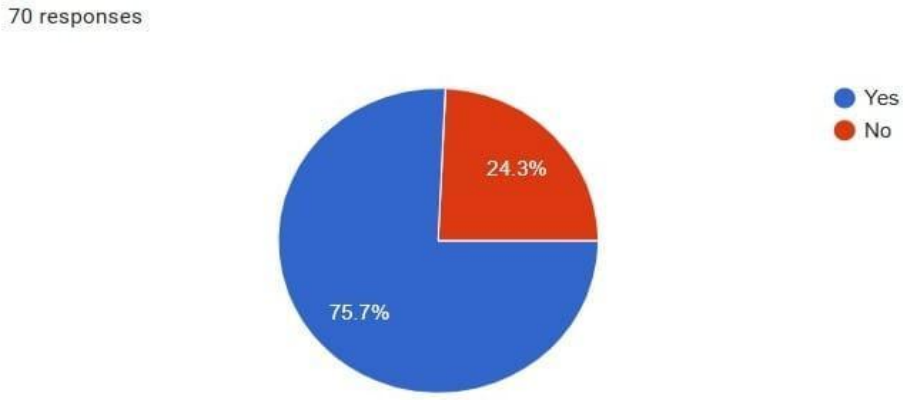
18. Do you think that social media influences tourists towards sustainable tourisms?



19. Would you be interested in volunteering for environmental and cultural conservation?



20. Do you think that technology plays an important role in promoting sustainable tourism?



Findings

Economic Benefits of Sustainable Tourism:

Sustainable tourism has been a game-changer for local economies, creating jobs and boosting small businesses. Places that focused on eco-tourism or cultural experiences saw an increase in both visitors and revenue, without compromising their local traditions. That said, not all the economic benefits were equally spread—bigger businesses often reaped more rewards compared to smaller, community-driven projects.

- **Environmental Impact:** While sustainable tourism can reduce environmental damage, it's not without its challenges. For instance, overcrowding, unregulated eco-tours, and waste management still caused harm to some natural sites. However, areas that enforced strong environmental policies—like waste reduction and wildlife protection—were able to limit these issues. It's clear that without careful planning, even the best intentions can lead to unintended consequences.
- **Cultural Preservation:** When done right, sustainable tourism can be a powerful tool for preserving and promoting local cultures. Many communities have seen tourism help keep their traditions alive, with tourists learning about local crafts, food, and customs. But there's also the risk of cultural commodification, where traditions get altered or performed for tourists in a way that feels inauthentic. Finding that balance between honouring culture and creating experiences for visitors is tricky but crucial.
- **Balancing the Three Pillars:** The key takeaway here is that balancing the economy, environment, and culture isn't easy, but it's possible. In places where governments, local communities, businesses, and tourists worked together, sustainable tourism flourished. The best results came when all three pillars were considered equally, with clear guidelines that allowed tourism to support the local community, protect the environment, and celebrate cultural heritage.

Suggestions

Collaborative Initiatives: Achieving sustainable tourism necessitates collaboration among governments, local communities, businesses, and travellers. It is essential for stakeholders to unite in developing frameworks and policies that promote responsible practices and comprehensively address all facets of sustainability.

Community Engagement and Empowerment: The participation of local communities in tourism development is vital. By empowering these communities through equitable benefit-sharing, involvement in decision-making, and initiatives aimed at cultural preservation, a sense of ownership and accountability towards sustainable tourism practices is cultivated.

Strengthening Policies and Regulations: It is imperative for governments to implement more stringent regulations to mitigate environmental harm and ensure sustainable tourism practices. This encompasses establishing clear directives regarding waste management, carbon emissions, habitat conservation, and the protection of biodiversity.

Education and Awareness Initiatives: Raising awareness among travellers about the environmental and cultural repercussions of their travel decisions is crucial in mitigating adverse effects. Promoting eco-conscious behaviours, such as opting for sustainable travel alternatives, is essential.

Integration of Technology: The application of technology can enhance tourism management. Advanced destination management systems can effectively monitor tourist traffic, alleviate overcrowding, and manage environmental impacts with greater efficiency.

Cultural Respect: It is important to prevent the commodification of local cultures. Sustainable tourism should advocate for the genuine representation of local traditions, crafts, and customs, ensuring they are honoured and not modified solely for the sake of tourism.

Focus on Long-Term Sustainability: Research underscores that sustainable tourism should be regarded as a long-term commitment rather than a temporary fix. This entails the ongoing evaluation of tourism impacts and the necessary adjustments to policies and practices to guarantee enduring sustainability for local economies, ecosystems, and cultural heritage.

Conclusion

In conclusion, sustainable tourism can truly make a difference when it comes to balancing economic growth, environmental protection, and cultural preservation. But it's not a one-size-fits-all solution. Achieving this balance requires collaboration from everyone involved—governments, local communities, businesses, and tourists. By working together, they can create a tourism model that benefits everyone in the long run. The challenge is real, but the rewards are equally significant, not just for the places we visit, but for the future of travel itself. When tourists take responsibility and respect local customs, and when destinations prioritize sustainability, we can ensure that tourism continues to be a positive force for both people and the planet.

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SUSTAINABLE MOBILE TECHNOLOGIES: IMPACT AND FUTURE PROSPECTS

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Abstract

The rapid evolution of mobile technologies has led to a significant impact on various industries, but this growth has also raised concerns about environmental sustainability and resource consumption. As mobile devices become increasingly integral to daily life, the demand for energy-efficient and eco-friendly solutions is more urgent than ever. This paper explores the future prospects and challenges of sustainable mobile development, focusing on green technologies, energy-efficient software design, and the lifecycle management of mobile devices. It examines innovative strategies for reducing the carbon footprint of mobile apps, the importance of sustainable hardware development, and the role of recycling and reuse in minimizing e-waste. By analyzing current trends and forecasting future directions, this research aims to provide a comprehensive overview of sustainable practices in mobile development, offering insights into how the industry can evolve toward a more sustainable and environmentally responsible future.

Purpose of the Paper: This paper seeks to explore the impact of mobile technologies on sustainability and discuss the ongoing efforts to mitigate their environmental consequences. It also examines future innovations in mobile technology aimed at enhancing sustainability

Keywords: Sustainable mobile development, green technology, energy efficiency, software design, mobile apps, lifecycle management, e-waste, eco-friendly mobile devices, mobile technology trends, future prospects.

Introduction:

Mobile technology has become a central aspect of modern life, transforming how people communicate, work, and access information. With billions of devices in use worldwide, the demand for mobile solutions continues to grow exponentially. However, this expansion also brings significant environmental concerns, including energy consumption, resource depletion, and the rising issue of electronic waste (e-waste). In response to these challenges, there is an increasing push toward sustainable mobile development—an approach focused on minimizing the environmental footprint of mobile devices and applications throughout their lifecycle.

Sustainable mobile development involves designing, manufacturing, and utilizing mobile technologies in ways that reduce negative environmental impacts. This includes energy-efficient software design, the use of eco-friendly materials in hardware production, and improving recycling and reuse practices. As mobile devices become more integrated into every aspect of life, it is crucial for developers, manufacturers, and policymakers to consider the broader environmental implications and adopt strategies that promote sustainability.

This paper examines the future of sustainable mobile development, exploring emerging trends, challenges, and potential solutions. It highlights innovations aimed at reducing energy consumption, extending the lifespan of devices, and minimizing waste.. Ultimately, the paper aims to offer insights into how mobile technology can continue to advance while contributing to a more sustainable and eco-friendly future.

In the following sections, we will explore the environmental issues associated with mobile technologies, examine the role of energy-efficient software and hardware, and discuss strategies for managing the full lifecycle of mobile devices. The paper will also look into emerging trends that have the potential to drive sustainable change in the mobile industry.

Overview of Mobile Technologies and Their Growing Influence:

Sustainable mobile technologies represent a growing field focused on developing and utilizing mobile devices and networks that minimize environmental impact, promoting sustainability by employing eco-friendly materials,

energy-efficient designs, and optimized usage patterns, while simultaneously leveraging mobile connectivity to address critical environmental and social challenges through innovative applications and data analysis, ultimately contributing to achieving the UN Sustainable Development Goals.

- **Overview of Mobile Technologies:** Mobile technologies, including smartphones, tablets, and wearables, have become integral to daily life. Their adoption continues to grow rapidly worldwide, impacting communication, business, healthcare, and entertainment.
- **Need for Sustainability:** With increasing mobile device usage, the environmental impact of production, energy consumption, and disposal has become more significant. Mobile technologies are resource-intensive, contributing to carbon emissions, pollution, and e-waste. This has led to a call for sustainable practices in the mobile tech industry.

Sustainable mobile technologies play a crucial role in promoting environmental, social, and economic sustainability. They help reduce reliance on printed materials, conserving trees and minimising deforestation, while also lowering energy consumption compared to traditional classroom settings. Socially, they enhance inclusivity by offering tailored learning experiences that accommodate diverse needs and support lifelong learning. Economically, they reduce costs associated with transportation, infrastructure, and printed materials in education.

The impact of sustainable mobile technologies in higher education is evident in their growing adoption across disciplines, with innovations such as mobile applications, gamified learning, augmented reality, and location-based experiences. AI-driven algorithms enable personalised learning, providing real-time assessment and feedback. These technologies also improve accessibility by fostering digital inclusivity and supporting learners with diverse backgrounds. Additionally, they contribute to cognitive development, knowledge retention, and adaptive learning, helping bridge educational gaps.

Future research should explore new avenues in sustainable mobile learning, conduct longitudinal studies on long-term educational and environmental benefits, and integrate emerging technologies like AI and virtual/augmented reality. Advancements in AI-powered tools can enhance personalised learning, while mobile strategies can address sustainability challenges across industries.

For effective implementation, a comprehensive approach addressing all three sustainability pillars is essential. Mobile learning strategies should be continuously refined based on empirical evidence and user feedback. Collaboration among educators, technologists, and sustainability experts is crucial for innovation. Ensuring equitable access to mobile technologies and digital literacy training is vital, along with regular assessments of their environmental impact.

Sustainable Practices in Mobile Technology Development:

Mobile technologies have a significant environmental impact due to resource consumption, energy use, and electronic waste. The production of mobile devices relies on raw materials like lithium, cobalt, and gold, which are extracted through environmentally harmful mining processes. Additionally, manufacturing is energy-intensive, contributing to carbon emissions, while efforts to source sustainable materials and reduce the carbon footprint remain challenging. Mobile devices also require substantial energy, both in production and usage. Although newer models are more energy-efficient, increasing connectivity demands, such as 5G and high-speed data, continue to drive higher energy consumption in mobile networks. Another major concern is electronic waste, as mobile devices have a short lifecycle, with frequent upgrades leading to vast amounts of discarded electronics. Due to their complex components and toxic substances like lead and mercury, recycling remains a challenge, often resulting in improper disposal that harms the environment.

Mobile learning has become a significant component of higher education in the robotic era, offering a unique form of e-learning where educational content is exclusively delivered through mobile devices. These devices are now well-equipped to support higher education, providing a highly personalised and collaborative communication tool. This enables students to extend their learning beyond the classroom, reaching remote areas where computers may not be accessible.

During the COVID-19 pandemic, mobile phones have played a crucial role in the teaching–learning process. To prevent academic losses, many educational institutions adopted online methods, making e-learning an essential part

of education. Higher education institutions, in particular, have utilised mobile devices in various ways to ensure global accessibility. With the growing reliance on mobile learning, studies have been conducted to assess its effectiveness during the pandemic.

Sustainable mobile technology has also gained attention, with companies like Apple, Samsung, and Fairphone incorporating recycled materials, such as aluminium and plastic, into their designs. The shift towards renewable resources and modular phones is making devices easier to repair and upgrade. Energy efficiency is another focus, with optimised software, low-power modes, and 5G technology helping to reduce energy consumption. Advancements in battery technology, including alternatives to lithium-ion and the development of more sustainable batteries, further contribute to eco-friendly innovations.

Recycling initiatives and the adoption of a circular economy model are essential for reducing e-waste. Take-back programmes, device refurbishment, and reuse efforts aim to extend product lifespans, while initiatives like Apple's Daisy robot recover valuable materials from old devices. Additionally, sustainable manufacturing practices are reducing the carbon footprint of production facilities through renewable energy use, improved supply chain management, and the minimisation of toxic chemicals. Many companies are working towards zero-waste goals and energy-efficient processes to make mobile technology more environmentally responsible.

All the information and data presented in this paper were gathered from various sources of secondary data. The sources came from online databases like ProQuest, Emerald, Ebsco and ScienceDirect. The online search database provided secondary data such as journals and extracts from newspapers, books and magazines. Some of the information and data were obtained from the internet search engines like Google.The research framework was developed as shown in Figure 1.

Sustainability and the future:

The future of sustainable mobile technologies is driven by advancements in battery technology, AI integration, and next-generation wireless networks. Emerging battery innovations, such as solid-state and graphene batteries, promise longer lifespans, faster charging, and a reduced environmental footprint. These developments also aim to decrease dependence on rare materials like cobalt and lithium by exploring alternative chemistries.

The expansion of 5G and future wireless technologies, including 6G and advanced Wi-Fi, presents both challenges and opportunities. While 5G raises concerns about higher energy consumption, it enhances resource efficiency by enabling faster data transmission with lower energy costs per unit of information. Future advancements in wireless communication will further optimise energy use across mobile networks.

Artificial intelligence is also playing a crucial role in sustainability by optimising mobile networks and predicting energy consumption patterns to improve battery efficiency. AI-driven lifecycle management enhances device longevity by predicting maintenance needs and streamlining recycling processes.

Additionally, mobile solutions are emerging to support sustainability efforts. Applications that track personal carbon footprints, manage energy consumption, and encourage eco-friendly habits are becoming more widespread. Mobile-enabled smart grids and smart home systems integrate renewable energy sources more effectively, reducing overall energy demand and promoting a more sustainable digital future.

Achieving sustainability in mobile technologies faces several key challenges, including consumer demand, supply chain complexities, regulatory gaps, and economic constraints. One major issue is balancing the desire for newer, more advanced devices with the need for longevity and sustainability. Marketing strategies and planned obsolescence encourage frequent upgrades, leading to increased electronic waste and resource consumption.

Global supply chains add another layer of difficulty, as ensuring sustainability throughout the entire lifecycle of a mobile device—from raw material extraction to manufacturing and distribution—is highly complex. Ethical concerns also arise, particularly regarding labour practices and resource extraction in developing countries, where environmental and human rights issues persist.

Stronger regulatory frameworks are essential to enforce sustainable practices in mobile technology production and disposal. Government initiatives, such as the European Union's Ecodesign Directive, have influenced the industry

by setting standards for energy efficiency and recyclability, but broader global policies are needed for widespread impact.

Finally, scaling sustainable technologies remains a challenge due to economic and technological limitations. The development and implementation of alternative materials and energy-efficient components often require significant investment, making it difficult for companies to adopt these solutions on a large scale. Overcoming these barriers will require coordinated efforts from manufacturers, policymakers, and consumers to drive meaningful change.

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TECHNOLOGICAL SOLUTIONS FOR WASTE MANAGEMENT AND RECYCLING

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Abstract

Technologies in recycling and waste management are important to the growing environmental problems associated with urbanization and industrial development. With continuous increases in the generation of waste, innovative technical solutions play an increasingly important role in the reduction of waste volume, improvement of recycling efficiency, and minimization of ecological impacts. This paper reviews some of the technologies currently being used in waste management: pyrolysis, material recovery facilities, waste-to-energy plants, and smart recycling systems. Through an analysis of the performance metrics and advantages as well as challenges related to the implementation of these technologies, this work attempts to engender a better understanding of their roles toward sustainable waste management. This report addresses the challenges these technologies face, possible future paths, and opportunities for further development and integration of waste management solutions.

Keywords: Management of Waste, Upcycling, Innovative Technologies, Sorting of Waste, Energy from Waste, Pyrolysis Process, Intelligent Recycling, Ecological Balance.

Methodology

This study examines the technical developments in recycling and waste management through a systematic literature review. For current trends and experiences related to the technologies, this study includes various peer-reviewed journal articles, technical reports, case studies, and industry white papers. Pilot projects, performance evaluation, and case studies are crucial to determine their impact on waste management strategies. A balanced account is presented by integrating data regarding the efficiency, scalability, and ecological footprint of each technology. This report also attempts to enhance understanding by including graphs and diagrams for illustrative purposes.

Introduction

Recycling and waste management have become key components of sustainable urban development as a response to the challenges of waste generation. Garbage output has surged around the world due to urbanization, booming industrial activity and consumerism. Improper waste management leads to considerable resource depletion and environmental pollution and risks to human health. As a result, there is a larger demand today than ever before for high-tech solutions that can help raise recycling rates and improve waste disposal.

Technology has completely revolutionised the waste management landscape with the advent of pyrolysis, waste to energy technologies, automated sorting systems and smart recycling systems. Designed to help reduce the amount of waste a person produces, these solutions also enable recovery of valued materials, transforming garbage into sustainable energy. This paper assesses the different technologies that are currently being used, looks at their advantages and disadvantages, and discusses the challenges the waste management sector faces. It also details potential pathways for innovation and research opportunities in the waste management space.

Overview Of Technologies

Recycling and garbage management have been some of the most difficult problems that different technologies are trying to tackle. These technologies being developed for the purpose of recycling resources out of waste, reduce impact on environment and increase waste management work. Combustion, waste to energy technologies and automated trash sorting systems/intelligent recycling systems are highlighted as the primary technological answers in this study.

1. Automated Sorting Systems

Robotic sorting systems detect and rearrange waste materials using robot control and advanced image recognition technology. Our method works better than manual collection because it helps us sort more quickly and precisely. The devices use advanced sensors together with machine learning to recognize plastic metal paper and glass materials.

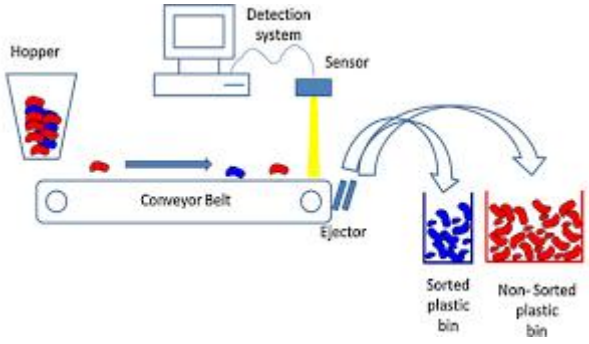

Figure: automated sorting systems

2. Waste-to-Energy Technologies (WTE)

Waste-to-energy systems can convert waste, particularly organic waste, into energy that can be used to produce heat, electricity, or biofuels. The most commonly used WTE technologies are anaerobic digestion, gasification, and combustion. In addition to minimizing the volume of waste deposited in landfills, these techniques help transfer energy and cut greenhouse gas emissions.

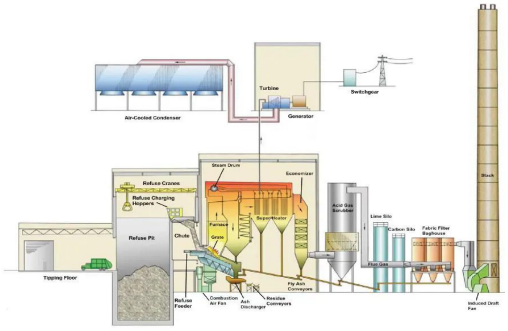

Figure: waste-to-energy technologies

3. Pyrolysis Technology

This process, called pyrolysis, breaks down organic materials such as tires, plastics and biomass without oxygen, producing useful byproducts like char, gasses and biofuels. This technology is particularly useful for preventing waste from being disposed of in landfills and instead converting it into alternative fuels or other useful products.

Figure: pyrolysis technology

4. Smart Recycling Systems

Smart recycling solutions use automation, data analytics and sensors to maximize the volume of recyclables collected, sorted and processed. These systems enable real-time monitoring of waste production, bump up recycling rates and reduce contamination of recyclables. Internet of things (IoT) sensors can be applied to recycling facilities and trash cans to determine how much garbage is being created and monitor performance.

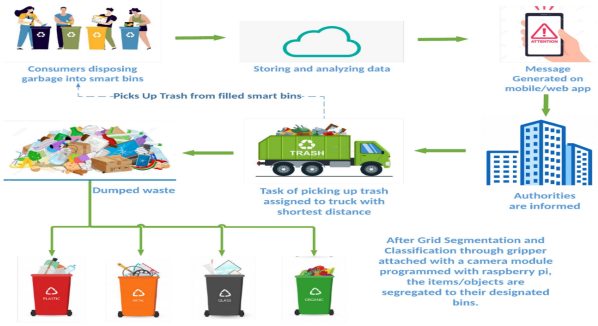

Figure: A futuristic smart recycling system with automated conveyor belts, robotic arms sorting recyclables, and IOT sensors integrated into garbage cans.

5. IoT sensors and smart containers for waste

Sensors and IoT capabilities of Smart bins keep alert and track the levels in the dump in real time. They connect to centralized systems and assist in the optimization of collection schedules and the minimization of operation costs. They make waste collection safer and more effective by reducing pollutants and saving fuel. Such waste collection techniques backed by internet have been deployed in in cities such as Singapore and Amsterdam thus promoting growth in the trash management space.

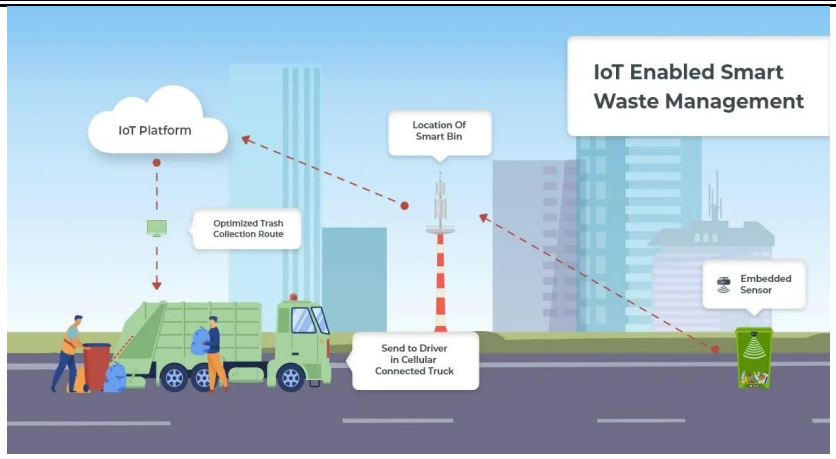

Figure: Smart trash cans with IOT sensors and LCD panels that display waste levels in real time in a bustling metropolitan environment.

6. Blockchain for Waste Management

Blockchain technology is a wonderful technology that helps to make waste management visible and traceable by giving a secure and immutable ledger that shows every aspect of the life cycle of the waste from production to disposal or recycling. This is done by getting rid of the illegal dumpings and the bad management processes through keeping an eye on all the activities and verification of the same. In fact, a smart contract or in other words real-time tracking is employed to make sure that parties like garbage producers, collectors, and recyclers do not get away with their obligations. This in turn helps to increase the accountability of the participants in the waste management operations. Namely, the creation of a tamper-proof record of transactions and the proper allocation of funds, incentives, and resources to be used for the conferred purposes by the corruption-free recycling programs are overriding beneficial factors that bring about both the efficiency and trust of the waste management ecosystem.

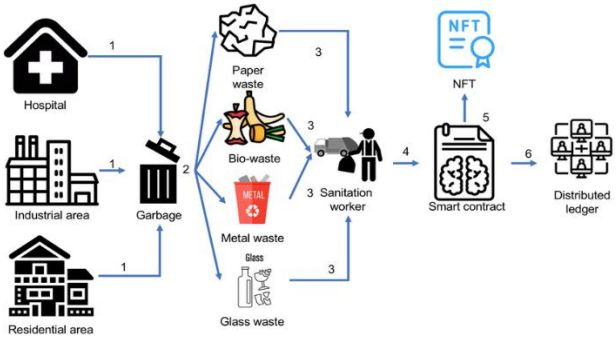

Figure: - A speculative image of blockchain technology applied to garbage management, with interconnected chunks of data floating in a digital

7. 3D Printing with Recycled Materials

Resolute Manufacturing is a leading industry player in 3D printing that has introduced more techniques of utilizing waste materials. The use of recycled plastic, metal scraps and other kinds of waste for 3D printing has become an inventive as well as a greener method of production. To wit, the use of these materials in 3D printing is such a way that we don't depend on new resources, thereby, taking care of the natural environment by means of reducing overall consumption. Consequently, the project includes upcycling waste using i.e. making dresses, bags, shoes among others from waste materials. As such, green technology applications have been increased, and businesses and individuals can now break through and become leaders in the use of renewable energy and other sustainable practices.

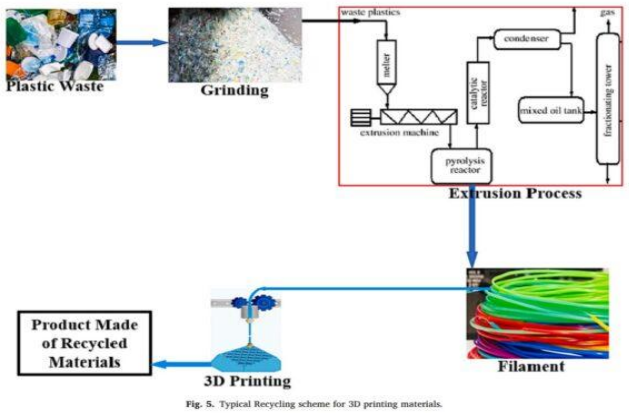

Fig. 5. Typical Recycling scheme for 3D printing materials.

Figure: 3d printing with recycled materials

8. Drone Technology for Landfill Monitoring

The application of drones on garbage sites is a new technology often referred to be drone technology for landfill monitoring which involves the deployment of unmanned aerial vehicles (UAVs) against equipped with cameras, thermal sensors, and GPS to the landfill pits to monitor the piles of waste and to distinguish those that were left illegally. The drones are smart and move with speed, either up or down, and cover large areas instantly, generating real-time aerial images that inform the garbage accumulation, site conditions, and environmental implications. Drones extend surveillance and thus bring the monitoring of inaccessible and hazardous sites to full compliance with environmental regulations. Also, their skill in mapping landfill changes helps to improve trash management strategies and cut down on the need for in-person waste checks. This enhances safeguarding the environment and benefits both efficiency and expense reduction.

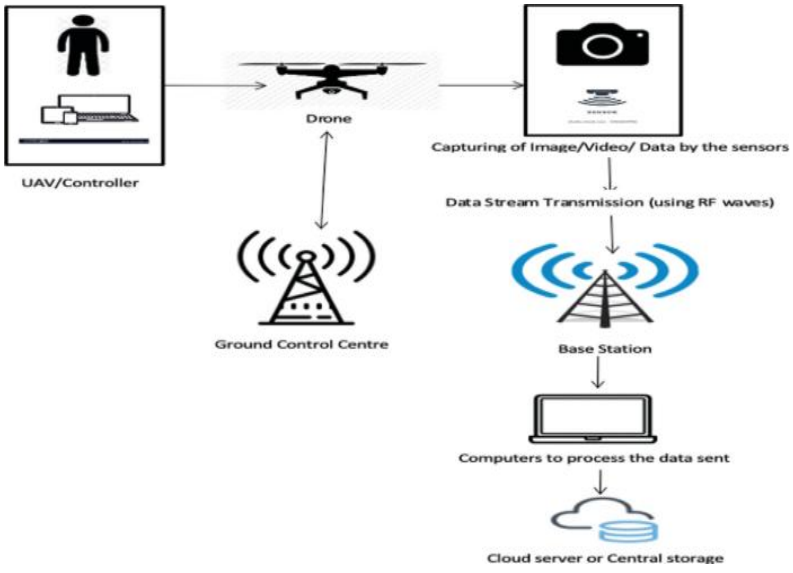

Figure: monitoring landfills using drone technology

9. Predictive Analytics Driven by AI

Future waste production patterns can be predicted by analysing historical data using machine learning algorithms in AI-driven predictive analytics. By predicting garbage patterns, AI helps save money on recycling and make better use of resources. It accomplishes this by identifying waste tendencies, resulting in more efficient use of available resources. This means that artificial intelligence (AI) can help make recycling more cost-effective and environmentally beneficial. By reason of this technology, waste management organizations and local governments are able to gauge the demand for trash collection services, as well as detect places where recycling efforts are to be

improved and act upon waste management policies that respond immediately to the available data. The formation of the policies that are data-based on waste management manifest the sustainability aspect that is one of the foremost issues and by the use of artificial intelligence in such an area also the operational aspects of the organization can be improved and thus, intelligent, proactive environmental measures can be generated. AI is empowering waste management with the insights provided by autonomous analytics-based data. These insights are enhancing waste management through the implementation of innovative technology and green energy that is connected to the development of communities, buildings, and transportation.

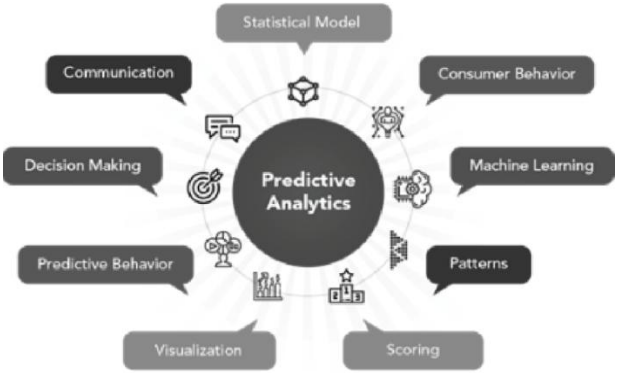

Figure: predictive analytics driven by AI

Discussion

This section includes the pros and cons of the main mentioned elements of technology in full detail. A comparison table is presented to portray the merits and demerits of each technological advancement.

Technology	Advantages	Disadvantages
Automated Sorting Systems	Faster and more accurate sorting Reduces operating costs Can handle tons of garbage.	Substantial capital investment stem is in need of frequent upgrading and maintenance.
Waste-to-Energy Technologies	Advantages are less waste going to the landfill, and generation of renewable energy. less greenhouse gas emissions.	There may be air pollution induced by the emissions. Which cost the infrastructure enormous money.
Pyrolysis Technology	Converting non-recyclable waste into lucrative products Decreases landfill volume Eco-friendly	High energy usage more expensive technology setup.
Smart Recycling Systems	Minimizes contamination of recyclable materials Enhances waste collection and recycling processes Generates real-time data	Needs advanced infrastructure. Requires an internet connection.
IoT Sensors and Smart Containers for Waste	Delivers up-to-the-minute information on waste levels Streamlines waste collection routes Improves overall operational efficiency	Requires a reliable internet connection. The cost of implementing large-scale systems can be significant.
Blockchain for Waste Management	Enhances transparency and traceability – diminishes fraud and unlawful dumping Fosters accountability among all stakeholders	Implementation costs Challenges in integrating with current systems

3D Printing with Recycled Materials	Reduces dependency on virgin materials Promotes upcycling- Enables the creation of new products from waste	Requires specialized equipment Limited material options and quality concerns
Drone Technology for Landfill Monitoring	Provides real-time data and surveillance Enhances monitoring of illegal dumping Can access hard-to-reach areas	High operational and maintenance costs Limited battery life for largescale coverage
Predictive Analytics Driven by AI	Optimizes waste collection and recycling strategies Offers data-driven perspectives for formulating policies. Forecasts future waste trends	Requires large datasets for accuracy Dependence on skilled personnel for setup and analysis

Challenges And Limitations

Despite the general adoption and effectiveness of these technological solutions, several problems and disadvantages persist, even amidst the hype:

- **Expensive:** Automated sorting and pyrolysis systems can be costly to set up and maintain, which may be prohibitive for smaller waste management facilities.
- **Use of Energy:** Even though waste-to-energy and pyrolysis technologies are helpful in minimizing waste volume, they produce excess energy consumption stemming from non-renewable sources which puts the sustainability model in risk.
- **Transformation of technology:** There is waste of various kinds in waste management, it is not practically possible to manage sorted or mixed waste by many technologies. For instance, most automated sorting algorithms perform poorly at differentiating between some ecologically friendly products.
- **Acceptance of technology:** Certain waste-to-energy and even treated waste technologies such as incineration face legislation barriers in some places, resulting from public concerns over pollution. Besides, public opposition to such technologies can create a barrier to their practical use.

Future Directions And Opportunities

In the coming years, it looks like there are tremendous possibilities for innovation and growth in the area of waste management and recycling.

- **AI and Robotics Utilization:** Robotics and artificial intelligence are going to make waste sorting systems more precise and effective. This would allow for the elimination of a considerable amount of the annoying manual work required, thereby enhancing total system productivity.
- **Circular Economy Application:** Faulty products produced using resources have to be repaired, reused, and recycled within modern waste management systems, which is why we need to adopt contemporary waste management systems that maximize efficiency and minimize the usage of resources.
- **Blockchain Waste Monitoring:** The blockchain technology enables tracking the waste from points of collection to the recycling centres. This will solve the problem of inefficient resource allocation as well as responsibility allocation.
- **Energy Efficiency Technique Development:** Subsequent studies may seek to refine the waste to energy processes by using pyrolysis in order to make more efficient use of energy, which would reduce consumption and the carbon footprint negative impact.

- **Enhancement of Public Education:** Growing public knowledge and educating citizens on proper waste sort and recycling may positively change their attitude toward the modern technologies being used and actually increase the percentage of recycling being performed.

Conclusion

Technology is revolutionising waste and recycling management. This is because they optimize the process and reduce the adverse ecological impacts by providing new material recycling alternatives. Among these new technological breakthroughs are waste-to-fuel production, energy generation using discarded items, and the use of robots in waste management and recycling. Nonetheless, there are still a few problems: the difficulty of new methods costing, necessary energy, and lack of cooperation from the government. Research will the deal with these challenges more easy, new technology will appear the result of them, and policies will be enforced. The future of waste management requires not only a decrease in generation rates, but also recycling, technology, and necessary human behavior modifications for lesser disposal.

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THE IMPACT OF AUTONOMY AND ROBOTICS ON THE ENVIRONMENT

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Abstract

Over the last few decades, the industrial landscape has been ever changing due to the rise of Automation and use of Robotics in almost all sectors, however, their integration into our production and industrial practices has presented both incredible opportunities and monumental challenges.

This paper will outline the vast possibilities that can revolutionize our industrial capabilities, such as precise resource utilisation, reducing waste, energy consumption, and greenhouse gas emissions. They have also helped us in environmental monitoring and conservation efforts.

However, these benefits are counterbalanced by substantial environmental concerns. The production and operation of these technologies results in the generation of substantial E-waste and in many sectors, results in the displacement of workers who may rely of these sectors as their only source of income.

This study aims to provide a comprehensive overview of the role Automation plays in Environmental conservation and its impact on the ecosystem.

Introduction:

Automation and Robotics have emerged as transformative technologies in modern industries, offering innovative solutions to problems that challenged humans in the past, reshaping the industry whilst also having a huge impact on the environment.

Automation and Robotics enhance energy efficiency by optimizing energy usage, reducing waste and lowering carbon emissions during the manufacturing process, thus elevating the production process by optimising resource use, minimizing wastage through precise control over the amounts of materials used, improving resource utilization and sustainability. This results in a significant reduction in emissions and pollution as compared to traditional methods.

Automation involves little to no human intervention, greatly reducing the likelihood of human error. This minimizes defects and mistakes, leading to higher-quality products and less time spent on inspecting for errors or flaws.

Although the positives of automation and robotics are vast, their implementation and operation of said machines come with significant challenges, the biggest of them being its impact on employment, as the automation of usually repetitive and even complex tasks leads to job displacement, disproportionately affecting low-skilled workers. Beyond this socio-economic implication, the environmental impacts of automation are also multifaceted.

The manufacturing of robotic systems is very energy-intensive, can lead to a large amount of E-waste, and contributes to carbon emissions. The manufacturing process also relies heavily on rare earth elements that lead to damaging mining practices and production of harmful by-products.

Objectives:

- To create a comprehensive view of automation throughout the years and its development
- To point out the pros and cons of automation with its effects on the ecosystem in mind
- To give possible solutions to the shortcomings and the socio-economic impacts of robotics
- To study its effects on various fields

- To gauge public opinion and awareness of automation

Energy and Resource Utilization:

Once implemented, robotic technologies deliver improved results while consuming the same amount of energy. Automating repetitive and time-consuming tasks is the most efficient option for manufacturers, as it reduces the need for extensive manual labour.

These tasks are the most vulnerable to human error in traditional production, so automating them can improve product quality and reduce energy consumption that would otherwise be spent on extra steps like error checking and cut down on material waste from defective products.

A higher level of automation and the adoption of robotics technology make the transition to renewable energy sources more feasible. By streamlining production processes, automation enhances system flexibility, allowing industries to easily integrate solar, wind, or other renewable energy sources. This shift helps lessen the dependence on conventional energy production methods, reducing carbon emissions and minimising environmental impact.

In agriculture, robotics that manage tasks like irrigation or harvesting are designed to minimise water and energy use, thus lowering energy consumption while enhancing crop yields. Automated machines are used to detect and eliminate weeds and unwanted pests without the use of harmful pesticides and herbicides. Other automated systems used for irrigation, like drip irrigation use up to 50% less water than conventional methods.

Reduction of Waste Materials:

Automation in the waste management industry has significantly improved process efficiency and enhanced pollution monitoring systems. Robotic systems can be integrated with advanced fume extraction and filtration technologies to capture harmful gases and particles released during manufacturing processes. They have also helped revolutionise the recycling industry by improving speed, accuracy, and efficiency of waste sorting.

Automated systems in food production can reduce food waste by improving sorting, packaging, and distribution processes. They can also optimise harvesting, reducing the loss of crops due to human inefficiency or mistakes.

Robotics-enabled 3D printing technology has become more widespread than ever; it is highly efficient in terms of material usage, unlike traditional subtractive manufacturing methods that create excessive waste.

Scalability of Automated Systems:

Automated systems are highly flexible and adaptable; it is easy to scale them up or down with respect to demand, and they do not need significant investments in infrastructure or labour.

As automation and robotics continue to grow in industries, an increasing number of products will be designed specifically for production by autonomous systems. Many car manufacturers, such as Tesla, use robotic systems for tasks like welding, painting, and assembling components with high precision. As automation increases, vehicles are being designed with these robotic systems in mind, resulting in more optimised designs that are easier and more cost-effective to produce using autonomous technology.

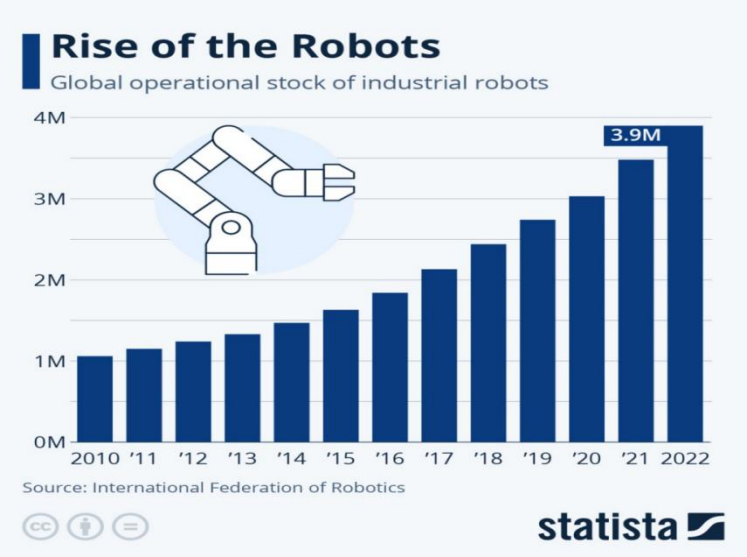


Figure 1. Global operational stock of industrial robots.

This figure shows the near exponential growth of the number of industrial robots in use around the world

We have thoroughly explored the positive impacts of automation and robotics on the environment. However, like all technologies, it is important to evaluate both their positive and negative effects independently.

The Impact on Employment:

The adoption of automation in industries, while delivering substantial economic benefits to companies, often comes at a significant cost to employees. The transition to robotic technology leads to the displacement of workers, leaving many without jobs. This particularly affects roles that are repetitive and typically classified as unskilled labour, disproportionately impacting those from less advantaged backgrounds.

This only increases the economic disparity between the wealthiest and the working class.

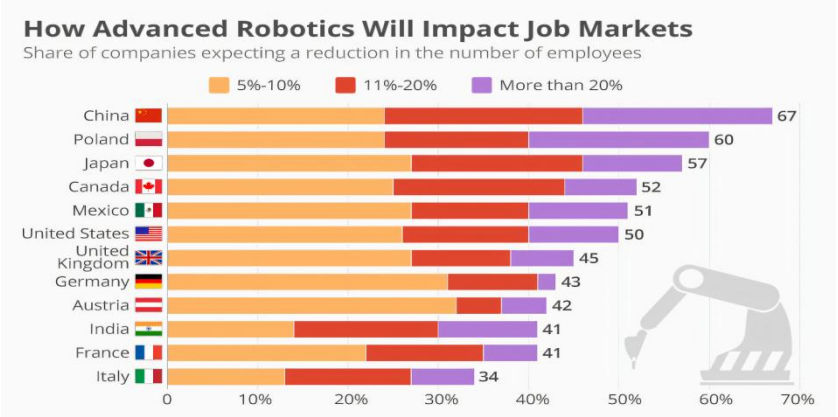


Figure 2. The Proportion of companies expeciting a reduction in number of employees due to automation in idustry

The above figure shows the number of companies that are expecting to let go of employees in the coming years due to the automation of processes, this also shows us the proportionally higher effect of automation in highly developed and developing countries.

Manufacturing of Robotic Systems is damaging and costly:

The production of autonomous systems and robots poses significant environmental challenges. Their advanced and complex manufacturing processes are resource-intensive and costly, contributing to higher carbon emissions.

Additionally, these systems rely heavily on rare earth metals, the extraction of which involves environmentally harmful mining practices.

Many of the materials used in the manufacturing process are LREEs (Light Rare Earth Elements) and HREEs (Heavy Rare Earth Elements); these elements are critical in various high-tech applications, including electronics. Mining REEs often requires open-pit or strip mining, which involves clearing large areas of land. During mining and refining, radioactive waste, which can be a by-product of REEs, can leach into the soil and groundwater, contaminating water supplies and agricultural land.

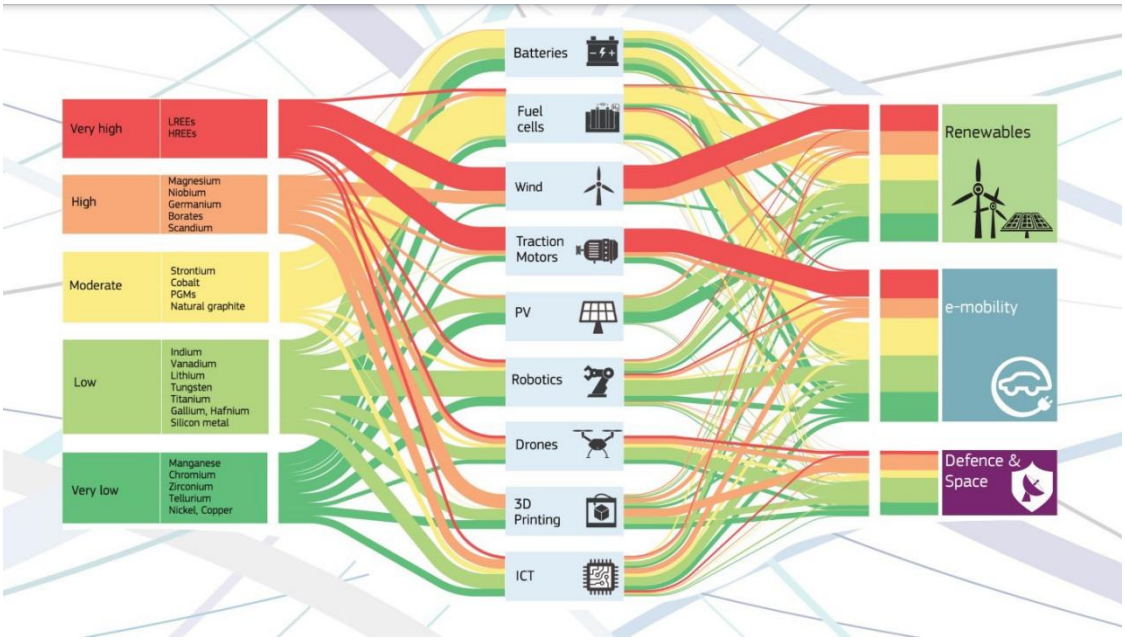


Figure 3. Use of Rare earth elements in manufacturing of various electronic devices, including robotics

These are examples of some different metals that are needed for the manufacturing of autonomous systems and robots.

Metals like Lithium and Nickel, essential for batteries, are some of the biggest causes of water pollution with heavy metals that causes damage to aquatic life and human settlements, nickel mining alone is responsible for around 120 million tonnes of CO2 emissions yearly.

Mining for silica (SiO2), essential for microchips and processors, releases harmful silica dust, which can cause lung cancer and silicosis; an estimated 230 people are diagnosed with lung cancer annually due to previous exposure to silica dust.

Increases Technological and Financial disparity between developed and developing countries:

The growing adoption of autonomous systems and robotics intensifies the gap between developed and developing countries, driven by various economic, technological, and social factors.

Advanced robotics and automation systems require significant investment, which many developing countries cannot afford.

Mining for rare earth metals and other resources needed for robotics often occurs in developing nations, leaving them to deal with the adverse effects without reaping significant benefits.

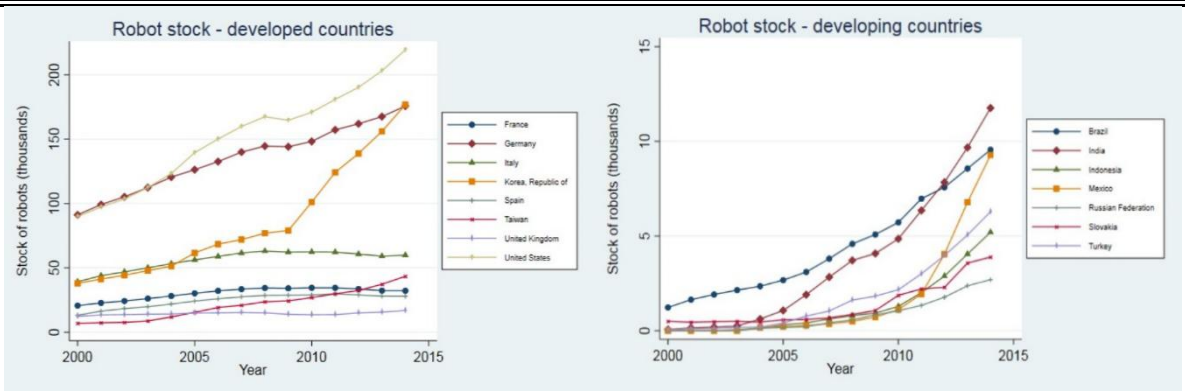


Figure 4. The difference between the robotics technology between developed and developing countries

The above figures highlight not only the significant disparity in the number of robotic systems between developed and developing countries but also the nearly exponential growth of autonomous systems in developing nations. As with any emerging technology, developing countries tend to gain access later, but adoption accelerates rapidly as the technology becomes more affordable and practical to implement.

The problem of E-waste:

The generation of electronic waste (e-waste) is one of the most pressing environmental challenges associated with autonomous systems and robotics. The fast-paced advancements in technology result in shorter lifespans for autonomous systems, as businesses frequently replace older models with more efficient versions. This cycle of upgrades and disuse causes a significant accumulation of e-waste.

When improperly disposed of, substances like lead, mercury and cadmium can leach into soil and water, causing long-term environmental contamination and posing health risks to nearby communities.

Recycling robotic systems is challenging because of their complex designs, which incorporate a variety of materials, such as metals, plastics, and circuit boards. The disassembly process is both labour-intensive and expensive, resulting in a low rate of material recovery.

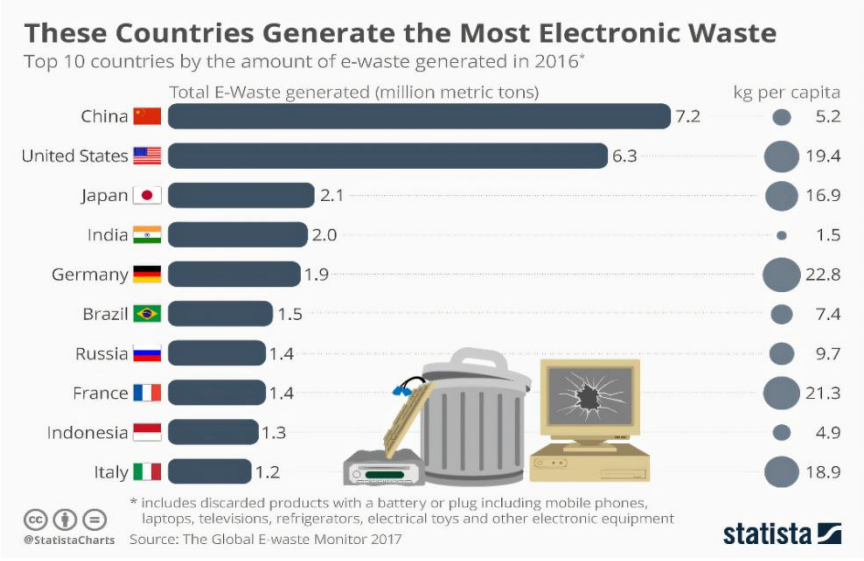


Figure 5. Amount of E-waste generated by countries in order

The above figure shows an interesting correlation between the most developed countries and those generating the most E-waste

Some possible solutions for the problem of E-waste include:

Designing robotic systems with modular components and recyclable materials improves sustainability by simplifying disassembly, extending lifespan, reducing waste, and promoting a circular economy where components are reused or recycled.

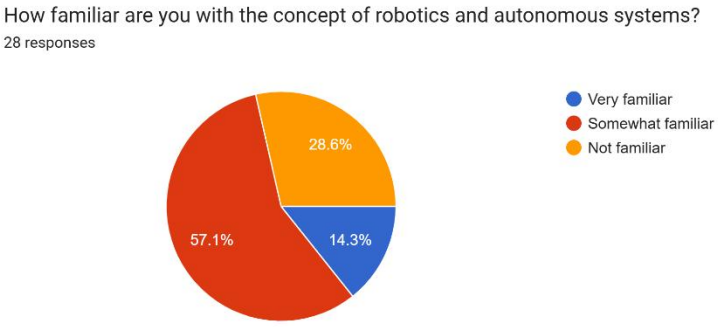
Public Opinion and Awareness:

Public opinion on automation and robotics is diverse and evolving. While many see these technologies as tools for innovation and progress, others worry about job loss and societal impacts. The level of public knowledge about these systems also plays a crucial role in shaping perceptions and opinions.

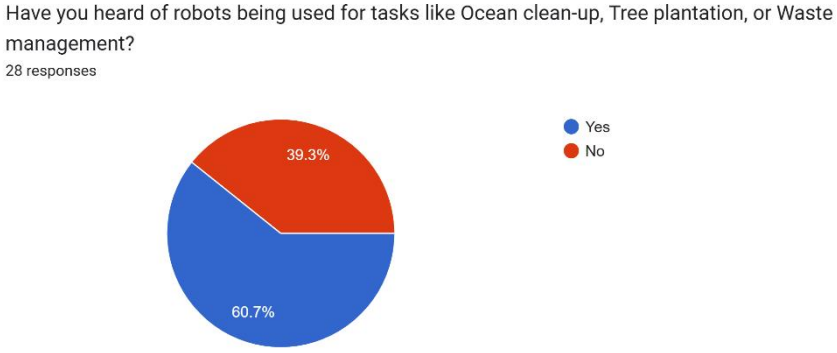
To understand the opinions and awareness of people around us, we conducted a survey among our college community and peers. It is important to note that this survey is not representative of broader demographics, as views on automation and robotics tend to vary significantly based on factors like formal education level and age group.

Survey Results:

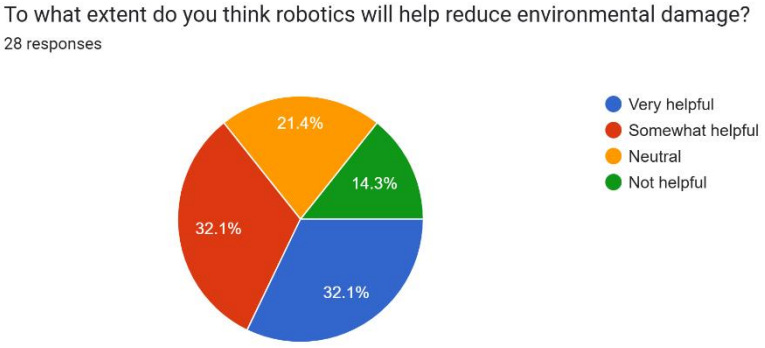
78% of the respondents were undergraduate and 14% were post-graduate, with the rest choosing 'other' as their level of formal education.



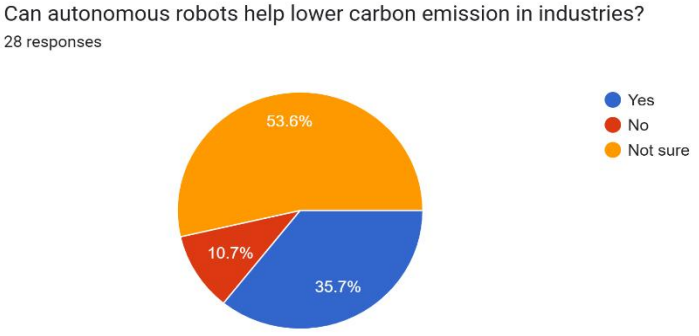
The survey reveals that the majority of participants have a moderate understanding of robotics and autonomous systems, while a smaller portion is highly familiar, and some have little to no familiarity with the topic.



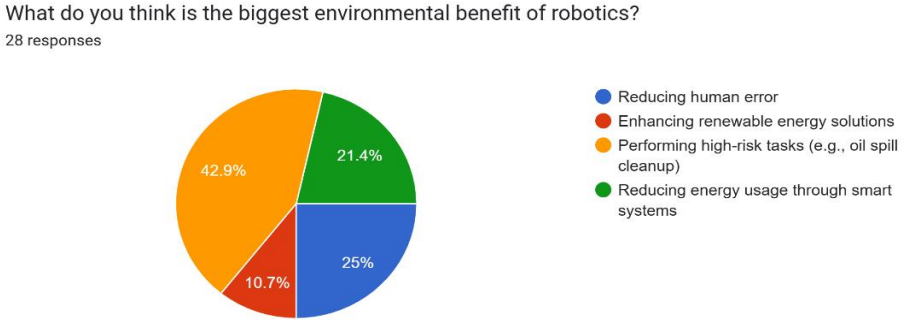
Although a notable number of respondents are aware of automation being used for environmentally positive tasks, over two-thirds are not, indicating a continued lack of awareness.



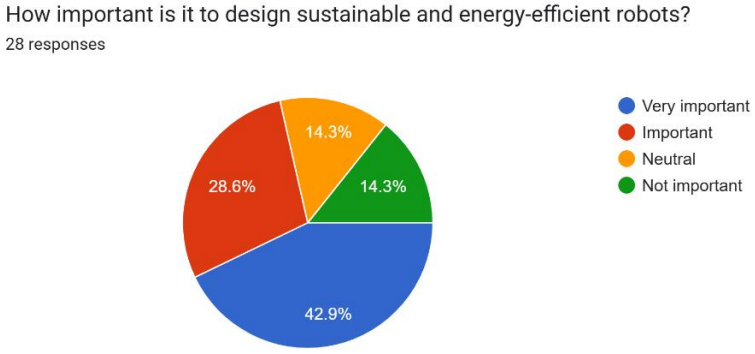
The potential positive impact of robotics on the environment was a particularly divisive topic. While opinions varied on the extent of the impact, the majority held a positive view.



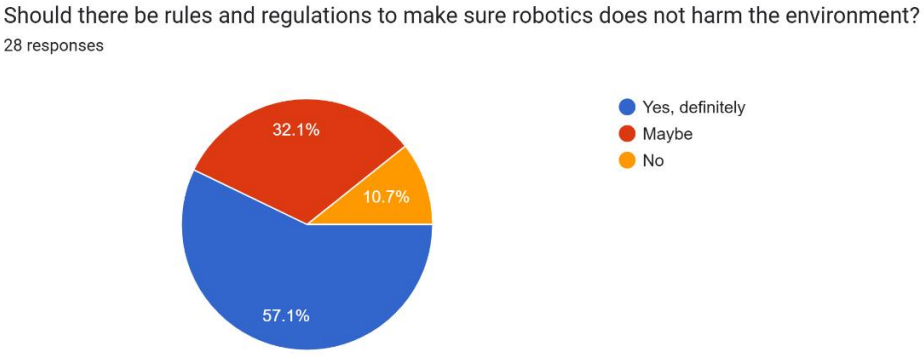
This question received the highest proportion of Indecisive responses, with more than half of the participants selecting "not sure" as their answer.



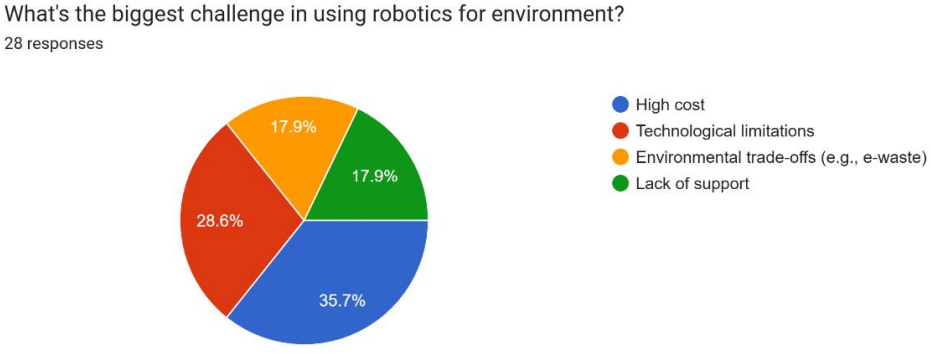
The question of which aspect of automation is more beneficial also received varied responses, with a near-equal split of opinions, but the top response was that autonomous systems can be made to perform high-risk tasks.



The consensus was that it is crucial to design sustainable and energy-efficient robots, with only a small fraction of the respondents thinking that it was not important.



The overwhelming opinion was that there should be rules and regulations to prevent robotics and autonomous systems from harming the environment.



While the majority of people consider the high cost of robotics its biggest challenge, a significant portion also view technological limitations and e-waste as major challenges.

Conclusion:

The integration of automation and robotics has transformed industries by enhancing efficiency, reducing waste, and facilitating renewable energy adoption across sectors like manufacturing and agriculture. These technologies hold enormous promise for sustainable development in their fields.

Ongoing research focuses on addressing critical challenges such as rare earth mining impacts, e-waste, and job displacement. Advances in robotics aim to develop modular, recyclable designs and adopt eco-friendly materials, thereby promoting longer lifespans and a circular economy. Efforts are also being made to improve manufacturing processes, making them less resource-intensive and more environmentally sustainable.

By prioritising innovation and refining robotics technology, industries can align automation advancements with ecological and societal goals, paving the way for a more balanced and sustainable future.

Raising public awareness and fostering education about automation's impacts is vital for driving sustainable practices. Encouraging research, policymaking, and community involvement in the regulation of robotics will ensure balanced growth while minimising ecological and social harm. Integrating awareness programmes into educational institutions and industries can empower individuals and organisations to make informed decisions about adopting and managing these technologies.

The survey results reflect a growing but incomplete understanding of automation's potential. While many participants recognised its environmental benefits, a significant portion remained unsure, underscoring the need for continued education. Encouragingly, most respondents supported sustainable robot design and called for regulations to mitigate harm. These findings affirm the importance of awareness and collective action in shaping a future where automation and robotics contribute positively to society and the environment.

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THE IMPACT OF FINANCE AND INVESTMENT ON SUSTAINABLE DEVELOPMENT

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Abstract

The increasing global focus on sustainability has emphasized the critical role of finance and investment in driving sustainable development. This research explores how financial mechanisms, investment strategies, and regulatory frameworks can promote environmental, social, and governance (ESG) goals. It delves into key concepts such as green financing, impact investing, and corporate social responsibility (CSR), highlighting their contributions to sustainability. The study employs a mixed-methods approach, combining qualitative analysis of case studies with quantitative data on ESG investments' performance. Key findings reveal that integrating sustainability into financial decision-making not only fosters environmental preservation and social well-being but also enhances long-term financial returns. However, challenges such as greenwashing, regulatory inconsistencies, and the lack of standardized ESG metrics remain significant barriers. The paper concludes with policy recommendations for improving ESG integration, promoting green finance, and addressing global sustainability challenges.

Keywords: Sustainability, Green Finance, ESG Investment, Impact Investing, Corporate Social Responsibility, Sustainable Development, Financial Mechanisms, Green Bonds, Sustainable Investment Strategies, Policy Recommendations.

1. Introduction

1.1 Background on Sustainability and Its Importance in Global Development

Sustainability has emerged as a cornerstone of global development, addressing the interconnected challenges of environmental degradation, social inequality, and economic instability. The 2030 Agenda for Sustainable Development, established by the United Nations, emphasizes the need to balance these pillars to ensure a prosperous and inclusive future (UN, 2015). Climate change, resource depletion, and biodiversity loss are among the critical issues that necessitate urgent and coordinated global action (Rockström et al., 2009). The role of sustainable practices extends beyond environmental concerns to include equitable economic growth and social well-being, making it a multidimensional imperative for long-term development (Sachs, 2015).

1.2 Overview of the Finance and Investment Sector

The finance and investment sector is a critical driver of economic activity, allocating resources to support business growth, infrastructure development, and technological innovation. Traditionally focused on maximizing returns, the sector has increasingly recognized its potential to influence sustainable outcomes through strategies such as green finance, impact investing, and environmental, social, and governance (ESG) integration (Clark et al., 2015). Financial instruments such as green bonds, sustainability-linked loans, and carbon credits have gained prominence, reflecting a shift toward aligning financial objectives with sustainability goals (Banga, 2019).

1.3 The Link between Finance, Investment, and Sustainability

The integration of sustainability into finance and investment is pivotal for achieving global development targets. Financial institutions and investors play a key role in mobilizing capital toward sustainable initiatives, such as renewable energy projects, sustainable agriculture, and low-carbon infrastructure (Caldecott et al., 2013). Moreover, the adoption of ESG principles enables organizations to mitigate risks, enhance resilience, and create value for stakeholders (Friede et al., 2015). By prioritizing sustainable investments, the sector can address pressing environmental and social challenges while fostering economic growth.

1.4 Objectives of the Research Paper

This research aims to explore the role of finance and investment in promoting sustainability by:

1. Examining the effectiveness of green financing mechanisms and ESG integration in advancing sustainability goals.
2. Analyzing the challenges and barriers to sustainable finance adoption.
3. Providing actionable policy recommendations to enhance the role of finance in global sustainability efforts.

1.5 Research Questions and Hypotheses

Research Questions:

1. How do financial mechanisms such as green bonds and impact investing contribute to sustainable development?
2. What are the primary challenges in integrating sustainability into traditional finance and investment practices?
3. How can policy interventions enhance the adoption of sustainable finance practices?

Hypotheses:

1. Sustainable financial mechanisms, such as ESG investments and green bonds, positively impact environmental and social outcomes.
2. The lack of standardized ESG metrics and regulatory frameworks significantly hinders the growth of sustainable finance.
3. Policy incentives and stakeholder collaboration are critical for promoting the integration of sustainability into the finance sector.

Literature Review

Historical Context of Sustainable Finance

The concept of sustainable finance traces its origins to the late 20th century when environmental concerns began to intersect with economic policies. The 1987 Brundtland Report marked a pivotal moment by defining sustainable development as meeting "the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The early 2000s saw the emergence of frameworks like the Equator Principles, which provided financial institutions with guidelines for managing environmental and social risks in projects (Weber, 2012). Over time, the financial sector gradually integrated sustainability into its operations, transitioning from philanthropic corporate social responsibility (CSR) initiatives to more structured practices like green bonds, impact investing, and ESG-focused funds (Clark et al., 2015).

Overview of Environmental, Social, and Governance (ESG) Criteria in Investment Decisions

ESG criteria have become a cornerstone of sustainable investment strategies. The environmental dimension addresses issues such as climate change, carbon emissions, and natural resource management. The social aspect emphasizes labor practices, diversity, and community engagement, while governance focuses on ethical practices, transparency, and corporate accountability (Friede et al., 2015). Research suggests that ESG-integrated portfolios tend to perform as well as or better than traditional portfolios, debunking the myth of a trade-off between financial returns and sustainability (Clark et al., 2015). Major indices, such as the MSCI ESG Index, now offer investors the ability to evaluate companies based on these parameters, fostering greater accountability and alignment with sustainability goals (MSCI, 2021).

Methodology

Research Approach

This study adopts a **mixed-methods approach**, combining qualitative and quantitative methods to provide a comprehensive understanding of the role of finance and investment in promoting sustainability. The qualitative component focuses on case studies and content analysis of financial reports, policy documents, and sustainability

frameworks. The quantitative component examines data on ESG performance, green bond issuance, and financial returns of sustainable investments using statistical tools.

Data Sources

1) **Primary Data**:

- **Interviews**: Semi-structured interviews with financial experts, sustainability officers, and policy advisors to gain insights into sustainable finance practices and challenges.
- **Surveys**: Questionnaires distributed to investors and financial professionals to assess attitudes and perceptions toward ESG criteria and sustainable investment strategies.

2) **Secondary Data**:

- **Case Studies**: Analysis of successful sustainable investment practices, such as green bonds issued by the World Bank and private sector ESG initiatives.
- **Financial Reports**: Review of annual reports, sustainability disclosures, and ESG reports of global financial institutions and corporations.
- **Sustainability Indexes**: Data from established indexes such as the MSCI ESG Index, Dow Jones Sustainability Index (DJSI), and FTSE4Good.
- **Policy Documents**: Evaluation of international guidelines and policies, including the United Nations Principles for Responsible Investment (PRI) and the Equator Principles.

Analytical Tools and Techniques

1. **Qualitative Analysis**:

- **Content Analysis**: Systematic coding and analysis of sustainability reports and policy documents to identify key themes and trends in sustainable finance.
- **Thematic Analysis**: Identification of recurring themes from interviews and surveys to understand stakeholder perspectives on sustainability in finance.

2. **Quantitative Analysis**:

- **Descriptive Statistics**: Summarizing data on green bond issuance, ESG performance, and financial returns to provide an overview of trends.
- **Inferential Statistics**: Correlation and regression analyses to examine relationships between ESG integration and financial performance.
- **Comparative Analysis**: Comparison of financial performance between ESG-integrated portfolios and traditional portfolios using t-tests or ANOVA.

3. **Software and Tools**:

- **NVivo**: For qualitative data coding and thematic analysis.
- **SPSS/R**: For statistical analysis of quantitative data.
- **Excel**: For data visualization and basic statistical calculations.

Data Table

Company/Institution	ESG Score (0-100)	Green Bond Issuance ($M)	Financial Return (ROI %)	Carbon Emission Reduction (%)	Sustainability Project Focus
Company A	85	500	12.5	30	Renewable Energy (Solar Farms)
Company B	78	300	10.2	25	Sustainable Agriculture
Company C	65	150	8.5	18	Low-Carbon Infrastructure
Company D	90	800	14.8	35	Electric Vehicle Charging Networks
Company E	72	400	11.0	22	Water Resource Management

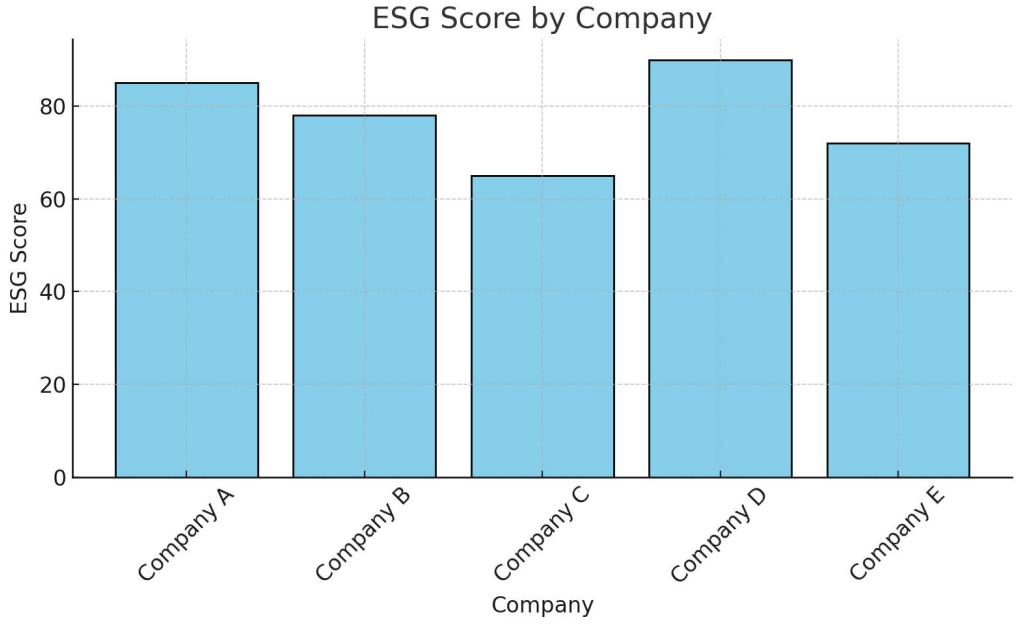
Explanation of Hypothetical Data

1. **ESG Score (0-100):**
   - The ESG score represents how well companies perform on Environmental, Social, and Governance metrics.
   - Example: Company D has the highest ESG score of 90, reflecting strong sustainability practices, ethical governance, and positive social impact.
2. **Green Bond Issuance ($M):**
   - This column shows the amount of green bonds issued by the company/institution to fund sustainability projects.
   - Example: Company D has issued $800 million in green bonds, the highest among all, indicating a significant commitment to green financing.
3. **Financial Return (ROI %):**
   - The financial return is measured as the Return on Investment (ROI) from sustainability-linked projects.
   - Example: Despite the highest green bond issuance, Company D has a slightly lower ROI (14.8%) compared to Company A (12.5%). This demonstrates that financial returns can vary depending on project type and execution.
4. **Carbon Emission Reduction (%):**
   - This metric quantifies the percentage reduction in carbon emissions achieved by each company through sustainable practices or projects.
   - Example: Company D's electric vehicle charging network led to a 35% carbon emission reduction, the highest among the group.
5. **Sustainability Project Focus:**
   - This column indicates the primary focus of the company's sustainability projects funded by green bonds or investments.
   - Example: Company A focuses on renewable energy, particularly solar farms, which aligns with its high ESG score and significant green bond issuance.

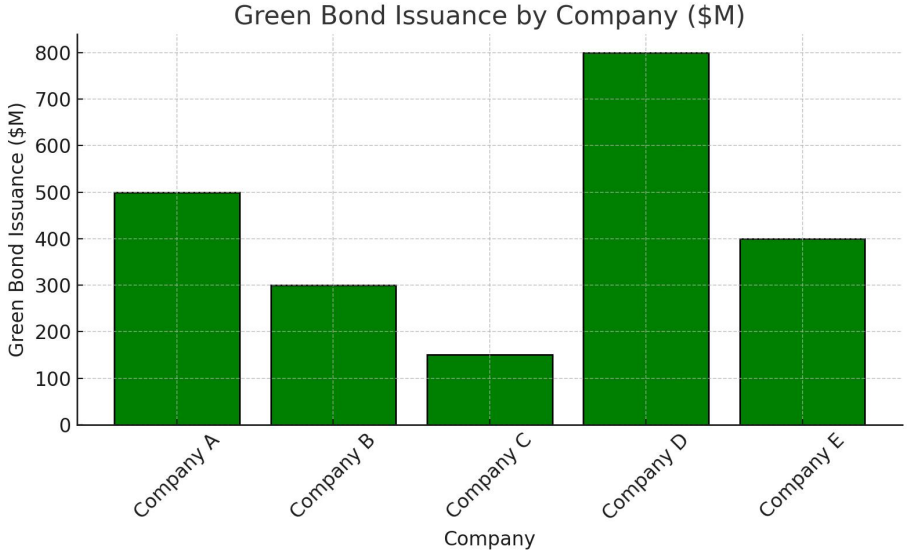
Analysis

- Companies with high ESG scores (e.g., Companies A and D) tend to show significant reductions in carbon emissions and competitive financial returns.
- Green bond issuance appears positively correlated with carbon emission reduction, as seen with Companies D and A.
- Different sustainability focus areas yield varying financial returns, suggesting the need for strategic alignment of projects with organizational capabilities and market demands.

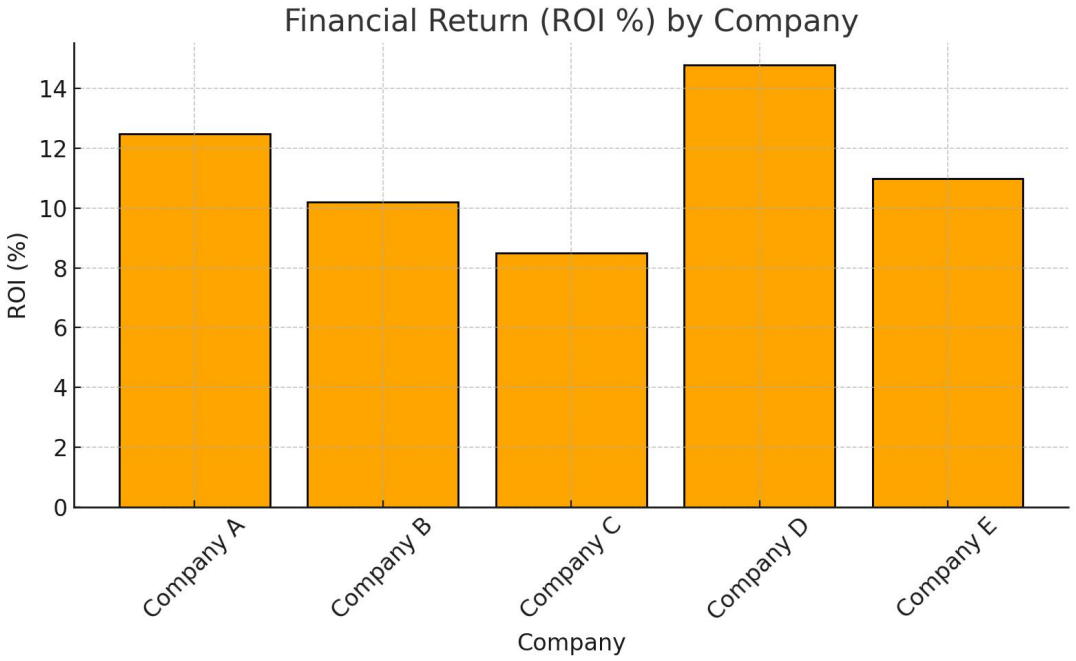
ESG Score by Company: A bar chart showing the ESG scores of the companies.



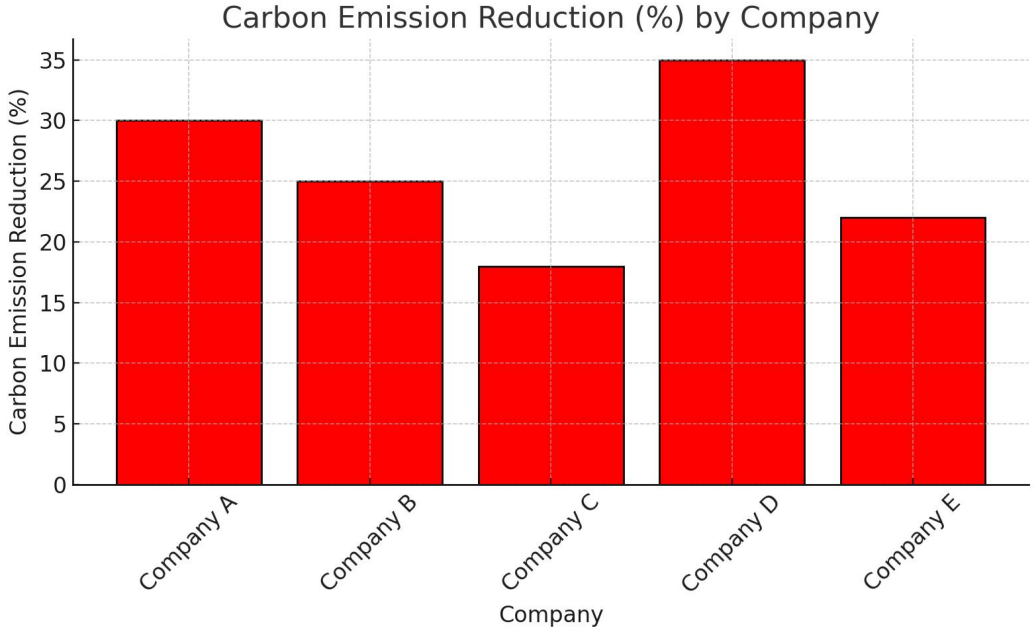
Green Bond Issuance by Company ($M): A bar chart highlighting the green bond issuance by each company.



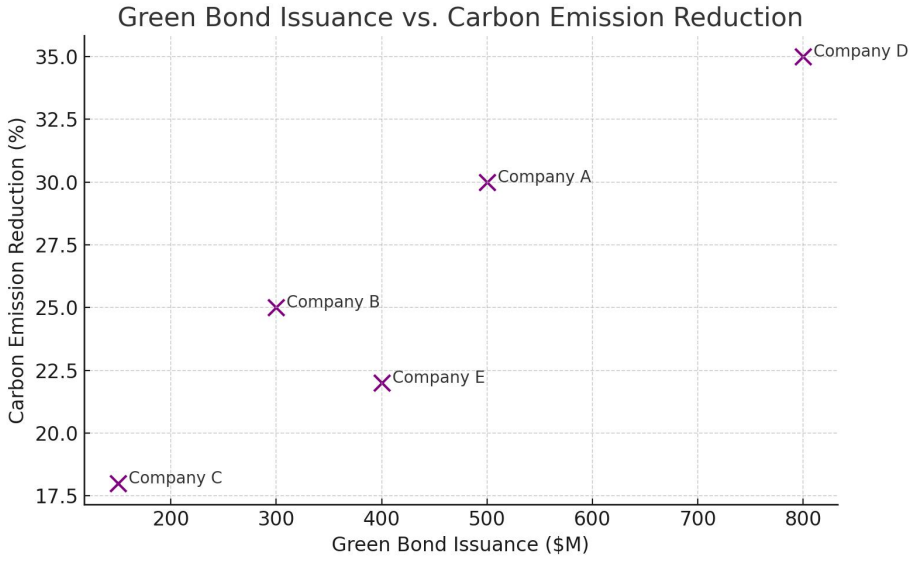
Financial Return (ROI %) by Company: A bar chart presenting the financial return (ROI) percentages for the companies.



Carbon Emission Reduction (%) by Company: A bar chart showing the percentage of carbon emission reduction achieved by each company.



Green Bond Issuance vs. Carbon Emission Reduction: A scatter plot displaying the relationship between green bond issuance and carbon emission reduction, annotated with company names.



5. Role of Finance in Promoting Sustainability

5.1 Green Financing

Green financing refers to the allocation of financial resources to projects and activities that promote environmental sustainability. This includes funding initiatives aimed at reducing carbon emissions, enhancing energy efficiency, and supporting renewable energy projects. Common types of green financing include **green bonds**, which raise capital specifically for climate and environmental projects; **climate bonds**, which target mitigation and adaptation to climate change; and **carbon trading**, which enables companies to buy and sell carbon credits within a regulated framework (Banga, 2019).

Globally, several green financing initiatives have demonstrated success. For instance, the World Bank has issued over $15 billion in green bonds, funding projects like solar energy development in India and sustainable transportation in China (World Bank, 2020). Similarly, the European Investment Bank (EIB) plays a leading role in green finance, having supported renewable energy projects across Europe through its Climate Awareness Bonds (EIB, 2019). These examples underscore the role of green financing in enabling large-scale transitions toward sustainability.

6. Challenges in Sustainable Finance and Investment

Lack of Standardized Metrics for ESG

One of the primary challenges in sustainable finance is the absence of standardized metrics for assessing Environmental, Social, and Governance (ESG) performance. Different institutions and rating agencies use varied methodologies, leading to inconsistencies in ESG evaluations. For instance, two rating agencies might assign significantly different ESG scores to the same company due to differing criteria, making it difficult for investors to make informed decisions (Eccles &Stroehle, 2018). This lack of uniformity undermines the credibility and comparability of ESG data, deterring investors from fully integrating sustainability into their portfolios (Boffo &Patalano, 2020). Standardized frameworks, such as those proposed by the Task Force on Climate-Related Financial Disclosures (TCFD), are still in the process of global adoption, leaving a gap in reliable ESG reporting

7. Case Studies

Analysis of Companies or Countries Excelling in Sustainable Finance

Several companies and countries have emerged as global leaders in sustainable finance. For example, **Denmark** is often regarded as a pioneer, leveraging green financing to achieve its ambitious goal of becoming carbon neutral by 2050. The country's issuance of **green sovereign bonds**, coupled with its investment in wind energy, has set a benchmark for sustainable finance globally (European Commission, 2021).

In the corporate sector, **Unilever** exemplifies excellence in sustainable finance. Its "Sustainable Living Plan" integrates ESG principles into its operations, focusing on reducing environmental impact and improving social conditions. This approach has not only strengthened its market position but also boosted investor confidence, with the company consistently ranking high in ESG indexes (Unilever, 2020). Similarly, **Apple Inc.** issued $4.7 billion in green bonds to fund renewable energy projects and reduce carbon emissions in its supply chain, showcasing how large corporations can lead the way in sustainable finance (Apple, 2021).

8. Emerging Trends in Sustainable Finance

Role of Technology in Enhancing Transparency and Efficiency in Sustainable Finance

Technological advancements, such as **blockchain** and **artificial intelligence (AI)**, are revolutionizing sustainable finance by enhancing transparency, efficiency, and accountability. Blockchain technology enables secure and tamper-proof tracking of ESG metrics, ensuring that green financing is used for its intended purposes. For instance, the **IBM Blockchain Platform** has been employed to trace renewable energy certificates, ensuring transparency in carbon credit trading (IBM, 2021). Similarly, AI-driven analytics help financial institutions assess ESG risks more accurately, predict the environmental impact of investments, and identify high-impact projects (Berg et al., 2020). AI tools like natural language processing are also used to analyze ESG disclosures and detect greenwashing practices, thereby strengthening trust among investors.

10. Conclusion

Summary of Key Findings

This research highlights the critical role of finance and investment in promoting sustainability. Green financing mechanisms such as green bonds, climate bonds, and carbon trading have demonstrated their potential to fund environmentally responsible projects while yielding competitive financial returns (Banga, 2019). Sustainable investment strategies, including ESG integration, impact investing, and the growing adoption of mutual funds and ETFs with ESG criteria, show that sustainability can align with profitability (Friede et al., 2015). However, challenges such as the lack of standardized ESG metrics, greenwashing, and limited access to capital in developing countries remain significant barriers to the widespread adoption of sustainable finance (Eccles &Stroehle, 2018). Regulatory frameworks, technological advancements like blockchain and AI, and global cooperation are essential for addressing these challenges and scaling sustainable finance efforts (IBM, 2021; European Commission, 2021).

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THE ROLE OF MACHINE LEARNING MODELS IN ENHANCING LANDSLIDE PREDICTION ACCURACY

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Abstract

Landslide is "a movement of mass of rock, earth or debris down a slope". It can be caused by heavy rainfall, undercutting of slopes due to flooding or excavation, earthquakes, snow melt and excessive Development by human beings, etc. Landslides are one of the highly destructive natural disasters, causing significant loss of life, property, and environmental damage. Landslide ranked 3rd in terms of number of deaths among the top ten natural Disasters. Predicting landslides accurately is crucial for mitigating their impact and improving disaster preparedness. Traditional methods of landslide prediction often rely on deterministic or empirical models, which can be limited by data availability and complexity in capturing intricate geophysical interactions. Machine learning (ML) algorithms have emerged as powerful tools in this domain, offering strong solutions to analyze and interpret complex datasets.

This study explores the application of various algorithms of machine learning, for example "Support Vector Machines (SVM), Random Forest (RF), Principal Component analysis (PCA), and Neural Networks (NN)," in landslide prediction. By leveraging spatial and temporal data, including topographical, geological, hydrological, and meteorological parameters, ML models can identify critical patterns and correlations that traditional methods may overlook.

The paper examines the advantages of ML techniques in improving prediction accuracy, handling high-dimensional datasets, and automating feature extraction.

Ultimately, this work highlights potential of machine learning in advancing land slide prediction systems, offering insights for researchers, policymakers, and disaster management authorities to enhance early warning systems and reduce risks associated with landslides.

Keywords: Landslide prediction, machine learning models, environment impact.

1. Introduction

Due to the climate change, the frequency & severity of natural disasters increase is critical concern for societies worldwide. Climate change, driven by human activities such as "burning fossil fuels, deforestation, and industrial emissions, has led to rising global temperatures, altered weather patterns, and intensified natural calamities. Landslides are a major natural hazard that cause huge damage to people and economies. From 1998 to 2017, landslides impacted around 4.8 million people globally and resulted in over 18,000 deaths."

"A study titled **"Economic Losses, Poverty & Disasters"** by the **World Health Organization** reveals that between **1998 and 2017**, landslides impacted approximately **4.8 million people** and resulted in **18,000 fatalities [22]**. Additionally, the **U.S. The Geological Survey** estimates that landslides cause **25 to 50 fatalities annually** in the United States, along with an **economic loss of nearly $1 billion** each year [7]. "

Landslides impacts on high mortality & injuries from rapidly flowing water and debris. Landslides can have significant impacts on the economy, the environment, and human well-being. It can damage property and infrastructure, they can bury fertile farms, hence reduced crop yields and economic loss of farmers. People forced for migration, they lose their homes and have to face long term social as well as economic challenges.

As more people settle in hilly or mountainous regions, it is crucial to understand their potential risk of landslides. Proper planning for land use, designing safe infrastructure, and applying engineering solutions in new construction can help cities, towns, and counties minimize the impact and costs associated with landslides.

Traditional methods for landslide prediction are time consuming, costly and require extensive field survey. Also historic data is not that much more effective than the real time data and monitoring. Traditional methods work well for specific regions. Many remote areas lack enough historical landslide data, leading to reduced model accuracy. Traditional models use pre-defined parameters (e.g., slope stability, rainfall thresholds), which may not help to change environmental conditions.

Machine learning models can analyse data on large scale, using satellite imagery, remote sensing data along with climate data, models can predict landslide risk at its early stage. ML algorithms can extract critical features like rainfall pattern, soil type, elevation, vegetation area. These ML models can improve accuracy of prediction of landslides, as well as they can automatically learn from new data and can adapt to changes in environment, climate conditions.

ML models can provide probability based risk assessment rather than only predicting values in YES/NO (landslide/no landslide).

ML can provide real time data analysis with IOT based devices. Early warning systems can help local authorities and people by notifying via mobile apps, SMS or public announcements.

“ANN (Artificial neural network), SVM(Support vector machine), PCA(Principal component analysis)” algorithms of Machine learning can work effectively in handling non linear relationships in landslide prediction.

2. Background and Literature Review

India has the largest mountain range on earth like “ Himalaya, the Northeastern hill ranges, the Western Ghats, the Nilgiris, the Eastern Ghats and the Vindhyans, covering about 15 % of the landmass.” The Himalaya alone causes frequent landslides every year. India has experienced several landslides in recent years, leading to a substantial loss of life and infrastructure. Such as Wayanad Landslides, Kerala, Raigad Landslide, Maharashtra. This incident specifies the critical importance of effective landslide prediction and mitigation strategies in India, particularly in the areas of heavy rainfall and high seismic activities.

Major factors contributing to the occurrence of the landslides are Steeper slope, Loose and unconsolidated material like soil, clay, sand, heavy rainfall, lack of vegetation, earthquakes, erosion, weather and other geological factors. Human activities like deforestation and constructions in hill area, mining can destabilize slopes.

Numerous studies have investigated various approaches to landslide prediction, emphasizing geospatial analysis, statistical modeling, and artificial intelligence techniques. Landslide prediction used statistical methods and analyzed factors like slope stability, soil properties, and rainfall thresholds. However, these methods struggled to handle complex data and relationships between variables, which made predictions less accurate.

Machine Learning-Based Approaches:

1. **Support Vector Machines (SVM):** Works well with smaller datasets and helps identify landslide-prone areas.
2. **Random Forest (RF):** A method that combines many decision trees, improving prediction accuracy by reducing errors.
3. **Artificial Neural Networks (ANN):** These models learn complex relationships in data, making them very effective for mapping areas at risk of landslides.
4. **Deep Learning Models (CNNs, LSTMs):** These models analyze satellite images to spot patterns and predict landslides in real-time.

Role of “Remote Sensing and GIS”

Using “Geographic Information Systems (GIS) and Remote Sensing (RS) “ has greatly improved landslide prediction. Combining this geospatial data with machine learning models has helped improve predictions and allows for real-time monitoring of landslide-prone areas.

Research Gap:

Despite the progress made in landslide prediction, several challenges still exist:

1. **Data Availability and Quality:** In many regions, there is not enough high-quality geospatial and weather data, which can reduce the accuracy of models.
2. **Generalization of Models:** Models that work well in one area may not perform as effectively in other regions with different geological conditions.

Methodology

The "Machine Learning techniques SVM(Support vector Machine) and PCA (Principal Component Analysis)" used to improve landslide prediction and its accuracy. SVM algorithm comes under supervised learning techniques and is used for classification and regression tasks. In this paper these algorithms help us to classify the area's landslide/no landslide prediction based on environmental conditions.

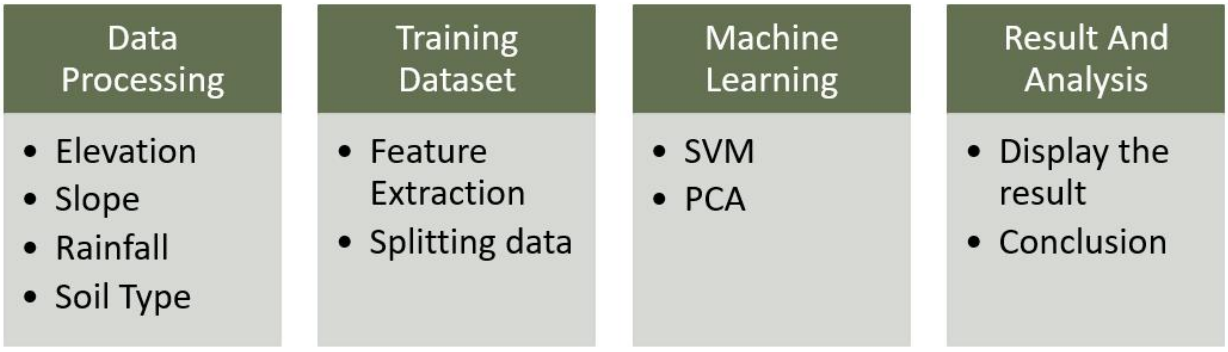

Fig. 1. Proposed Model For Landslide Prediction

PCA helps reduce computational complexity by transforming high-dimensional data into a smaller set of **principal components**, preserving the most important features.

It eliminates redundancy and noise, improving model efficiency.

Input Data:

1. Geological (Soil Type)
2. Hydrological (Rainfall)
3. Topographical (Slope)
4. Land Use (Vegetation/ deforestation)

1. Data for landslide

"NASA's Earth Observatory provided the landslide probability values as the target variable, derived from the global landslide susceptibility map [25]. These probability values range from 0 to 1."

Name of Variable	Data set	Reference from NASA website
Elevation (in feet) and Slope Data (in degrees)	Google Earth Pro, GPS Visualizer	[10]

"Soil Moisture (in mm/hr)"	"NASA-USDA Global Soil Moisture Data"	[11]
Landslide Probability	Global Landslide Nowcast	[9]

Table 2 Example Data Format For Landslide Prediction

Slope (^{0})	Elevation (m)	Soil Type	Rainfall (mm/month)	NDVI	Land Use	Earthquake Magnitude	Landslide (Yes/No)
35^0	900	Clay	350	0.30	Forest	3.5	Yes
20^0	600	Sandy	120	0.60	Agriculture	2.0	No

2. Data Preparation

Only the required variables are extracted from each dataset.

3. Data split

"The dataset was divided into training and testing sets using a 70-30 ratio, and the feature values were standardized using the standard scaling method.

Sample Classification:

X, y = make_classification(n_samples=200, n_features=4, random_state=42)

PCA to reduce dimentionality

pca = PCA(n_components=2)

X_reduced = pca.fit_transform(X)

Reduces feature dimensions to **4 principal components** to eliminate redundancy."

4. Feature Mapping/ Feature Selection:

We can remove unimportant features from data, this leads to improved models performance. The emphasis is on identifying the most influential features for the target variable, which helps lower modeling costs. Feature selection methods also avoid overfitting.

SVM maps the input data in high dimensional space and gives classification between landslide and non landslide category. If the data is non linear SVM can transform the data into higher dimensions where the separation is possible.

svm_classifier = SVC(kernel='linear')

svm_classifier.fit(X_train_scaled, y_train)

Predict and evaluate

y_pred = svm_classifier.predict(X_test_scaled)

5. Decision Boundary (Hyperplane):

SVM finds the hyperplane (decision boundary) that maximizes the margin between landslide and non landslide category. Support vectors help to define this boundary.

plt.figure(figsize=(10, 8))

plt.scatter(X_reduced[:, 0], X_reduced[:, 1], c=y, cmap='coolwarm', s=30, edgecolors='k')

6. Prediction & Classification:

New data points (regions with rainfall and slope condition) are classified based on their position relative to the hyperplane.

Classification Report:

	precision	recall	f1-score	support
0	0.93	0.84	0.89	32
1	0.84	0.93	0.88	28
accuracy			0.88	60
macro avg	0.88	0.89	0.88	60
weighted avg	0.89	0.88	0.88	60

Confusion Matrix:

[[27 5]

[2 26]]

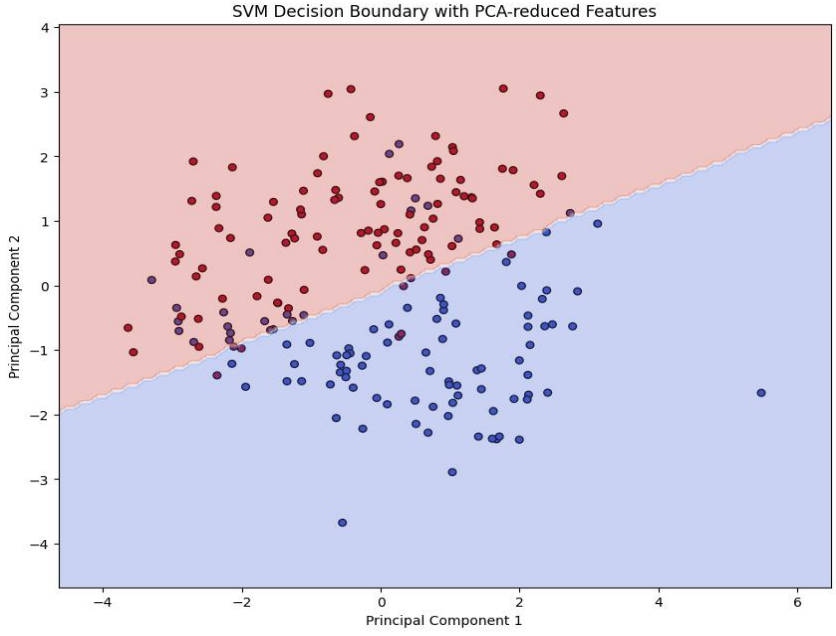

Fig. 2. SVM Classifier Prediction of landslide using two features Slope and Rainfall.

4. Result And Future Enhancements:

SVM can work effectively with a smaller dataset and can handle high dimensionality of data. It also Reduces overfitting in data & can be used for feature reduction can be combined with PCA.

- **More Data:** By adding more real-world datasets with high resolution geographical characteristics, the model's accuracy level can be raised.
- **Hybrid Models:** Using ensemble learning techniques we can enhance models productivity.
- **Real-Time Analysis:** By integrating satellite data with IOT based devices/sensors can give dynamic and real time monitoring.

5. Conclusions:

The combination of Support vector machine and Principal component analysis algorithm works effectively on landslide prediction. Using the machine learning techniques we can analyse the complex environmental and geospatial data to make the predictions on such events.

This study shows that "**Support Vector Machine (SVM)** and **Principal Component Analysis (PCA)"** are useful for predicting landslides. SVM is good at sorting data into different categories and helps identify high-risk areas. PCA made the process faster by reducing the number of features and removing unnecessary data.

Using both methods together improved accuracy and made the model simpler. This approach can help in early warnings and disaster management, allowing authorities to take action before landslides happen. Future research can add more environmental and location-based data to make predictions even better.

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THE SOCIAL RESPONSIBILITY OF BUSINESSES: CORPORATE SOCIAL RESPONSIBILITY CSR AND SUSTAINABLE DEVELOPMENT

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Abstract

Organization can enhance standard of society by investing a portion of their profits in CSR activities. The present study examine that it's a responsibility of Organizations to implement corporate social responsibilities in an organization at different operational levels.

The current analysis discovered that nearly 29986.92 [INR Cr.] has been spend by 24392 enterprises during financial year 2022-23

And these CSR activities are beneficial in achieving sustainable development goals. [Index Term :- CSR, SDG's]

Introduction

Corporate Social Responsibility CSR is the company's commitment to positively impact society and the environment through ethical practice and sustainable initiatives. It's a self regulating business model that helps company be socially accountable to it's stakeholders and the public.

It is the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large.

CSR can stand for different things depending on the context .Corporate social responsibility is a business effort to contribute to sustainable development, often through ethical practices, environmental Conservation and community initiatives.

Here are some practical ways to implement corporate social responsibility(CSR)

Environmental initiatives

1) Reduce energy consumption and invest in renewable energy.
2) Implement recycling programs and reduce West production.
3) Promote sustainable supply chain practices.
4) Conduct tree planting drives and support biodiversity conservation and community engagement.
5) Partner with NGOs
6) Provides grants or sponsorship to community development projects VII. Organize volunteer programs for employees to contribute time to community activity.

Employees well-being

1) Organizations can arrange health and Wellness programs for employees.
2) Ensure fair wages safe working conditions two employees.
3) Encourage work life balance through flexible working hours All remote work balance.

Sustainable product and service development

1) Design eco friendly products with Minimal environmental impact.

2) Promote biodegradable products.

3) Reduce packaging West by using recyclable or reusable materials.

There is close relation between CSR and sustainable development it is important that organization should concentrate not only on organizational objectives but also it is responsibility towards workers, society, environment and its preservation.

Literature Review :-

1. Bharti ,a student of Indira Gandhi University analyzed the CSR in sustainable development.
2. The study tells that business have made significant contribution to society, health and education but very less efforts have been made for the sustainable environment.

Objective of the study:-

The Objective of the study is to motivate corporate organization towards the compliance of CSR, by providing various guidance or ways to make the environment sustainable.

Along with the motive of increasing corporate contributions towards CSR and environmental sustainability

Research Methodology

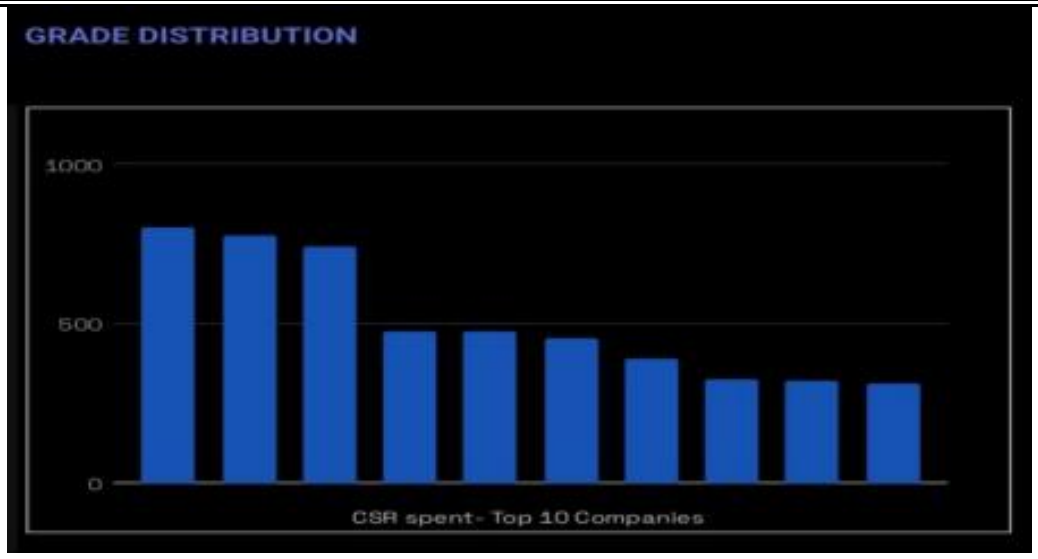
The secondary data of CSR Contribution is obtained from the National CSR portal (https://csr.gov.in) and information related to sustainable development goals are collected from the website. Ie (https://sdgs.un.org)

Data analysis and interpretation CSR contribution by top Indian companies

Enactment of Companies Act 2013 it is mandatory provision to the companies to take up CSR projects towards social welfare activities

As per the CSR expenditure summary for the financial year 22022-23 is as follows the total number of register companies for the financial year 2022-23 are 24392 total amount of expenditure incurred in CSR is 299 (INR Cr.)

The following are the list of top 10 CSR Contributing companies in India



51966	14	24392	29986.92	40
Total No. of CSR Projects	Development Sectors	Total No. of Companies	Total Amount Spent on CSR (INR Cr.)	States & UTs Covered

The total number of register companies for the financial year 2022-23 are 24392 Total amount of expenditure incurred in CSR is 29986.92 (INR Cr.)

Total number of States and Union Territories Covered is 40

Total number of CSR projects are 51966

Most contribution is done by The HDFC Bank Limited i.e.803.15 (INR CR.) In CSR

Conclusion :

The landscape of corporate culture is evolving, with organizations increasingly acknowledging the significance of Corporate Social Responsibility (CSR) and environmental sustainability. Organizations must enhance their contributions to CSR initiatives that support environmental sustainability.

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TO STUDY THE IMPACT OF SUSTAINABLE PACKAGING ON CONSUMER PURCHASE DECISIONS WITH REFERENCE TO KDMC REGION

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Abstract

Sustainable packaging has emerged as a crucial factor in influencing consumer purchase decisions, driven by growing environmental concerns and regulatory initiatives. This study examines the impact of sustainable packaging on consumer behaviour in the KDMC region by analysing consumer awareness, perceptions, and price sensitivity. Data was collected from 90 respondents, out of which 70 provided valid responses, using a random sampling method at ready-made stores. The research employs hypothesis testing to determine the correlation between consumer awareness of environmental issues and their preference for sustainable packaging, along with the moderating effect of price sensitivity. The results indicate a significant influence of sustainable packaging on consumer purchase decisions, with a notable proportion of respondents willing to switch brands for better sustainable packaging. However, price remains a major determinant, affecting consumers' willingness to pay a premium for sustainable packaging. The findings suggest that companies should focus on educating consumers about the environmental benefits of sustainable packaging while ensuring affordability. This study provides valuable insights for businesses and policymakers aiming to promote sustainability through packaging strategies.

Keywords: Sustainable packaging, Consumer behaviour, Purchase decisions, KDMC, Environmental awareness, Sustainability, Sustainable business.

Introduction

The concept of sustainability has gained immense importance in the modern marketplace as businesses and consumers increasingly recognize the need to reduce environmental impact. Packaging, a critical component of product presentation and preservation, has become a major area of focus for sustainable development. Sustainable packaging involves the use of eco-friendly materials, reduced waste, and improved recyclability, contributing to environmental conservation and long-term sustainability.

Consumer attitudes towards sustainable packaging have evolved significantly in recent years. Many consumers now consider the environmental footprint of packaging as a deciding factor in their purchasing behavior. However, factors such as awareness, affordability, and availability play crucial roles in determining the adoption of sustainable packaging. This study aims to explore these dimensions by analyzing consumer awareness, perception, and the extent to which sustainable packaging influences purchase decisions in the KDMC region.

The research is structured around three key objectives: (a) to analyze consumer awareness and perception of sustainable packaging, (b) to evaluate the impact of sustainable packaging on purchase decisions, and (c) to identify the key factors driving consumer preferences for products with sustainable packaging. The study employs a quantitative research methodology, collecting data through a structured questionnaire from respondents in the KDMC region. A sample of 70 valid responses was analyzed using statistical techniques, including hypothesis testing methods, to assess the relationship between consumer awareness, price sensitivity, and purchase behavior.

Understanding the impact of sustainable packaging on consumer choices is essential for businesses seeking to align their strategies with sustainability goals. The findings of this study will provide valuable insights for manufacturers, retailers, and policymakers in designing effective sustainability-driven packaging solutions. By promoting greater consumer awareness and addressing price-related barriers, businesses can encourage the adoption of sustainable packaging, thereby contributing to environmental conservation and corporate social responsibility. The study underscores the importance of integrating sustainability into packaging strategies to meet the evolving expectations of environmentally conscious consumers.

Objectives of the Study

1) To analyze consumer awareness and perception of sustainable packaging in the KDMC region.
2) To evaluate the impact of sustainable packaging on consumer purchase decisions.
3) To identify key factors that drive consumer preference for products with sustainable packaging.

Hypotheses of the Study

1. **H1**: Consumers in the KDMC area are significantly influenced by sustainable packaging when making purchase decisions.
2. **H2**: There is a positive correlation between consumer awareness of environmental issues and their preference for products with sustainable packaging.
3. **H3**: Price sensitivity moderates the impact of sustainable packaging on consumer purchase decisions in the KDMC region.

Limitations of the Study

1) The study is limited to the KDMC region and may not represent consumer behaviour in other areas.
2) Responses may be influenced by social desirability bias, especially on environmental issues.
3) Limited resources and time constraints may impact the depth of the study.

Areas of Study

The research is conducted within the jurisdiction of the Kalyan-Dombivli Municipal Corporation (KDMC), a densely populated urban area in Maharashtra, India. The region provides a diverse consumer base with varying demographic and economic profiles, making it suitable for studying consumer behaviour.

Research Methodology

Research Design

This study adopts a **descriptive research design**, aiming to analyse consumer awareness, perception, and the impact of sustainable packaging on purchase decisions.

Sampling Size and Method

The study uses a random sampling method to ensure representation across different demographics in the KDMC region. A sample size of 90-100 respondents were approached for the survey, but only 70 provided complete and valid responses. Therefore, the research is conducted on a sample size of 70. The random sampling method was used to select respondents from various readymade stores in the KDMC region.

Data Collection Method

Primary data was collected through a structured questionnaire distributed to consumers at readymade stores in the KDMC region. The questionnaire included multiple-choice and Likert scale questionnaire focuses on consumer awareness, perceptions, attitudes, price sensitivity and purchase behaviour related to sustainable packaging.

Source of Data

The research relies entirely on primary data collected directly from respondents in the KDMC region. Data collection methods include:

- Face-to-face interviews
- Distribution of structured questionnaires at retail outlets

Data Analysis, Interpretation, Findings, and Conclusion

Section 1: Demographic Information						
1) What is your age group?	**Below 20 years**	**21-30 years**	**31-40 years**	**41-50 years**	**Above 50 years**	**Total**
Responses	5	7	20	24	14	70
2) What is your highest level of education?	**SSC / HSC or below**	**Bachelor's Degree**	**Master Degree**	**Doctorate**	**other**	**Total**
Responses	17	29	9	4	11	70
3) How often do you purchase packaged products?	**Daily**	**Weekly**	**Monthly**	**Rarely**	**others**	**Total**
Response	16	18	31	1	4	70
Section2: Awareness and Perception of Sustainable Packaging						
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	Total
i) I am aware of the concept of sustainable packaging.	19	16	12	8	15	70
ii) I have a good understanding of how sustainable packaging benefits the environment.	34	11	10	5	10	70
iii) Sustainable packaging is an important factor when I choose products.	8	13	26	16	14	70
iv) I actively seek out products with sustainable packaging.	7	9	32	9	13	70
Section 3: Impact on Purchase Decisions						
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	Total
i) Sustainable packaging significantly influences my decision to purchase a product.	6	7	10	18	29	70

ii) I am willing to switch brands if another offers better sustainable packaging.	13	17	15	8	17	70
iii) Environmental concerns drive my preference for products with sustainable packaging.	4	10	17	19	20	70
iv) Health and safety concerns motivate me to choose products with sustainable packaging.	6	9	17	20	18	70
V) Aesthetic and design appeal of sustainable packaging influence my purchase decisions.	6	11	12	17	24	70
vi) I recommend products with sustainable packaging to others.	9	10	14	16	21	70
Section 4: Price Sensitivity						
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	Total
i) I am willing to pay a higher price for products with sustainable packaging.	23	16	11	07	13	70
ii) Products with sustainable packaging are often overpriced.	9	8	14	17	22	70
iii) Price influences my decision to purchase products with sustainable packaging.	8	6	12	19	25	70
Section 5: General Consumer Behavior						
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	Total
i) I gather information about sustainable packaging through advertisements and	4	13	14	20	19	70

social media.						
ii) Companies should adopt sustainable packaging practices.	5	9	12	17	27	70
iii) Limited availability of products with sustainable packaging affects my purchasing behavior.	8	8	16	20	22	70

Data Analysis

Demographic Information

Age Group Distribution:

- The majority of respondents (24) belong to the 41-50 years age group, followed by 31-40 years (20).
- Fewer respondents fall into the below 20 years (5) and 21-30 years (7) categories.
- This indicates that middle-aged individuals are more engaged in the study.

Education Level:

- The highest proportion of respondents hold a Bachelor's degree (29), followed by SSC/HSC or below (17).
- A relatively small number of respondents have a Doctorate (4).
- This suggests that a significant portion of the respondents have basic to advanced education levels, which may influence their awareness of sustainable packaging.

Purchase Frequency of Packaged Products:

- Most respondents purchase packaged products monthly (31), while daily (16) and weekly (18) purchases are also common.
- Only 1 respondent rarely purchases packaged products, indicating that most respondents have regular purchasing habits, which strengthens the study's relevance.

Awareness and Perception of Sustainable Packaging

- 35.7% of respondents (Strongly Disagree + Disagree) are unaware of sustainable packaging, while only 32.8% (Agree + Strongly Agree) show awareness.
- 64.2% of respondents either disagreed or remained neutral about understanding the benefits of sustainable packaging.
- Only 30 respondents (42.8%) considered sustainable packaging as an important factor in purchase decisions, while 47.1% remained neutral or disagreed.
- Seeking out sustainable packaging had a high neutrality rate (32 respondents), indicating a gap between awareness and action.

Interpretation:

The results suggest that awareness of sustainable packaging exists but is not strong enough to significantly drive consumer choices.

Impact on Purchase Decisions

- 47 respondents (Agree + Strongly Agree) believe that sustainable packaging influences their purchase decisions.
- 50% of respondents are influenced by environmental concerns, confirming that sustainability awareness does impact consumer behavior.
- Health and safety concerns (38 respondents) and aesthetic appeal (41 respondents) also play a role in purchase decisions.
- 37 respondents recommend sustainable packaging products to others, reinforcing the idea that sustainable choices are gaining traction.

Interpretation:

Consumers acknowledge the importance of sustainable packaging, with environmental, health, and aesthetic concerns driving their preferences.

Price Sensitivity

- 39 respondents (Strongly Disagree + Disagree) are unwilling to pay a higher price for sustainable packaging.
- 39 respondents believe that sustainable packaging is overpriced.
- 44 respondents state that price influences their purchasing decision.

Interpretation:

Despite positive perceptions of sustainable packaging, price sensitivity remains a significant barrier to adoption.

General Consumer Behaviour

- 39 respondents actively seek information on sustainable packaging through advertisements and social media.
- 44 respondents agree that companies should adopt sustainable packaging practices.
- 42 respondents feel that limited availability affects their purchasing behaviour.

Hypothesis Testing

H1: Consumers in the KDMC area are significantly influenced by sustainable packaging when making purchase decisions.

- **One-sample t-test** was applied to test whether sustainable packaging influences consumer choices.
- **Result:** $t = 5.20$, $p = 0.00000196$ (highly significant)
- **Conclusion:** H1 is **accepted**. Sustainable packaging significantly influences consumer purchase decisions.

H2: There is a positive correlation between consumer awareness of environmental issues and preference for products with sustainable packaging.

- **Pearson correlation test** was applied to determine the relationship between awareness and preference.
- **Result:** $r = 0.91$, $p < 0.0000000000000000000000000001$ (highly significant)

- **Conclusion:** H2 is **accepted**. Environmental awareness strongly correlates with consumer preference for sustainable packaging.

H3: Price sensitivity moderates the impact of sustainable packaging on consumer purchase decisions.

- **One-Way ANOVA** was used to analyze price sensitivity's impact.
- **Result:** F = 26.65, p = 0.0000008336 (highly significant)
- **Conclusion:** H3 is **accepted**. Price sensitivity significantly moderates the impact of sustainable packaging on consumer decisions.

Findings

1. Consumer awareness exists, it is not uniformly strong. Many consumers remain neutral or uninformed about sustainable packaging benefits.
2. Sustainable packaging impacts purchasing behavior, particularly for environmentally and health-conscious consumers.
3. Consumers are price-sensitive, limiting their willingness to pay a premium for sustainable packaging.
4. Consumers expect companies to adopt sustainable packaging practices and believe availability influences purchases.

Conclusion

- The study confirms that **sustainable packaging significantly influences consumer purchase decisions**, but price sensitivity is a major limiting factor.
- Awareness of sustainable packaging and environmental concerns correlate strongly with consumer preference for eco-friendly packaging.
- Companies should focus on **educating consumers**, **making sustainable packaging more affordable**, and **enhancing availability** to increase adoption rates.

Recommendation:

1. **Increase Consumer Awareness:** More educational campaigns on the benefits of sustainable packaging.
2. **Price Reduction Strategies:** Businesses should explore cost-effective sustainable packaging solutions.
3. **Enhanced Product Availability:** Companies should improve distribution channels for sustainable packaging.

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"UNEMPLOYMENT AND SUSTAINABLE ECONOMIC GROWTH: EXPLORING OKUN'S LAW WITH REFERENCE TO THE INDIAN ECONOMY"

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Abstract

Okun's law is the empirically demonstrated inverse relationship between unemployment and GDP growth. Suppose there is no variation between key situations and the fluctuation is short-lived. In that case, the statistical relationship between unemployment and Indian GDP may be able to accommodate the usual moveable probability between the Indian employment and GDP ratio year over year.GDP and unemployment must have a negative relationship. Economic and employment growth should follow a linear trajectory and drive the economy towards developmental achievement under all conditions, except severe declines in dire situations. This citation information is used as a population sample for regression analysis, correlation, and variance statistical tests conducted to analyze, and a T-test and F-test to ensure probability results. Between variables in a specific period (1991-2023) in the Indian Economy.

Introduction:

Arthur Okun was a Yale professor and economist who studied the relationship between unemployment and output. Okun longevity periods (1928 - 1980), He earned a Ph.D. in economics from Columbia University. During his time at Yale, Okun was selected to President John F. Kennedy's Council of Economic Advisors, a position he held under President Lyndon B. Johnson.a theory called Okun's law, a 1% decline in employment usually results in a 2% drop in GDP. Additionally, a 1% increase in employment correlates to a 2% increase in GDP.

On the global level platform there are 195 countries today. Within them 69 countries are developed countries as per HDI Index whose HDI Index not less than 0.801 and According to the IMF standards, there are 152 developing countries, with a current population of approximately 6.90 billion. At 85.59 percent, this reflects a sizable fraction of the world's population whose HDI is less than 0.800,most of the developing countries try to occupy their growth level as per population demand.

In the Indian economy since independence various types of planning and programs launched by central and state government focus to enhance skill labour force by forecasting on contributing GDP growth.which id generating employment as per increasing population. Since 1991 India launched LPG Model to survive the economy by forecasting the "India will be Developed until 2047 with third largest world economy by reducing Unemployment and increasing GDP , as per above discussion Okun's law grants us a path of glimmers of expected developed economy on the world's platform.

Literature Review:

It was essentially put down by economist Arthur Okun in 1962 and says that the unemployment rate falls when GDP grows quickly, increases when growth is very low or negative, and stays the same when growth matches potential.

On the global platform world countries rarely study the relationship between GDP and Labour force employment except in Western countries and this is not a different example from what Prithvi Kalkunte and Tyler Atkinson Said "Rising unemployment doesn't counter sign of strong GDP growth. on December 3, 2024

Real (inflation-adjusted) GDP grew at a strong annualized pace of 2.9 percent in the second and third quarters of 2024. But there was also a 0.4 percentage point increase in the jobless rate, which is exceptionally high outside of recessions. Several experts have seen a tendency for GDP growth revisions to be downward before a recession. They argue that labor market indicators should be weighed more when assessing cyclical strength. However, we find that, especially when considering a recent increase in unemployment, it is improbable that GDP growth would

be reduced to zero or even become negative. Due to the early stages of recessions, initial GDP estimates decreased in the third quarter.

In the late nineteenth century, German economist Adolph Wagner thoroughly examined the increase in government spending. These findings led him to develop "The Law of Increasing State Activity."

Wagnar's states that "the government role increase in the economy continuously." produces opportunities to serve economy and launch new models for fulfillment of additional demand in economy also guide to government and forecast the model of expenditures and revenue generation as on applicability of model also guide for employment generation through revenue and expenditure to generate GDP.

Christopher J. Neely (vice President &Economist) mentions in his Short essay in 'Economics Synopses' dated 4th Nov 2010, he studied within 6 Countries out of 30 OECD Countries (US, France, Canada, UK, Japan, and Germany) data interpreted between 2008: Q2 -2009: Q3 for sampling and vocalized an employment protection index how easily terminated workers or hire temporary workers in the above major countries, Okun's relationship between Unemployment and GDP fitted as per law despite of global Deflation.

Literature Gap:

Research literature and Okun's law is not applicable only for developed countries where there unemployment as Phillips curve, Its also studies and illustrating with the developing countries. As per research review and literature developing countries and underdeveloped countries can apply this model in his economy for development and growth this is a question , Barely literature are found as type that studying about emerge countries like India, observer select the latest modern period between 1991-2023 for analysis okun's model with reference to Indian Economy.

Research Methodology:

The quantitative and the qualitative approach is utilized for analysing the Okun's law in the context of the Indian Economy. Researcher used population data sampling method by using lagged model of Okun's law in specific period of time (1991-2023) and analysis data with regression, coefficient correlation, F-test with p-value to find significant difference between Hypothesis.

Data collection and Source:

Table No. 1: **Year Wise Unemployment Growth Rate And Gdp Growth Rate** (1991 To 2023)

Year	Unemployment Growth Rate	GDP Growth Rate
1991	6.85	1.0568
1992	6.853	5.4824
1993	6.859	4.7508
1994	6.828	6.6589
1995	6.99	7.5745
1996	7.147	7.5495
1997	7.335	4.0498
1998	7.517	6.1844
1999	7.682	8.8458
2000	7.856	3.841
2001	8.039	4.824
2002	8.248	3.804
2003	8.397	7.8604
2004	8.551	7.9229

2005	8.697	7.9234
2006	8.614	8.0607
2007	8.534	7.6608
2008	8.486	3.0867
2009	8.406	7.8619
2010	8.318	8.4976
2011	8.222	5.2413
2012	8.156	5.4564
2013	8.088	6.3861
2014	7.992	7.4102
2015	7.894	7.9963
2016	7.8	8.2563
2017	7.723	6.7954
2018	7.652	6.4539
2019	6.51	3.8714
2020	7.859	-5.7777
2021	6.38	9.6896
2022	4.822	6.987
2023	4.172	7.584

Source of Data:

Required data source use as “www.macrotrends net”. Easily available to use and calculated for research purposes without consisting of different kinds of things to accept the relation between GDP and Unemployment in the Indian Economy from the year 1991 to 1923. By rejection of Deflation in 2015 and Covid-19 Fluctuation in the Indian Economy. because of short time fluctuations and errors in the economy never underestimate long-run growth in the economy

Data Analysis:

Consider the lagged Model

$$(U_t-U_{t-1}) = ß_1 - ß_2 (Y_t-Y_{t-1}) + e_t$$

Where

U_t = Unemployment Growth Rate in current year

U_{t-1} = Unemployment Growth Rate in previous year

(U_t-U_{t-1}) = lagged difference of Unemployment Growth Rate

Y_t = GDP Growth Rate in current year

Y_{t-1} = GDP Growth Rate in previous year

(Y_t-Y_{t-1}) = lagged difference of GDP Growth Rate

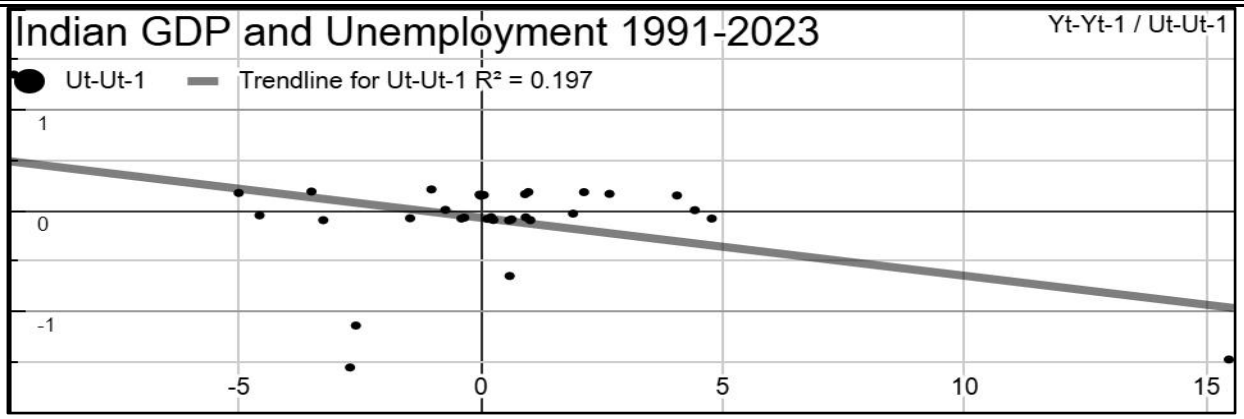
$ß_1$ = Intercept

$ß_2$ = Okun’s coefficient

e_t = Error term

Table No. 2: **Year Wise Lagged Difference Of Unemployment Growth Rate And Lagged Difference Of Gdp Growth Rate**

Year	Ut-Ut-1	Yt-Yt-1
1992	-	-
1992	0.003	4.4256
1993	0.006	-0.7316
1994	-0.031	1.9081
1995	0.162	0.9156
1996	0.157	-0.025
1997	0.188	-3.4997
1998	0.182	2.1346
1999	0.165	2.6614
2000	0.174	-5.0048
2001	0.183	0.983
2002	0.209	-1.02
2003	0.149	4.0564
2004	0.154	0.0625
2005	0.146	0.0005
2006	-0.083	0.1373
2007	-0.08	-0.3999
2008	-0.048	-4.5741
2009	-0.08	4.7752
2010	-0.088	0.6357
2011	-0.096	-3.2563
2012	-0.066	0.2151
2013	-0.068	0.9297
2014	-0.096	1.0241
2015	-0.098	0.5861
2016	-0.094	0.26
2017	-0.077	-1.4609
2018	-0.071	-0.3415
2019	-1.142	-2.5825
2020	1.349	-9.6491
2021	-1.479	15.4673
2022	-1.558	-2.7026
2023	-0.65	0.597



Regression Statistics	
Multiple R	0.4442318931
R Square	0.1973419749
Adjusted R Square	0.1705867074
Standard Error	0.4725452972
Observations	32

The regression statistics presented provide insights into the strength and reliability of the relationship between the lagged difference of Unemployment Growth Rate and lagged difference of GDP Growth Rate in this regression model. The Multiple R value of 0.4442 indicates a moderate positive correlation between the lagged difference of Unemployment Growth Rate and lagged difference of GDP Growth Rate . The R Square (R^2) value of 0.1973 suggests that approximately 19.73% of the variance in the lagged difference of Unemployment Growth Rate is explained by the lagged difference of GDP Growth Rate in the model. However, the Adjusted R Square of 0.1706 accounts for the number of predictors in the model and provides a more accurate measure of explanatory power, indicating a slight reduction when adjusted for degrees of freedom. The Standard Error of 0.4725 represents the average deviation of observed values from the predicted values, implying the extent of dispersion in the dataset. Finally, there were 32 observations used in the analysis, providing a relatively adequate sample size for this model. Overall, the output suggests a well-fitting model with strong predictive capabilities.

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.647013138	1.647013138	7.375817672	0.01086158306
Residual	30	6.698971737	0.2232990579		
Total	31	8.345984875			

The given ANOVA (Analysis of Variance) table provides statistical details regarding the significance of a regression model. The degrees of freedom (df) for the regression is 1, indicating that there is one predictor variable in the model that is lagged difference in GDP Growth Rate. The Sum of Squares (SS) for the regression is 1.647, representing the variation explained by the model. The Mean Square (MS) for regression is computed by dividing SS by df, resulting in 1.647. For the residuals (or error), the df is 30, meaning that there are 30 observations left after accounting for the predictor. The Residual SS is 6.699, which measures the unexplained variation in the model. The Residual MS is obtained by dividing 6.699 by 30, yielding 0.223.The F-statistic, which is the ratio of Regression MS to Residual MS, is 7.376. This value helps in determining whether the independent variable significantly predicts the dependent variable.Finally, the Significance F, or p-value, is 0.0109, which is below the common threshold of 0.05. This indicates that the regression model is statistically significant, meaning there is strong evidence that the predictor variable has an impact on the dependent variable.

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.071943882	0.0836468379	-0.860090875	0.3965604765	-0.2427735	0.09888574
Yt-Yt-1	-0.057573810	0.0211992202	-2.715845664	0.0108615836	-0.1008683	-0.0142792

The given table presents statistical results from a regression analysis, including coefficients, standard errors, and t-statistics for an intercept and a predictor variable lagged difference of GDP Growth Rate. The intercept has a coefficient of -0.0719, indicating that when the lagged difference of GDP Growth Rate is zero, the lagged difference of Unemployment Growth Rate takes this value. However, with a standard error of 0.0836, the associated t-statistic of -0.8601 suggests that the intercept is not statistically significant at conventional significance levels. The predictor variable, lagged difference of GDP Growth Rate, has a coefficient of -0.0576, meaning that for each unit increase in lagged difference of GDP Growth Rate, the lagged difference of Unemployment Growth Rate decreases by approximately 0.0576. With a standard error of 0.0212, the t-statistic is -2.7158, indicating that this predictor is statistically significant, likely at the 5% level, suggesting a meaningful relationship between the lagged difference of GDP Growth Rate and the lagged difference of Unemployment Growth Rate.

$$(U_t-U_{t-1}) = -0.07194388 - 0.05757381\,(Y_t-Y_{t-1}) + e_t$$

Hypothesis Testing:

A. Okun's Coefficient Significance (t-Test)

Null Hypothesis:

$H_0: \beta_2 = 0$

There is no relationship between lagged difference of GDP Growth Rate and the lagged difference of Unemployment Growth Rate

Alternative Hypothesis:

$H_1: \beta_2 < 0$

There is an Inverse relationship between lagged difference of GDP Growth Rate and the lagged difference of Unemployment Growth Rate

	Coefficients	*t Stat*	*P-value*
Yt-Yt-1	-0.057573810	-2.715845664	0.0108615836

The P-value associated with the t-Test is 0.0108615836. Since the p-value is less than 0.05 acceptance level. Reject the Null Hypothesis that is $H_0: \beta_2 = 0$ and accept the Alternative Hypothesis that There is an Inverse relationship between Unemployment and Gross Domestic Product.

B. Overall Model Significance (F-Test)

Null Hypothesis:

$H_0: \beta_2 = 0$

The lagged regression model is not statistically significant.

Alternative Hypothesis:

$H_1: \beta_2 \neq 0$

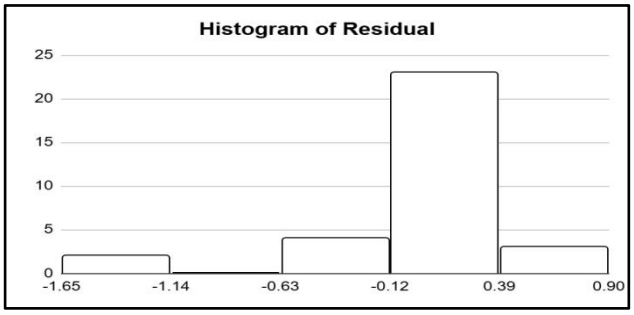
The lagged regression model is statistically significant

F	*Significance F*
7.375817672	0.01086158306

The p-value associated with the F-Test is 0.01086158306. Since the p-value is less than 0.05 acceptance level, we reject the null hypothesis and conclude that the regression model is significant. This means that the lagged difference of GDP Growth Rate explains a significant portion of the variance in lagged difference of Unemployment Growth Rate.

Model Verification Tests

A)Residual Normality



Histogram of residual

The residuals from the lagged difference of Unemployment Growth Rate regression appear symmetrically distributed, the distribution closely resembles a bell-shaped curve centered around zero. This symmetry indicates that the residuals follow a normal distribution.

B. Shapiro Wilk p-value

Shapiro Wilk p-value equals 0.00007557 of the lagged model. We fail to reject the null hypothesis, indicating that the data can be assumed to follow a normal distribution.

Conclusion:

The Indian economy progressively increases its autonomous Investment, also increasing its population and differential skill development programs and training provide skilled workers increasing productivity in physical terms of goods and services. And help to increase GDP as well as Employment to sustain growth and Development. Indian skilled Labour capable of producing Qualitative as well as Quantitative production and service to enhance the application as per time zone in transforming technology with quality research to grow applicability of GDP results reduced unemployment as per the Okun's Law model Indian economy Applicable to study the pros and cons, as on discussion also can apply as trustworthy model for Indian Statistical growths model studies between GDP and Unemployment in the year 1991-2023. Okun Law Best fitted and plotted correlation between GDP and Unemployment in the both developed countries as well as in developing countries like India.

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CARBON NANOFIBERS AND SOIL INTERACTIONS: IMPACTS AND IMPLICATIONS

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Abstract

Carbon nanofibers (CNFs) are a versatile class of materials with unique properties and a wide range of applications. These explore the synthesis, properties, and potential uses of CNFs, focusing on their structural characteristics, methods of production, and practical applications. CNFs are distinguished by their high aspect ratios, significant surface areas, and excellent electrical and thermal conductivities. These properties make them suitable for various applications, including reinforcement in composite materials, energy storage, environmental remediation, and biomedical uses. The various studies investigated several synthesis techniques, such as chemical vapor deposition, electrospinning, and carbon arc discharge, each offering specific advantages in terms of control over morphology and scalability. Moreover, the various studies investigated the interaction of CNFs with soil, demonstrating their potential to enhance soil properties by improving nutrient retention and water holding capacity, which can be beneficial in agricultural applications. The present study indicates that CNFs can significantly influence soil conductivity and structure, thereby impacting water and nutrient dynamics. This comprehensive examination of CNFs aims to provide insights into optimizing the application scope, highlighting the role in advancing materials science and environmental sustainability.

Keywords: - *Nanomaterials, Carbon nanofibers (CNFs), soil property, soil interaction, nutrient leaching, water retention, soil conductivity, agricultural applications.*

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A STUDY ON SUSTAINABLE LIVELIHOOD STRATEGIES FOR MIGRANTS IN PUNE DISTRICT

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Abstract:

Maharashtra is the second recorded populous state in India, with vast socioeconomic and geographical variations reflected in the pattern of temporary and seasonal migration.Labour is the only significant determinant in determining national income. Poverty is the primary obstacle to the development of any nation, and it is a critical phenomenon inwhich a portion of the population is unable to satisfy basic needs such as food, clothing, shelter, and education. People are unemployed in rural areas; their primary source of income is agriculture, and in some instances seasonal work in agriculture; as a result, workers face numerous challenges. In India's extensive Tribal Regions, intrusion by outsiders, settlements by out migrants, and the movement of the indigenous tribal peopleall played a significant role in migration.

Keywords: Migration, Maharashtra, Women.

Introduction:

Migration is the process of relocating to a new location to live and work. Migration is themigration of people from their native region, state, or country to another for reasons including employment, shelter, or other needs. Migration acts as barometer for changingsocio-economic and political conditions at the national and international levels. It is also a sign of wide disparities in socio-economic conditions between the origin and destination. It is a natural outcome of inequality in the distribution of resources. Migration and development is a growing area of interest. There has been much debateon the negative impact of migration on development and vice versa. On the one hand, it is argued that underdevelopment is a cause of migration, and on the other hand, prosperity leads to migration. The history of migration is the history of people's struggle to survive and to prosper, to escape insecurity and poverty, and to move in response to opportunity. In developing countries like India, migration mostly takes place not due to the so called pull forces of the destination place as usually happens in case of developed countries, but because of poverty, unemployment, natural calamities and underdevelopment at the origin place. Migration in developing countries like India is still viewed as a survival strategy. In India, internal mobility is critical to the livelihoods of many people, especially for people from rural areas. Internal migration is considerably more significant than international migration and has enormous potential to contribute to economic growth, social cohesion, and urban diversity. Migration has been defined differently by different experts. In ordinary parlance, migration is defined as the permanent or semi-permanent change of residence of an individual or group of people over a significant distance. Migration indeed may be international, inter-regional, inter-urban, rural-urban or intra-urban. It may be temporary or permanent (as per time criteria), long or short (distance criteria, individual or mass (number criteria), may be family or clan (social organization criteria) and may be economic, social, political or religious (cause criteria).

Literature Review:

The empirical studies {H. Browings, 1971) have shown that the migrants were somewhat selective, resourceful and better educated than the city dweller and have seized the opportunity for better jobs, which increased their income and thereby their standard of living (Kenneth G. Wills, 1974). The same has been observed by Weiner (1973), who had stated that the migrants were able to have occupied better earning occupation m cities like Bombay. However, Bock E. W and I. Sugiyama (1969) have stated that the migrants generally do not enjoy such advantages at the initial stages. This kind of rural to urban migration has also helped not only in getting more income but also in getting relevant training and skills in urban area which could be used to implement modem technology in agriculture and also to mai'ket the agricultural produces in the urban centre for better prices. Besides these, the migrant workers have also helped the towns to get improved public services in many developed countries (Harold Dunning, 1985).In India, rural out-migration, rural to rural migration consists of larger proportion of women, most of whom form the marriage-migration. However, a larger proportion of the male is found in the rural

to urban migration for employment (Census of India 2001). Another aspect of the migration is that most of the rural out-migrants belong to lower castes. This was supported by the study conducted by Gupta (1988) in Punjab. Another study by D.Ramesh (2007) corroborates this fact; he has found that migration, being among all the communities, was somewhat more prevalent among the scheduled and backward castes.

Objectives of the Study:

1. To investigate the causes of rural to urban migration in Pune District.
2. To examine the need and socio-economic characteristics of Rural Migrants.

Locale of the Study:

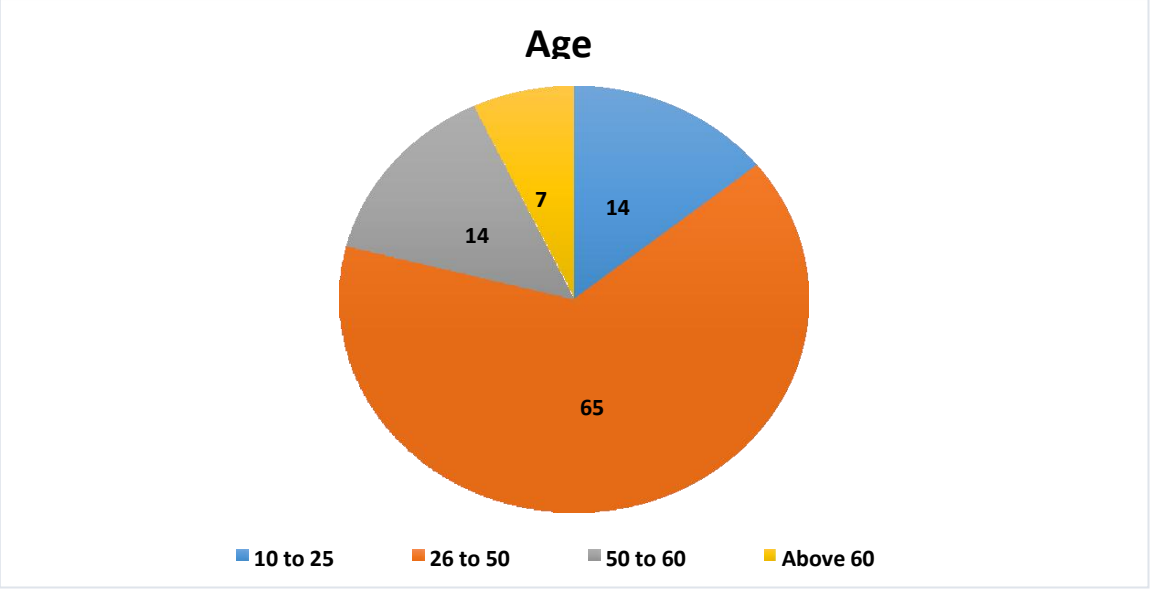
The study is primary done through survey method in Pune district specially in Maval and Khed Taluka

Hypothesis:

1. There is no statistically significance difference between Pull & Push Factorby Age of respondents.

Frequency Analysis:

Age	Counts	% of Total
10 to 25 years	57	14.2 %
26 to 50 years	259	64.8 %
50 to 60 years	56	14.0 %
Above 60 years	28	7.0 %



Interpretation: The given data represents the distribution of individuals based on theirage in four categories: 10 to 25 years, 26 to 50 years, 50 to 60 years, and above 60 years.

There was a total of 400 individuals in the sample population, and out of these, thehighest percentage of individuals (64.8%) were aged between 26 to 50 years. The next highest percentage was for the age group of 10 to 25 years, which accounted for 14.2% of the total population.

The age group of 50 to 60 years and above 60 years accounted for 14.0% and 7.0% of the total population respectively. This indicates that the population is relatively younger,with around 78.4% of individuals aged below 50 years.

Testing of Hypothesis:

1. There is no statistically significance difference between Pull & Push Factorby Age of respondents.

Results:

The one-way ANOVA with Welch's correction was conducted to determine if there were significant differences in the mean scores of pull factor and push factor based on education levels. The results showed that there was a significant difference in the mean scores of pull factor across education levels ($F(4, 85.8) = 2.579$, $p = 0.043$), but no significant difference in the mean scores of push factor across education levels ($F(4, 84.1) = 0.124$, $p = 0.974$). (table 1)

Table 1:

One-Way ANOVA (Welch's)				
	F	**df1**	**df2**	**p**
Pull factor	2.579	4	85.8	0.043
Push factor	0.124	4	84.1	0.974

Conclusions:

In conclusion, the socio-economic profile analysis of respondents from Pune District provides valuable insights into the characteristics and experiences of individuals who have migrated to urban areas. The findings shed light on various aspects of their demographic composition, educational background, migration patterns, reasons for visiting their native villages, and the impact of migration on their livelihoods.

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कल्याणमधील प्राचीन (ऐतिहासिक) वारसा स्थळे

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Vande Mataram Degree College of Arts, Commerce and Science Kopar, Dombivli(w)

उद्देश्य:-

प्रस्तावना:-कल्याण (अक्षांश १९०१४'३२ उ., रेखांश ७३०७'१ २पू.) हे महाराष्ट्रातील ठाणे जिल्ह्यातील एक महत्त्वाचे शहर तसेच प्राचीन बंदर आहे. इसवीसन सणाच्या पहिल्या शतकाच्या सुरुवातीला मोसमी वाऱ्याचा शोध लागला आणि पाश्च्यमात्य देशांशी चालणाऱ्या व्यापारात वाढ झाली. यासाठी भारताच्या पूर्व आणि पश्चिम किनाऱ्यावर मोठ्या प्रमाणावर व्यापारी मार्गाचे मुख्य बंदरे बाजारपेठ निर्माण झाले. यात कल्याण, सोपारा ,भरूच , चोळ यांनी देशांतर्गत तसेच आंतरराष्ट्रीय व्यापारामध्ये महत्त्वाची भूमिका बजावलेली आपल्याला इतिहास दिसून येते. कल्याणची भौगोलिक परिस्थिती अरबी समुद्रापासून 23 मैल आत मध्ये उल्हास नदीकाठी खाडी किनारी वसलेले असून उल्हास नदी पुढे वसई खाडी मार्गे अरबी समुद्राला जाऊन मिळते. पेरी प्लस च्या मते ; ते नहपानाच्या ताब्यात आल्यावर त्याने येथील व्यापारास प्रतिबंध केलेला आपल्याला दिसून येतो व येथील उतरणारी ग्रीक जहाजे भरूच येथे मिळण्यात येत असत. प्राचीन काळात कल्याणचा जुन्नरची घनिष्ठ संबंध होता. कल्याण बंदराव उतरणारा व्यापारी माल लमाणाच्या साह्याने नाणेघाट मार्गे सातवाहनांची राजधानी जुन्नर येथे पोहोचवल्या जात असे. जुन्नरच्या एका पेठेचे नाव देखील कल्याण वरून होते. कान्हेरी लेणी येथील 12 जुन्नर येथील २ शिलालेखत कल्याणच्या व्यापाऱ्यांनी दिलेल्या दानाचा उल्लेख सापडतो. कॉसमॉस इंडिको प्लूस्टेस याच्यामध्ये; इसवीसनच्या सहाव्या शतकात कांस्यकाम , शिसम ,कापड यासाठी प्रसिद्ध असलेल्या भारतामधील सहा मोठ्या बाजारपेठांमध्ये कल्याण याचा समावेश असलेला आपल्याला आढळून येतो. शीसम लाकडाचा बहुतांश व्यापार कल्याण मार्गे चालत असे. पर्शिया हा मुख्य देश होता ज्यातून बहुतेक सिसम आयात केले जात होते. कल्याण मधून दक्षिण अरेबिया या देशांमध्ये मोठ्या प्रमाणावर शिसम लाकूड निर्यात केले जात होते. अगदी प्राचीन ते मध्ययुगीन काळापर्यंत आपल्या भौगोलिक दृष्ट्या अतिशय महत्त्वाच्या स्थानामुळे कल्याण बंदराशी देश विदेशातील व्यापारी यांचा संबंध येत असलेला आपल्याला आढळून येतो. कल्याण जवळील लोणार गावाच्या उत्तरेला इसवीसन सहाव्या - सातव्या शतकातील अप्रतिम बौद्ध लेणे तसेच दक्षिणेला 12 व्या शतकातील शिलाहारकालीन शिव (लवणदित्य) मंदिर आहे. कल्याणच्या बंदरावर छत्रपती शिवाजी महाराजांनी स्वराज्याच्या आरमाराची कोनशीला दुर्गडी किल्ल्याच्या स्वरूपात रचली.

Kalyan city old photo.

कल्याण शहराच्या भौगोलिक इतिहास:-कल्याण शहर हे मुंबईच्या ईशान्येला असून समुद्रसपाटीपासून 8.84 मीटर उंचीवर वसलेले शहर असून एकीकडून ते कल्याण खाडीने वेढलेले असून हे शहर उल्हास नदीवर वसलेले आहे. कल्याण शहरातील क्षेत्रफळ 137.2 किलोमीटर इतका आहे.

ऐतिहासिक दृष्टिकोन:-कल्याणचा व्युत्पत्तिशास्त्रीय अर्थ ;- मंगल, शुभ. असा आहे. प्राचीन गाडी पश्चिम किनाऱ्यावरील या ठिकाणाला 'कालियन' असे नाव पडले होते. कल्याण हे शहर नेहमीच सक्रिय व्यापाराचे केंद्र राहिले आहे. पेरिप्लस ऑफ एरीथेरियन सी या पुस्तकामध्ये सातवाहन राजवटीच्या उदय आणि पत्नाची तपशीलवार माहिती आहे. कल्याण-व्यापारी बंदर येथेसातकर्णी राजाने राज्य केले होते.

सातवाहनांच्या नंतर कल्याणचा संदर्भ इसवी सन ६ शतकाच्या सुरुवातीला मिळतो. 525 मध्ये पश्चिम किनारपट्टीच्या प्रदेशाला इजिप्शियन व्यापारी-कॉसमॉस इंडिकोप्लेटस ने भेट दिली आढळते. त्याने त्याच्या लिखात असे वर्णन केलेले आढळते की सिलोन तसेच पर्शिया चे अतिशय उत्तम यशस्वी व्यापारी संबंध कल्याण सोबत होते. सातवाहनांच्या अध: पतनानंतर कल्याण वर राज्य करणारे शिलाहार राजवंश होते.

मध्ययुगीन काळामध्ये आदिलशहाने कल्याण चे महत्व ओळखले आणि म्हणून त्याने त्याला सुबा बनवले. छत्रपती शिवाजी महाराजांनी कल्याण,भिवंडी जिंकल्यावर कल्याणच्या खाडीत सुमुहुर्ताने आपल्या आरमाराची पहिली ठिकाणी तरती केली.

शहरातील वारसा स्थळे:-

दुर्गाडी किल्ला:-दुर्गाडी किल्ल्याचे बांधकाम शहाजानच्या कारकिर्दीत सुरू झाले होते आणि 1694 औरंगजेबच्या कारकीर्द पूर्ण झाले. दुर्गाडी किल्ला कल्याणच्या खाडीलगत टेकडीवर बांधलेला आहे छत्रपती शिवाजी महाराजांनी किल्ल्याचा वापर नौका आणि जहाजे बांधण्यासाठी गोदी म्हणून वापरला होता. मराठ्यांनी हिंदू देवी दुर्गेचे एक छोटेसे मंदिर किल्ल्याच्या बालेकिल्ल्यात बांधलेले आहे देवीच्या सन्मानार्थ किल्ल्याला दुर्गाडी असे नाव दिले आहे.१८७६ मध्ये दुर्गा देवीची मूळ मूर्ती चोरीला गेली होती. छत्रपती नौदलाचे शिवाजी महाराजांनी हिंदवी स्वराज्याच्या पहिल्या काम येथून सुरू केले . छत्रपती शिवाजी महाराज यांनी कल्याण येथील दुर्गाडी किल्ल्याच्या आश्रयाने भारतीय आरमाराचा पाया घातला होता.

नौदलगोदी बांधण्यासाठी त्यांनी 340 पोर्तुगीज कामगारांना कामावर घेतले होते. नंतर या किल्ल्याची रामजी महादेव बिवलकर यांनी केली. सरदार हसन अली खान ने 1682 मध्ये हा किल्ला ताब्यात घेतला नंतर मराठ्या साम्राज्याचे दुसरे छत्रपती संभाजी महाराज यांनी पुन्हा ताब्यात घेतला. मोगलांनी हा किल्ला 1689 मध्ये पुन्हा ताब्यात घेतला. नंतर पेशव्यांनी या किल्ल्याला आपल्या ताब्यात घेतले. पोर्तुगीजांनी 1728 मध्ये या किल्ल्यावर हल्ला केला पण संकरजी केशव फडके या पेशवे सेनापतींनी त्यांना परतवून लावले. ब्रिटिश राजवटीत कल्याण आणि ठाणे घाट बांधण्यासाठी किल्ल्याच्या भिंतीवरील दगडांचा वापर करण्यात आला होता. किल्ल्याच्या प्रवेशमार्गावर सध्या कमान उभारलेली आहे. कल्याण ठाणे घाट या मार्गावर पूर्व दरवाजा आहे यालाच गणेश दरवाजा म्हणून संबोधले जात असे येथे गणपतीची मूर्ती आढळून आली आहे. या किल्ल्यावर दुर्गा मातेचे मंदिर आहे. यामंदिरात पूर्वीचा देवीचा तांदळा असून नव्याने बसविलेली मूर्तीही आहे.मंदिराजवळ गडाच्या खाडीकडील भागकडे तटबंदी व बुरुजाचे अवशेष आहेत. गडावरील अवशेष मात्र काळाच्या ओघात लुप्त झाले आहेत.

लोणाड लेणी:- इसवी सनाच्या पाचव्या ते आठव्या शतकातील लोणाड लेणी आहे. या लेणीमध्ये बौद्ध भिकू राहत असं लोणाड लेण्यांमध्ये रॉक कट बौद्ध मंदिर शिल्पे आणि हिंदू शिल्पे प्रदर्शित आहे. चैत्यगृह हे या लेणीचे मुख्य शिल्प आहे. लँड स्लायडिंगमुळे बाहेरील वर अंड्याचे नुकसान झाले आहे. गुहेत चार खांब अतिशय उत्तम कोरलेले आहेत. या लेणी मध्ये सिंदूर पावडर मढवलेली दोन शिल्पे आणि गजानन महाराजांचे चित्र आहे. या लेणीच्या दरवाजा भोवती मुख्य तुळईवर वेसंतरा जातकाचा शिलालेख आढळतो. अलीकडच्या काळात लोणाड च्या बौद्ध मूर्तीचे हिंदू मूर्तीत रूपांतर झाले आहे. मोहित महिषासुर मर्दिनी आणि खंडेश्वरी च्या प्रतिमा आहे. लेणीच्या उजव्या बाजूला राजाराणी आणि त्यांच्या मंडळाची शिल्पे आहेत. वेसंत ताराचे वडील (राजा) दरबारी आणि सेवकांच्या मध्ये एक उच्च आसनावर बसलेले आहेत. राजकुमारी व्यसनताराला निर्वासित करायचे की नाही हे ठरत आहे. लोणार लेणी येथील शिवमंदिर हे देखील प्रसिद्ध आहे हे मंदिर इसवी सन पहिल्या शतकात बांधले गेले होते मंदिराच्या खांबावर आणि दरवाजावर सुंदर कोरीव काम आहे.

बिर्ला मंदिर:- बिर्ला मंदिर भगवान पांडुरंग आणि देवी रुक्मणी, महाराष्ट्राच्या वारकरी संप्रदायातील लोकप्रिय देवता यांना समर्पित आहे. हे उद्योगपती बिर्ला कुटुंबाने बांधले आहे , त्यांनी विविध हिंदू देवतांना समर्पित अनेक ठिकाणी मंदिरे बांधली आहेत. हे मंदिर संगमरवरी दगडाचे बनलेले आहे आणि एखाद्या प्राचीन मंदिरासारखे दिसते, त्याच्या आतील आणि बाहेरील भिंतींवर अनेक मूर्ती कोरलेल्या आहेत, प्रवेशद्वारावर दगडी हत्ती आहेत.जुन्या काळापासून हे बॉलीवूड चित्रपटांसाठी सुप्रसिद्ध शूटिंग स्थान म्हणून काम करत आहे. सुहाग, तेरे नाम, गोलमाल: फन अनलिमिटेड इत्यादी सारख्या विविध प्रसिद्ध बॉलीवूड चित्रपटांचे शूटिंग येथे झाले आहे.

काली मशीद :-काली मशीद काला तलावाच्या नैऋत्य कोपऱ्यावर आहे, ती जामा मशीद म्हणूनही ओळखली जाते जी इ.स. 1643 (हिजरी 1054) मध्ये विजापूरच्या युसूफ आदिल शाहच्या एका सुभेदाराने स्वखर्चाने बांधली होती. ही मशीद काळ्या खडकांनी बांधलेली आहे ज्याच्या समोर तीन कमानी आहेत आणि दोन मशिदीच्या आत आहेत, कमानी आणि घुमट चांगल्या स्थापत्य रचनेत बांधलेले आहेत. मकबरा हे तलावाच्या कास्ट बाजूला औरंगजेबाचा गव्हर्नर मताबर खान यांची कबर आहे, ज्यावर 'सेंटर हेवन' असा शिलालेख आहे ज्यावर 1108 हिजरी (एडी 1694) तारीख आहे. या स्मारकासाठी सुमारे एक लाख रुपये खर्च आल्याचे सांगण्यात येते. मकबरा (कबर) जवळ एक छोटी मशीद आहे. मतबर खान (१६२८ ते १६५८).हा शाहजहानचा मंत्री होता.

कल्याणच्या नेतिवली टेकडीवरील एक अपरिचित लेणी स्थापत्य :-सदरील लेणी आतील बाजूने काहीशी अंतर्वक्र आहे. या लेणीस्थापत्याची लांबी ११ फूट, रुंदी ९ फूट तसेच उंची ५.६ फूट आहे. मागील भिंतीपासून पुढे दोन फूट दगडी बाक कोरण्याचा प्रयत्न झालेला दिसतो. तसेच; मागील भिंतीत मध्यभागी खोबणी दिसून येते या खोबणीच्या डाव्या बाजूला एक पुरुषाचे चित्र तैलरंगाने रंगवलेले आहे. लेणीच्या वरील बाजूच्या उतारावरून पावसाळ्यात पाण्याचा प्रवाह वाहतो. यामुळे लेणीच्या आतील बाजूस मागील तसेच उजव्या भिंतीत भेगा पडल्या आहेत. प्रवेशद्वाराच्या डाव्या बाजूस आतील बाजूने दारकससाठी काटकोनात अंतर्वक्र रचना दिसते. डाव्या बाजूच्या भिंतीवर काही ठिकाणी मातीच्या गिलाव्याचे काम दिसते, लेणीच्या दर्शनी भागात प्रवेशाच्या वरील बाजुस मुळ दगडाला चर खोदले असून मध्यभागी पिंपळपानी अपूर्ण आकार दिसून येतो लेणीच्या माथ्यावरील छत सपाट असून त्यावर पुढील दिशेस मध्यभागी एक खोबणी (५ इंच) आहे. लेणीच्या आतील बाजूस अलीकडच्या काळात केलेले रंगकाम दिसून येते.आतील तीनही बाजूने अपूर्ण राहिलेली बाकाची रचना तसेच बाहेरील बाजूस पाण्याच्या कुंडाचे अपूर्ण काम पाहता प्रथमदर्शनी हे साधे मटप प्रकारातील स्थापत्य दिसते. सुरूवातीच्या काळात याचा उपयोग बहुउद्देशीय कारणासाठी केला जात असावा. कदाचित इसवी सनाच्या पहिल्या शतकात नहपानाने कल्याण बंदरावर प्रतिबंध आणल्याने येथील व्यापार काही काळ ठप्प झाला. यामुळे; कल्याण बंदरात येणाऱ्या व्यापारांनी पर्यायी मार्ग स्वीकारल्यामुळे इथे देणगीअभावी कार्य थांबले असण्याची शक्यता आहे.

सदर लेणीच्या दर्शनी भागात प्रवेशद्वाराच्या वरील बाजूस केलेले त्रिकोणी चर, पिंपळपानी (चैत्यगवाक्षसदृश?) अपूर्ण रचना, तसेच मागील भिंतीत केलेली खोबणी यांवरून नंतरच्या काळात येथे वज्रयान पंथाचे प्राबल्य असादे मागील भिंतीतल्या खोबणीचे प्रयोजन चल स्वरूपातील वज्रयानी देवता स्थापन करण्यासाठी केली असण्याची शक्यता आहे. हा कालखंड इसवी सनाचे सहावे सातवे शतकाच्या दरम्यानचा असावा.

जुना साठेवाडा :- १४१ वर्षे जुना असलेला आणि पोर्तुगीज वास्तुकलेची साक्ष देणारा कल्याणातील साठेवाडा त्याच्या अनेक अर्थाने वैशिष्ट्यपूर्ण आहे. कल्याण आणि परिसरातील इतिहासाच्या वास्तुखुणांचा तपशील चाळत असताना साठेवाडय़ाचा उल्लेख आवर्जून करावा लागतो.

श्री त्रिविक्रमाचे मंदिर :- हे मंदिर पेशव्यांच्या काळातील आहे आणि पेशव्यांची सेवा करणारे श्रीमंत बळवंतराव मेहंदळे यांनी १८ व्या शतकात गुजरात मोहिमेदरम्यान येथे मूर्ती आणली होती. ही मूर्ती गंडकी (एक प्रकारचा संगमरवरी) संगमरवरी बनविली गेली आहे आणि तिच्याभोवती एक आभा आहे. या आभाळाच्या दोन्ही बाजूला देवता विष्णूचे दहा अवतार तसेच वैकुंठचे द्वारपाल जय-विजय आणि राय-रखुमाई (विष्णूची दैवी शक्ती) कोरलेली आहेत. या मूर्तीला कमळ, चकती, शंख असे चार हात आहेत. तसेच परंपरेनुसार ते डोक्यावर लिंग शोभते. ही मूर्ती सर्व देवतांचे शिव आणि विष्णू भक्तांचे मिलन असल्यामुळे त्यांचे एकाच वेळी दर्शन होते.

सातवाहनांच्या नंतर, कल्याणचा संदर्भ थेट इसवी सन 6 व्या शतकाच्या सुरुवातीला येतो. 525 मध्ये पश्चिम किनारपट्टीच्या प्रदेशाला इजिप्शियन व्यापारी - कॉसमॉस इंडिकोप्लटसने भेट दिली होती. तो, त्याच्या लेखांत, वर्णन करतो की कल्याणने सिलोन तसेच पर्शियाशी अतिशय यशस्वी व्यापारी संबंध प्रस्थापित केले होते. ते पुढे म्हणतात की पश्चिम भारतीय किनारपट्टीवर पाच राजांचे वर्चस्व होते. कल्याण हे या राजांच्या वैकल्पिक वर्चस्वाखाली असावे किंवा बहुधा 'मुक्त बंदर' असावे. सातवाहनांच्या अधःपतनानंतरचा काळ हा महाराष्ट्राच्या आणि त्याप्रमाणे कल्याणच्या दृष्टीने एक प्रकारचा काळोख आहे. कल्याणवर राज्य करणारे पुढचे प्रमुख राजवंश शिलाहार होते, राष्ट्रकूटचे सरंजामदार जे उत्तर कोकणात वास्तव्यास होते त्यांनी ठाणे आणि कुलाबाच्या क्षेत्रावर नियंत्रण ठेवले. पेरिप्लस, तसेच टॉलेमी, भारताच्या पूर्व किनाऱ्यावरील व्यापाराचा उल्लेख करतात. बाजार, कल्याण, बिदर, गोलकोंडा आणि हैदराबादमार्गे जाणारा मार्ग, तो वर्णन करतो.

नवीन शतकाच्या उदयासह, कल्याणने मध्ययुगीन काळातील संक्रमण पाहिले. तथापि, विजापूर दरबाराचा भाग होईपर्यंत कल्याणाविषयी फारशी माहिती उपलब्ध नाही. आदिलशहाने कल्याणचे महत्त्व ओळखले आणि म्हणून त्याने त्याला सुबा बनवले. सुभा कल्याण मोठ्या क्षेत्राचा समावेश होता. उत्तरेला इगतपुरी पर्यंत, दक्षिणेला साष्टी म्हणून ओळखल्या जाणाऱ्या कर्जत आणि पश्चिमेला कुलाबा आणि सुवर्णदुर्गाचा काही भाग. आज जे स्थान कल्याण शहर म्हणून ओळखले जाते ते सुभा कल्याणचे प्रवेशद्वार होते. आता पुढे कल्याणने कधीही न संपणारे युद्ध, राजकारण आणि अत्यंत अस्थिर परिस्थितीच्या दृश्यात प्रवेश केला. पुढील ६-७ शतके, कल्याणला प्रचंड विरोधाभासी उलथापालथ झाली. यात केवळ राजकीय व्यत्ययच नाही तर स्थैर्याचा काळही दिसला, अर्थव्यवस्थेला चालना मिळाली तसेच भयानक दुष्काळही पाहिला. कधीकाळी हे ठिकाण खूप समृद्ध केंद्र होते, तर दुसरीकडे ते नो मॅन्स लँडही बनले होते. यात सल्तनत, हिंदवी स्वराज, मुघल साम्राज्य, मराठा साम्राज्य, कंपनी शासन तसेच ब्रिटीश साम्राज्याचा उदय आणि अस्त झाला. ते भारताच्या स्वातंत्र्यलढ्याचे प्रेक्षकही होते. .

या सर्व स्थित्यंतरांनी या शहराच्या संस्कृतीवर आपली छाप सोडली. कल्याण, नेहमीपासून, एक बहुसांस्कृतिक शहर होते कल्याण, जुने शहर असल्याने, आज एक विशिष्ट सांस्कृतिक नमुना दर्शवितो. ख्रिश्चन काळापूर्वी हे एक प्रस्थापित व्यापारी केंद्र असल्याने, ग्रीक, इंडो-ग्रीक, रोमन, अरब आणि ब्रिटिश यांसारखे अनेक परदेशी लोक कल्याणमध्ये स्थायिक झाले, त्यामुळे ते अनेक संस्कृतींचे वितळणारे भांडे बनले. आज, तसेच, कल्याण हे सांस्कृतिक वैविध्य असलेले ठिकाण आहे. कल्याणने विविध धर्मांना आश्रय दिला. विविध जाती आणि पोटजातींचे हिंदू लोकसंख्येतील बहुसंख्य आहेत, त्याशिवाय इतर धर्मही आहेत उदा. मुस्लीम, ख्रिश्चन, बौद्ध, जैन आणि अगदी पारशी हे शहर प्रकट करतात

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माध्यमांवर होणारा राजकीय प्रभाव आणि त्याचा अभिव्यक्ती स्वातंत्र्यावर होणाऱ्या परिणामांचा शोध घेणे

शुभम रेखा शंकर पेडामकर
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पार्श्वभूमी

जनमत तयार करण्यात आणि राजकीय प्रवचनावर प्रभाव टाकण्यात माध्यमे महत्त्वाची भूमिका नेहमीच बजावतात. तथापि माध्यमांवर होणाऱ्या राजकीय प्रभावामुळे अभिव्यक्ती स्वातांत्र्यावर परिणाम होऊ शकतो. माध्यमे नेहमीच लोकशाहीला धरुन भूमिका बजावण्याचा प्रयत्न जरी करत असली तरी अर्थकारणाच्या दृष्टिकोनातून काहीवेळेला त्यांना देखील भाषण स्वातंत्र्य मर्यादित ठेवावे लागत असावे. माध्यमांची भूमिका राजकारणी मंडळींमुळे बदलते का ? लोकशाहीचा चौथा आधार स्तंभ ढासळतोय का ? यासह अनेक प्रश्नांची उकल या शोध निबंधामुळे प्राप्त होऊ शकते.

कळ शब्द - माध्यमे, राजकीय प्रभाव, अभिव्यक्ती स्वातंत्र्य, परिणाम

प्रस्तावना

आपल्या सर्वांनाच माहिती आहे की , लोकशाहीमध्ये माध्यमे ही केवळ माहिती पुरवण्याचे साधन नसून, जनमत घडवण्याचे आणि राजकीय प्रवचनाला दिशा देण्याचे प्रभावी माध्यम आहेत. माध्यमे ही नेहमी जनतेच्या हितासाठी कार्यरत असतात. मात्र त्यांच्यावर असलेल्या राजकीय आणि आर्थिक दबावामुळे त्यांची भूमिका काळानुरूप बदलू शकते.

राजकीय सत्ताधाऱ्यांचा प्रभाव, मालकी हक्काचे केंद्रीकरण, आणि व्यावसायिक हितसंबंध यामुळे माध्यमांची स्वायत्तता धोक्यात येते का, हा एक प्रश्न सध्या गंभीर आहे. प्रसारमाध्यमांनी लोकशाहीच्या चौथ्या स्तंभाची जबाबदारी पार पाडायची, की विशिष्ट गटांच्या हितसंबंधांसाठी कार्य करायचे, हा आजच्या काळातील एक महत्त्वाचा वादविवाद आहे.

या शोध निबंधात माध्यमांवरील राजकीय प्रभाव, अभिव्यक्ती स्वातंत्र्यावर त्याचा होणारा परिणाम आणि लोकशाहीवरील संभाव्य परिणाम यांचे सखोल विश्लेषण करण्याचा छोटेखानी प्रयत्न केला आहे. माध्यमे जनहितासाठी कार्यरत राहतील की सत्तेच्या कचाट्यात सापडतील, याचा विचार या अभ्यासातून मांडण्यात आला आहे.

संशोधन प्रश्न

माध्यमांवर होणाऱ्या राजकीय प्रभावामुळे भाषण स्वातांत्र्यावर कसा परिणाम होतो?

शोध निबंधाची उद्दिष्टे

१. प्राथमिक उद्दिष्ट: लोकशाही समाजात भाषण स्वातांत्र्यावर राजकीय प्रभावामुळे माध्यमांची बदलणाऱ्या भूमिकेचा आणि परिणामांचा अभ्यास करणे.

२. दुय्यम उद्दिष्टे :

१.माध्यमांवर होणाऱ्या राजकीय हस्तक्षेपामुळे भाषण स्वातंत्र्याच्या बदलणाऱ्या प्रवाहाचा शोध घेणे.

२. माध्यमांची पारदर्शकता टिकून राहण्यासाठी काय पावले उचलली जावी याचे निष्कर्ष काढणे.

शोध निबंधाच्या मर्यादा

१. भौगोलिक मर्यादा - अभ्यास केवळ महाराष्ट्रातील राजकारणाचा केला जाईल.

२. टाइमफ्रेमिंग - आजपासून मागील ०२ वर्षातील माध्यमांवरील राजकीय हस्तक्षेप विचारात घेतला जाईल.

३. डेटा मर्यादा : अभ्यास प्राथिमक व दुय्यम डेटा या दोन्ही स्रोतांच्या मांडणीतून स्पष्ट केला जाईल.

माझ्या संशोधनाशी निगडीत काही गृहीतकृत्यांची मांडणी केली आहे.

शोध निबंधाची गृहीतके

१. राजकीय प्रभावाचा माध्यमांच्या भाषिक स्वातांत्र्यावर कोणताही महत्त्वाचा संबंध नाही.

२. राजकीय प्रभावामुळे लोकशाहीचा चौथा आधार स्तंभ म्हणून ओळखली जाणारी माध्यमे ढासळली आहेत.

परिमाणात्मक पद्धत (Quantitative Method)

१. संशोधन डिजाईन : अभ्यासामध्ये परिमाणात्मक

संशोधन डिजाईन; विशेषतःसर्वेक्षण संशोधना केला गेला आहे.

२. नमुन्याचा आकार: २०० हुन अधिक प्रतिसाद्कर्त्यांच्या डेटा गोळा केला आहे.

३. डेटा विश्लेषणात्मक पद्धतीने मांडला गेला आहे.

४. सर्व सामान्य व्यक्ती, राज्यशास्त्राचा अभ्यास करणारा विद्यार्थी वर्ग, नोकरदार वर्ग, शिक्षकांच्या व राजकारणातील कार्यकर्त्यांच्या प्रतिसादांचा समावेश आहे.

अभ्यासाची व्याप्ती

१. राजकीय प्रभावामुळे माध्यमांची भूमिका काळानुसार बदलू शकते त्यामुळे भविष्यात पुन्हा संशोधन करता येऊ शकते.

२. लोकशाहीचा चौथा स्तंभ ढासळत चालला आहे का ? हे वारंवार तपासता येऊ शकते.

माध्यमांवर होणाऱ्या राजकीय प्रभावाचा आणि त्याचा अभिव्यक्ती स्वातंत्र्यावर होणाऱ्या परिणामांचा अभ्यास करताना खालील **चार साहित्य अवलोकन** उपयुक्त ठरू शकतात:

1. हर्मन आणि चॉम्स्की यांचे "Manufacturing Consent"

- हे पुस्तक माध्यम संस्थांवर राज्य आणि कॉर्पोरेट हितसंबंधांचा कसा प्रभाव असतो, याचा सखोल अभ्यास करत आहे असे वाचल्यावर लक्षात आले.
- "प्रोपगंडा मॉडेलच्या संकल्पनेतून माध्यमे कशी नियंत्रित केली जातात आणि लोकांच्या विचारसरणीवर परिणाम करतात, हे स्पष्टपणे यामधून मांडण्यात आले आहे.
- अभिव्यक्ती स्वातंत्र्याच्या मर्यादा आणि दबाव यावर यामध्ये चर्चा करण्यात आली आहे .

2. मॅककॉम्ब्स आणि शॉ यांचे "The Agenda-Setting Function of Mass Media"

- या संशोधनात माध्यमे केवळ माहिती देत नाहीत, तर कोणते मुद्दे महत्त्वाचे आहेत हे ठरवण्याची त्यांची ताकद असते, असे नमूद केले आहे.
- राजकीय सत्ताधारी आणि माध्यमे यांच्या संबंधामुळे जनतेपर्यंत पोहोचणाऱ्या माहितीवर कसा परिणाम होतो, याचे विवेचन यामध्ये आहे.
- माध्यमांमधील विषय निवडीचा अभिव्यक्ती स्वातंत्र्यावर अप्रत्यक्षपणे होणाऱ्या प्रभावाचा अभ्यास यात केला गेला आहे.

3. उमबर्टो एको यांचे "Turning Back the Clock: Hot Wars and Media Populism"

- माध्यमे आणि लोकशाही यांच्यातील नाजूक संबंध स्पष्ट करणारे हे पुस्तक आहे.
- राजकीय सत्ताधारी माध्यमांचा वापर लोकशाही संकल्पनांना वाकवण्यासाठी कसा करतात, हे यात मांडण्यात आले आहे.

- विशेषतःमाध्यमे लोकांच्या दृष्टिकोनावर परिणाम कशी करतात आणि अभिव्यक्ती स्वातंत्र्यावर दबाव कसा टाकला जातो, याचे स्पष्टीकरण यामध्ये करण्यात आले आहे.

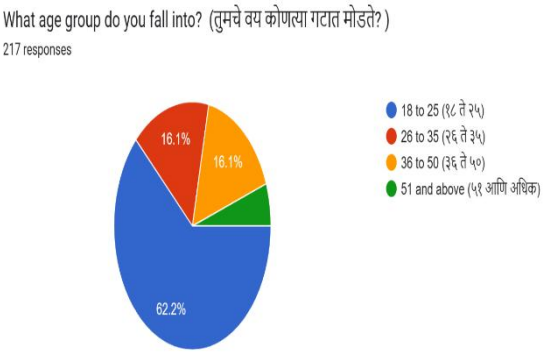
4. Indian Context – "Media Control in India: The Specter of Censorship" (रवीकांत आणि अनिता दत्ता)

- भारतातील माध्यमांवरील सरकारी आणि कॉर्पोरेट नियंत्रणाचा आढावा घेणारे हे पुस्तक आहे.
- डिजिटल सेन्सॉरशिप, मीडिया हाऊसेसवर राजकीय पक्षांचा प्रभाव, आणि अभिव्यक्ती स्वातंत्र्यावर परिणाम याची चर्चा यात आहे.
- विशेषतःआपत्तीजनक वृत्तांकन रोखण्यासाठी कायद्यांचा गैरवापर आणि पत्रकारांवर होणारे दडपशाहीचे प्रकार यात तपशीलवार नमूद आहेत. ही पुस्तके आणि संशोधनपत्रे माध्यमे, राजकीय प्रभाव आणि अभिव्यक्ती स्वातंत्र्य यांच्यातील गुंतागुंतीच्या नात्याचा अभ्यास करण्यासाठी उपयुक्त ठरतील.

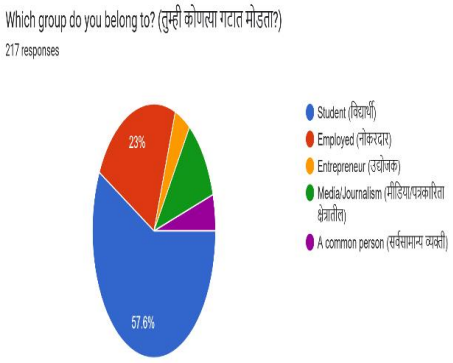
शोध निबंधाची पद्धत - सर्वेक्षण

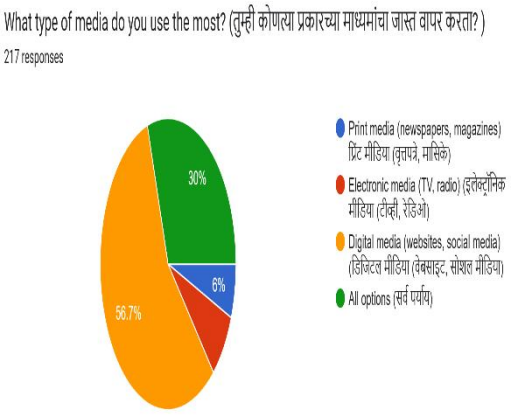
माध्यमांवर होणारा राजकीय प्रभाव आणि त्याचा अभिव्यक्ती स्वातंत्र्यावर होणाऱ्या परिणामांचा शोध घेण्यासाठी वेगवेगळ्या वयोगटातील लोकांचा समावेश करण्यात आला असून त्यात

१८ ते २५ - १३५
२६ ते ३५ - ३५
३६ ते ५० - ३५
५१ आणि अधिक – १२



लोकांनी गूगल फॉर्म सर्वेक्षणाला प्रतिसाद दिला असून
१२५ विद्यार्थी, ५० नोकरदार वर्ग , ०९ उद्योजक, २३ मीडिया/पत्रकार क्षेत्रातील, १० सर्वसामान्य व्यक्तींचा समावेश होता.
प्रतिसाद दात्यांना तुम्ही कोणत्या प्रकारच्या माध्यमांचा जास्त वापर करता ? असा प्रश्न विचारला असता





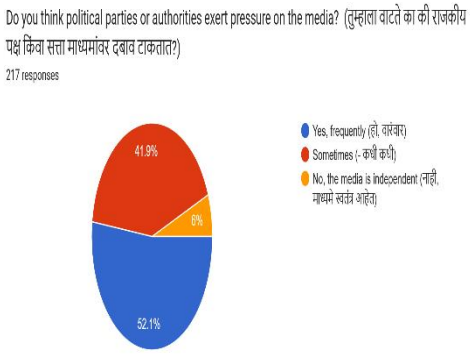
१३ लोकांनी प्रिंट मीडिया (वृत्तपत्रे, मासिके)१६ जणांनी इलेक्ट्रॉनिक मीडिया (टीव्ही, रेडिओ) १२३ लोकांनी डिजिटल मीडिया (वेबसाइट, सोशल मीडिया) तर ६५ लोकांनी सर्व पर्याय असा प्रतिसाद दिला.

त्यानंतर गूगल फॉर्मद्वारे कोणत्या प्रकारच्या माध्यमांवर तुम्हाला राजकीय प्रभाव सर्वाधिक जाणवतो ? असे विचारले असता मिळालेल्या २१७ प्रतिसादांमध्ये १०.१ % लोकांना (२२) - राष्ट्रीय वृत्तपत्रे ०८.०८ % - जणांना (१९) - स्थानिक वृत्तपत्रे, ४१.०५ %

लोकांना (९०) जणांना टेलिव्हिजन चॅनेल्स तर ३९.०६ % लोकांना अर्थात ८६ जणांना डिजिटल मीडिया (वेबसाइट, सोशल मीडिया) वर राजकीय प्रभाव सर्वाधिक असतो असं वाटतं.

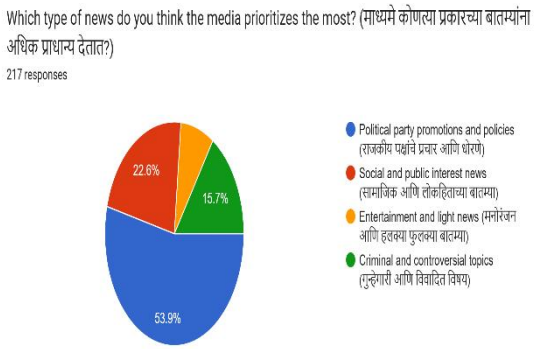
पुढे तुम्हाला वाटते का की राजकीय पक्ष किंवा सत्ता माध्यमांवर दबाव टाकतात? या प्रश्नावर ५२.१% (११३) जणांनी हो - वारंवार, ०६ % (१३) जणांनी नाही तर ४१.०९% (९१) जणांनी कधी कधी असं मत व्यक्त केलं.

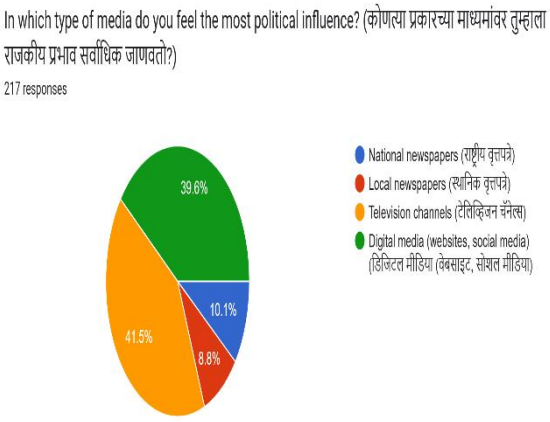
त्याचबरोबर माध्यमे जनतेपर्यंत पोहोचणाऱ्या माहितीमध्ये

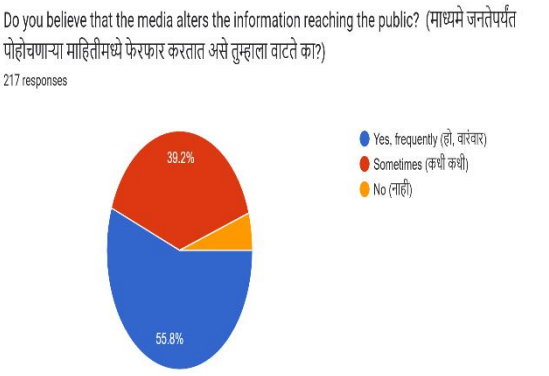


फेरफार करतात असे तुम्हाला वाटते का ? असा प्रश्न विचारला गेला असता यावर १२१ (५५. ०८%) जणांनी हो-वारंवार, ८५ (३९.०२%) लोकांनी कधी कधी आणि ११ (०५.०१%) जणांनी नाही असं उत्तरं दिलं .

त्यानंतर माध्यमे कोणत्या प्रकारच्या बातम्यांना अधिक





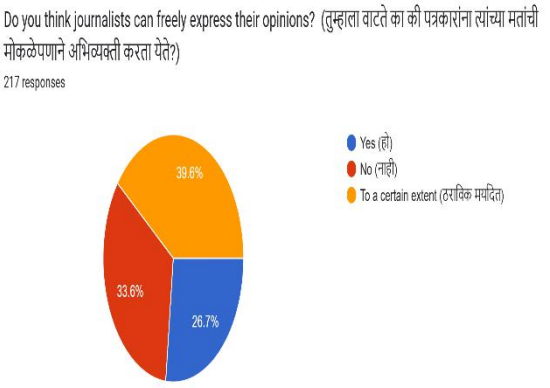


प्राधान्य देतात ? असा प्रश्न विचारला असता

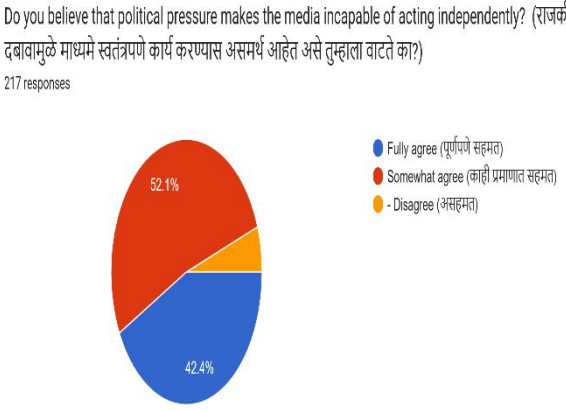
११७ जणांनी (५३.९%) - राजकीय पक्षांचे प्रचार आणि धोरणे, ४९ (२२.०६%) लोकांनी सामाजिक आणि लोकहिताच्या बातम्या त्याचबरोबर १७ जणांनी (०७.०८%) मनोरंजन आणि हलक्या फुलक्या बातम्या तर ३४ लोकांनी (१५.०७%) गुन्हेगारी आणि विवादित विषयाला प्राध्यान दिले जाते असं मांडले.

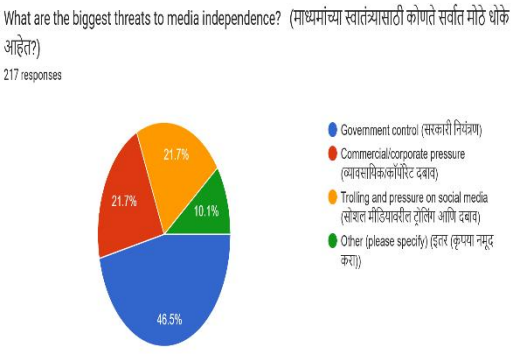
पुढच्या प्रश्नात तुम्हाला वाटते का की पत्रकारांना त्यांच्या मतांची मोकळेपणाने अभिव्यक्ती करता येते? यावर ५८ (२६.०७ %) जणांनी हो , ७३ (३३.०६%) जणांनी नाही तर ८६ लोकांनी

(३९.०६ %) ठराविक मर्यादित असं उत्तर दिलं आहे.



पुढच्या प्रश्नात - राजकीय दबावामुळे माध्यमे स्वतंत्रपणे कार्य करण्यास असमर्थ आहेत असे तुम्हाला वाटते का? यावर ९२ (४२.०४%) लोकं पूर्णपणे सहमत, १२ (०५.०५%) लोकं असहमत तर ११३ (५२.१%) लोकं काही प्रमाणत सहमत असल्याचे आढळून आले.

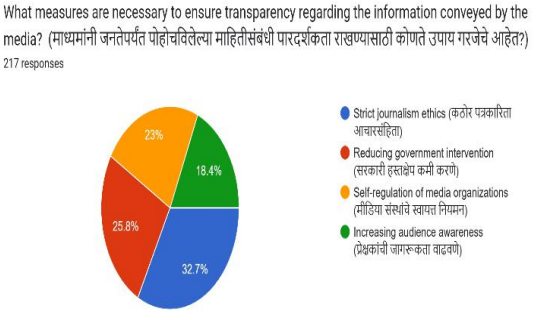


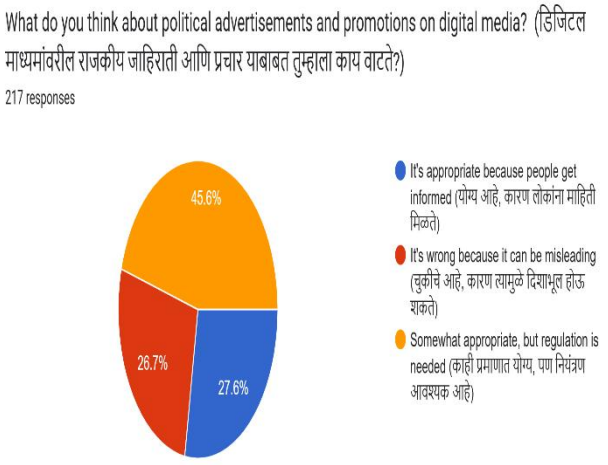


त्यानंतर माध्यमांच्या स्वातंत्र्यासाठी कोणते सर्वात मोठे धोके आहेत? असं विचारलं असता यावर १०१ (४६.५%) लोकांना सरकारी नियंत्रण, , ४७ (२१.०७ %) जणांना व्यावसायिक/कॉर्पोरेट दबाव व सोशल मीडियावरील ट्रोलिंग आणि दबाव यांसारखे धोके आहेत असं वाटतं .

त्यामुळेच माध्यमांनी जनतेपर्यंत पोहोचविलेल्या माहितीसंबंधी पारदर्शकता राखण्यासाठी कोणते उपाय करणं गरजेचे आहेत? असं विचारलं असता

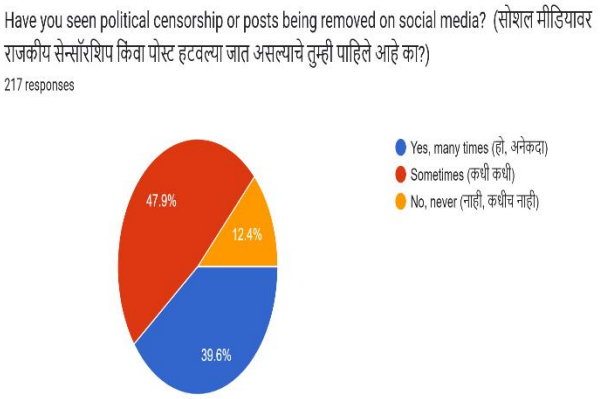
कठोर पत्रकारिता व आचारसंहिता असावी असं मत ७१ (३२.०७% लोकांनी मांडले. ५६ (२५.८%) लोकांनी सरकारी हस्तक्षेप कमी करावा असं सांगितलं तर ५० (२३%) जणांनी मीडिया संस्थांचे स्वायत्त नियमन असावं असं सांगितलं तर ४० (१८.०४%) लोकांनी प्रेक्षकांची जागरूकता वाढवण्याचा सल्ला दिला.





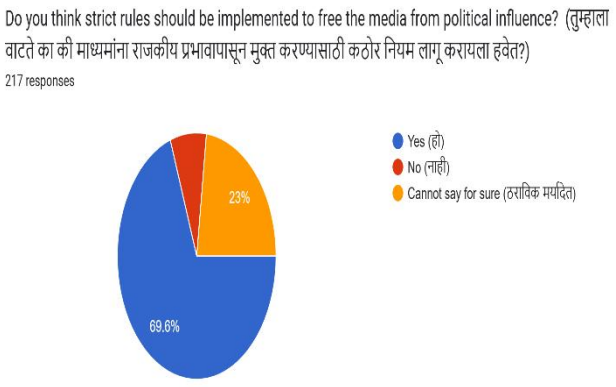
डिजिटल माध्यमांवरील राजकीय जाहिराती आणि प्रचार याबाबत तुम्हाला काय वाटते ?

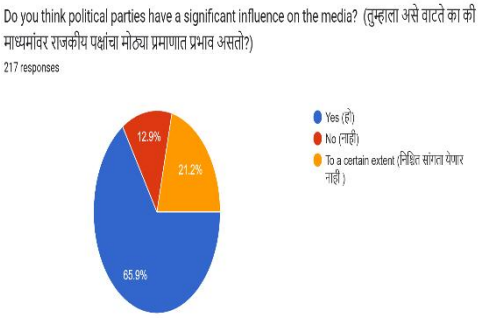
याबद्दल योग्य आहे, कारण लोकांना माहिती मिळते असं मत २७.६% (६०) लोकांनी मांडले तर २६.७ % (५८) जणांनी चुकीचे आहे, कारण त्यामुळे दिशाभूल होऊ शकते असं मत व्यक्त केलं तर काही प्रमाणात योग्य, पण नियंत्रण आवश्यक आहे असा प्रतिसाद ४५.६% (९९) लोकांनी दिला.



सोशल मीडियावर राजकीय सेन्सॉरशिप किंवा पोस्ट हटवल्या जात असल्याचे तुम्ही पाहिले आहे का ? यावर ८६ (३९.६%) लोकांनी हो अनेकदा , १०४ (४७.९%) लोकांनी कधी-कधी तर २७ (१२.४%) जणांनी नाही, कधीच नाही असा प्रतिसाद दर्शवला,

पुढच्या प्रश्नात - तुम्हाला वाटते का की माध्यमांना राजकीय प्रभावापासून मुक्त करण्यासाठी कठोर नियम लागू करायला हवेत? यावर १५१ (६९.६%) लोकांनी हो, १६ (७.४%) जणांनी नाही तर ५० (२३%) ठराविक मर्यादित असं मत मांडले.





तुम्हाला असे वाटते का की माध्यमांवर राजकीय पक्षांचा मोठ्या प्रमाणात प्रभाव असतो ?

यावर १४३ (६५.९%) लोकांनी हो, २८ (१२.९%) लोकांनी नाही तर ४६

(२१.२%) लोकांनी निश्चित सांगता येणार नाही असं मत मांडलं.

ठळक निष्कर्ष

प्रबंधासाठी काही गृहीतकृत्य मांडण्यात आली होती. त्या गृहीतकृत्यांना गृहीत धरून संशोधन करण्यात आले.त्या दृष्टीने करण्यात आलेल्या या शोध निबंधात काही ठळक निष्कर्ष समोर आले.

१. माध्यमांवर राजकीय प्रभाव मोठ्या प्रमाणात आहे.

- ६५.९% लोकांना वाटते की माध्यमांवर राजकीय पक्षांचा मोठ्या प्रमाणात प्रभाव असतो.

- ५२.१% लोकांनी मान्य केले की राजकीय पक्ष किंवा सत्ता माध्यमांवर वारंवार दबाव टाकतात.

- ४२.०४% लोकं पूर्णपणे सहमत होते की राजकीय दबावामुळे माध्यमे स्वतंत्रपणे कार्य करण्यास असमर्थ आहेत.

२. माध्यमे जनतेपर्यंत पोहोचणाऱ्या माहितीमध्ये फेरफार करतात.

- ५५.०८% लोकांना वाटते की माध्यमे वारंवार माहितीमध्ये फेरफार करतात.

- ३९.०२% लोकांना कधी कधी असे वाटते, तर फक्त ५.०१% लोकांनी नाही असे उत्तर दिले.

३. डिजिटल आणि इलेक्ट्रॉनिक माध्यमांवर सर्वाधिक राजकीय प्रभाव जाणवतो.

- ४१.०५% लोकांना टेलिव्हिजन चॅनेल्सवर सर्वाधिक राजकीय प्रभाव जाणवतो.

- ३९.०६% लोकांना डिजिटल मीडिया (वेबसाइट, सोशल मीडिया) वर प्रभाव जाणवतो.

४.पत्रकारांच्या अभिव्यक्ती स्वातंत्र्यावर बंधने आहेत.

- ३९.०६% लोकांनी मान्य केले की पत्रकारांना ठराविक मर्यादेतच अभिव्यक्ती स्वातंत्र्य आहे.

- ३३.०६% लोकांनी स्पष्टपणे सांगितले की पत्रकारांना मुक्तपणे आपली मते व्यक्त करता येत नाहीत.

५. माध्यमे राजकीय विषयांना अधिक प्राधान्य देतात.

- ५३.९% लोकांनी सांगितले की माध्यमे राजकीय पक्षांचे प्रचार आणि धोरणांना अधिक प्राधान्य देतात.

- सामाजिक आणि लोकहिताच्या बातम्यांना केवळ २२.०६% लोकांनी माध्यमांकडून महत्त्व दिले जाते असे नमूद केले.

६. माध्यमांच्या स्वातंत्र्यासाठी सर्वात मोठे धोके.

- ४६.५% लोकांना वाटते की सरकारी नियंत्रण हे सर्वात मोठे धोके आहे.

- २१.०७% लोकांनी व्यावसायिक/कॉर्पोरेट दबाव व सोशल मीडियावरील ट्रोलिंग हे धोके असल्याचे सांगितले.

७. डिजिटल माध्यमांवरील राजकीय जाहिरातींवर नियंत्रण आवश्यक.

- ४५.६% लोकांना वाटते की डिजिटल माध्यमांवरील राजकीय जाहिराती काही प्रमाणात योग्य आहेत, पण नियंत्रण आवश्यक आहे.

- २६.७% लोकांना वाटते की अशा जाहिराती चुकीच्या आहेत कारण त्याने दिशाभूल होऊ शकते.

८. सोशल मीडियावर राजकीय सेन्सॉरशिप दिसून येते.

- ४७.९% लोकांनी सांगितले की कधी-कधी, तर ३९.६% लोकांनी अनेकदा अशा पोस्ट हटवल्या जात असल्याचे पाहिले आहे.

९. माध्यमांना राजकीय प्रभावापासून मुक्त करण्यासाठी कठोर नियमांची आवश्यकता.

- ६९.६% लोकांनी मान्य केले की माध्यमांवरच्या राजकीय प्रभावावर कठोर नियम लागू करायला हवेत.

१०. राजकीय प्रभावामुळे माध्यमांची विश्वासार्हता कमी होत आहे.

- माध्यमांना लोकशाहीचा चौथा स्तंभ मानले जात असले तरी राजकीय दबावामुळे त्यांची विश्वासार्हता ढासळत आहे.

- ५३.९% लोकांनी सांगितले की माध्यमे राजकीय प्रचाराला अधिक प्राधान्य देतात, याचा अर्थ ते लोकशाहीसाठी संतुलित माहिती देण्याच्या भूमिकेत कमी पडत आहेत.

सारांश

या सर्वेक्षणावरून स्पष्ट होते की "राजकीय" प्रभावामुळे माध्यमांची स्वायत्तता कमी होत आहे आणि त्यामुळे माध्यमांवरील विश्वासार्हता ढासळत आहे.माध्यमांवर नियंत्रणासाठी कठोर नियम आणि पारदर्शकता आवश्यक आहे. पत्रकारिता आणि माध्यमांना अभिव्यक्ती स्वातंत्र्य मिळावे यासाठी लोकांनीही अधिक जागरूक राहणे गरजेचे आहे.

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