TOLANI COLLEGE OF COMMERCE (AUTONOMOUS)
150-151 SHER-E-PUNJAB SOCIETY, ANDHERI EAST MUMBAI-93

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GREEN HORIZONS

SUSTAINABILITY AND INNOVATION ACROSS DISCIPLINES

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INDEX

INDIA'S BOOMING SERVICE EXPORTS: AN ENGINE FOR ACHIEVING THE 2030 SDG AGENDA

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Abstract

The United Nations' Sustainable Development Goals (SDGs) provide a comprehensive framework aimed at eradicating poverty, reducing inequality, and promoting inclusive and sustainable economic growth. In this context, international trade particularly service exports emerges as a key driver in advancing these goals. This study examines the role of India's service exports in contributing to the achievement of the SDGs, emphasizing their multidimensional impacts across various sectors. The analysis highlights that India's service exports significantly contribute to GDP growth, employment generation, and foreign exchange earnings, positioning them as a cornerstone of the country's economic development. Specifically, the contribution of service exports aligns with several SDGs, including SDG 1 (No Poverty), SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 17 (Partnerships for the Goals). From a policy standpoint, these findings underscore the need for a robust and inclusive services trade policy that integrates with national development priorities. Strengthening and expanding service exports can thus serve as a strategic pathway for India to accelerate progress toward achieving the SDGs, while ensuring sustainable and equitable growth.

Keywords: Sustainable Development Goal, Service Exports, Inclusive Growth, India.

1. Introduction

The 2030 Agenda for Sustainable Development, adopted by the United Nations General Assembly in 2015, serves as a comprehensive global framework aimed at addressing key development challenges. It includes 17 Sustainable Development Goals (SDGs) and 169 associated targets, designed to eliminate poverty, reduce inequality, promote inclusive economic growth, ensure social well-being, and safeguard the environment. Officially titled *"Transforming Our World: The 2030 Agenda for Sustainable Development,"* the agenda came into effect in January 2016, following endorsement by all 193 United Nations member states.

International trade and trade policy play a vital role in advancing the Sustainable Development Goals (SDGs), serving as key instruments for economic inclusion and global cooperation. Several SDGs explicitly highlight the importance of trade. For instance, **Goal 2 (Zero Hunger)** calls for the elimination of distortions in global agricultural markets by removing export subsidies and similar trade-distorting measures. **Goal 17 (Partnerships for the Goals)** reinforces the critical role of trade by advocating for a universal, rules-based, open, non-discriminatory, and equitable multilateral trading system. It also emphasizes the need for timely and lasting implementation of duty-free and quota-free market access for all least developed countries (LDCs), while respecting national policy space and leadership in formulating strategies to achieve sustainable development. These provisions collectively underscore how inclusive and fair-trade policies can act as catalysts for achieving the SDGs by promoting economic resilience, reducing inequalities, and strengthening global partnerships.

India's service exports have demonstrated a multi-sectoral presence in global markets. The country's share in global service exports increased from approximately 1.9% in 2005 to around 4.3% in 2023, nearly doubling over this period. India now ranks as the second-largest service exporter in the world, reflecting its strong position in IT outsourcing, software development, and digital services. In the Telecommunication, Computer, and Information Services category, India commands 10.2% of the global export market, underscoring its

dominance in this sector. India is also emerging as a major hub for Global Capability Centres (GCCs). The country continues to innovate, with a strong focus on skill development and strategic policy interventions to support the services sector. In the Other Business Services category, India holds 7.2% of the global market share, making it the third-largest exporter in this segment. However, areas such as international tourism and global transport networks remain underdeveloped and present significant opportunities for growth. Additionally, e-commerce holds strong potential and is expected to become a key contributor to India's GDP in the coming years.

Aligning service export strategies with the Sustainable Development Goals (SDGs) is both highly relevant and urgently needed for the Indian economy. Such alignment addresses critical global challenges, including poverty, inequality, climate change, environmental degradation, and the promotion of peace and justice. It also reflects India's strong commitment to sustainability and responsible business practices. Moreover, integrating SDG principles into service export strategies can enhance India's global competitiveness, attract sustainable investment, and contribute meaningfully to a more inclusive and equitable global economy.

2. Research Objectives

The primary motive of the current study is to examine how the growth of service exports can act as a catalyst for achieving the Sustainable Development Goals (SDGs) by 2030, with a specific focus on the Indian context. The specific objectives are:

1. To analyze the evolving landscape of India's service sector and its role in the national economy.

2. To assess the impact of service exports on India's overall economic growth and development.

3. To explore the alignment as well as cross-sectoral linkages between India's service exports and the SDG agenda.

4. To identify key policy implications for enhancing the development impact of service trade.

5. To examine the major challenges and constraints in leveraging service exports for sustainable development.

3. Research Methodology

This study employs a descriptive and analytical approach using secondary data to explore the contribution of India's service exports toward achieving selected Sustainable Development Goals (SDGs). Data has been sourced mainly from the Reserve Bank of India (RBI) and complemented by relevant international reports. The analysis focuses on identifying sectoral linkages and assessing the qualitative impact of service exports on SDGs such as poverty reduction, education, gender equality, and economic growth,

4. Literature Review

Recent empirical studies underscore that service exports are increasingly becoming a key driver of economic growth, particularly in emerging economies, where they complement traditional goods exports. Sermcheep (2019) confirms the service export-led growth hypothesis in ASEAN countries using panel data analysis. Similarly, Stabler and Howe (1988) found that service exports accounted for 88% of regional growth in Canada's western provinces. Shieh (2020), analyzing data from 89 countries from 1970 to 2018 using panel cointegration and error-correction models, established a significant long-run contribution of service exports to economic growth, though evidence of reverse causality from income to exports was weak. In another study, Onose and Aras (2021) examined five emerging economies (Brazil, India, Nigeria, China, and South Africa BINCS) and found that while service exports contribute positively to short-term growth, long-term economic growth is primarily influenced by foreign direct investment, capital formation, and labor.

In the context of the Sustainable Development Goals (SDGs), Subramony and Rosenbaum (2023) argue that SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure) can

significantly enhance the service sector by promoting employee well-being, fostering resilience, and driving innovation through participatory action research, grassroots organizing, and digital service delivery. SDG 8 focuses on improving the dignity of service work through better wages, working conditions, and career development opportunities, while SDG 9 emphasizes building resilient infrastructure, promoting inclusive industrialization, and supporting sustainable innovation. Supporting this view, Raut et al. (2022) show that integrating sustainable practices into supply chains can improve human well-being, environmental quality, and economic prosperity. Additionally, Iqbal et al. (2020) provide evidence, using a stochastic frontier approach, that aligning with the SDGs has significantly enhanced China's exports of goods and services to Belt and Road Initiative (BRI) countries, highlighting the broader trade advantages of sustainability commitments.

Despite these contributions, there remains a notable research gap—limited studies have explored the link between service exports and the achievement of SDGs, particularly in the context of the Indian economy. Addressing this gap is critical to understanding how India's growing service exports can align with and advance national and global sustainable development objectives.

5. India'S Service Export Landscape

India's percentage share in global services exports has been steadily rising over the last two decades, partly offsetting the decline in its share of global merchandise exports. As of 2023, India ranks 7th globally and 2nd among developing economies in service exports, accounting for 4.3% of the world's total service exports, valued at USD 338 billion. This strong performance can be attributed to strategic policy reforms, increasing investments, and a large, skilled, and growing young workforce that continues to drive India's competitive edge in the global services market.

Chart VIII.2: India's share in global services and merchandise exports

India's share in global Services exports ■ India's share in global Merchandise exports

Source: United Nations Conference on Trade and Development

India's services exports have shown impressive growth, increasing at a trend rate of 11% between FY2014 and FY2023 at constant prices. The export value rose 6.5 times, from USD 52 billion in 2005 to USD 338 billion in 2023, recording a compound annual growth rate (CAGR) of 10.9%. During this period, India's contribution to global services exports expanded from 1.9% to 4.3%, placing the country among the top five fastest-growing services exporters globally in FY2025. The composition of services exports reveals a strong concentration, with approximately 70% of the total accounted for by Computer and Information Services and Professional, Scientific, and Other Business Services (including R&D), which together contributed nearly 68% of India's total services exports in 2023. Overall, the top seven service sectors contribute around 96% of the total export value, while the remaining sectors collectively account for only 4%. Other notable segments

include Travel services, Transport services, and Telecommunications and Financial services, though their individual contributions are relatively smaller compared to the dominant IT and business services sectors.

6. Impact of Service Exports on Economic Growth

India's service exports play a pivotal role in driving economic growth by significantly contributing to GDP, employment generation, and foreign exchange earnings. Accounting for over 50% of India's GDP, the services sector particularly IT and ITES, financial services, telecom, healthcare, and education has emerged as a core growth engine. In FY 2023, the IT-BPM sector alone directly employed around 5.4 million people and generated over 12 million indirect jobs through ancillary services such as transport, hospitality, and security. Travel, tourism, and hospitality services also create substantial employment, especially in semi-urban and rural regions, while sectors like financial services and KPOs increasingly absorb skilled urban youth. India's services exports reached USD 341.1 billion in FY 2023–24, up from USD 325.4 billion in FY 2022–23, reflecting a 4.9% growth and contributing significantly to foreign exchange reserves. Additionally, the steady rise in service exports has helped in narrowing the current account deficit, reinforcing the relevance of the service-led growth hypothesis in the Indian context.

7. Linking Service Exports To The 2030 Sdg Agenda

Service exports have emerged as a key pillar of economic development in many countries, offering a transformative route for achieving the United Nations Sustainable Development Goals (SDGs). Unlike goods trade, services encompass knowledge-intensive sectors such as information technology (IT), healthcare, education, finance, and tourism, which contribute not only to economic growth but also to inclusive and sustainable development. This analysis outlines the contributions of service exports to selected SDGs and their broader policy relevance.

SDG 1: No Poverty

Service exports reduce poverty by generating employment opportunities across high-growth sectors like IT, finance, healthcare, and tourism. These industries provide both direct and indirect jobs, especially in urban and semi-urban regions. The income generated from such employment enhances household livelihoods and contributes to the reduction of income poverty. For developing economies like India, where services form the largest share of GDP, growth in service exports has proven to be a strong poverty alleviation strategy.

SDG 3: Good Health and Well-being

Health services exports especially in medical tourism, telemedicine, and diagnostics enhance global access to quality healthcare. These services benefit patients across borders by providing specialized treatments and remote consultations. At the same time, they generate revenue and stimulate investments in domestic health infrastructure. Cross-border sharing of medical expertise and technology further strengthens public health systems globally, improving health outcomes in underserved regions.

SDG 4: Quality Education

The internationalization of education through online learning platforms, cross-border university partnerships, and training services expands access to quality education. These services address inequalities in educational access, particularly in low-income and remote areas. Exported education services also promote global knowledge exchange, capacity building, and lifelong learning. As a result, they directly contribute to enhancing human capital and supporting inclusive and equitable quality education.

SDG 5: Gender Equality

The digital services sector, including business process outsourcing (BPO), knowledge process outsourcing (KPO), and freelancing platforms, offers flexible, home-based employment options ideal for women. These opportunities help bridge the gender gap in labor force participation by removing traditional workplace

constraints. Service exports thus empower women economically and support gender-inclusive development, especially in regions where female employment opportunities are limited.

SDG 8: Decent Work and Economic Growth

Service exports are major drivers of income and employment growth. Sectors such as IT, tourism, finance, and consulting provide high-quality, formal employment opportunities, often with better wages and work conditions. Service exports also attract foreign investment and improve labor productivity, contributing to overall economic resilience. In India, service exports have played a significant role in structural transformation by shifting employment toward high-value sectors.

SDG 9: Industry, Innovation, and Infrastructure

Service exports in IT and professional services spur technological innovation and encourage the development of digital infrastructure. These sectors often involve high research and development (R&D) content, pushing economies toward knowledge-based industries. Moreover, the export of engineering, design, and urban planning services supports the creation of sustainable infrastructure, further advancing industrial development and innovation.

SDG 10: Reduced Inequalities

Services trade provides an inclusive platform for countries with fewer natural resources to integrate into global markets. By leveraging digital connectivity, marginalized populations including youth, women, and rural workers can access new economic opportunities. Services such as e-commerce and remote freelancing democratize income generation and reduce disparities within and across countries. Hence, service exports support more balanced and equitable economic development.

SDG 11: Sustainable Cities and Communities

Exportable services in areas like sustainable urban planning, eco-tourism, environmental consulting, and green architecture contribute to developing resilient and sustainable urban environments. These services facilitate the design and implementation of smart cities and sustainable housing solutions. Furthermore, they support climate-responsive urban policies through knowledge sharing and international best practices.

SDG 17: Partnerships for the Goals

Service exports often thrive on international collaboration. Cross-border partnerships in education, healthcare, and finance facilitate the sharing of expertise, technology, and investment. Through digital platforms and remote services, countries can engage in mutually beneficial trade relations that align with SDG 17's call for global cooperation. Such collaborations enhance service quality, expand markets, and accelerate sustainable development outcomes.

8. Cross-Sectoral Linkages

At least 11 of the 17 SDGs have strong connections to specific service sectors. Health services (SDG 3), educational services (SDG 4), and ICT (SDG 9) are most frequently cited in relation to sustainable development targets. Financial and transport services also play critical roles in enabling inclusive growth and infrastructure development. Service trade policy therefore directly impacts SDG achievement, especially through its influence on productivity, access, and innovation.

9. Policy Implications

To effectively contribute to the Sustainable Development Goals (SDGs), trade policy must be made more inclusive, equitable, and development-oriented. Governments should align their trade and service export strategies with the SDG framework, particularly emphasizing poverty reduction, inclusiveness, and the

reduction of inequalities. Furthermore, India should continue harmonizing its service export policies with SDG priorities to maximize developmental outcomes and promote sustainable growth.

10. Challenges

Despite global recognition of trade's role in sustainable development, integrating trade policy with SDG objectives remains a significant challenge. Policymakers often struggle to map the complex interlinkages between trade outcomes and specific SDG targets. Inconsistencies between national, regional, and global policies can undermine coherence, making it difficult to implement inclusive and sustainable trade strategies. Additionally, regulatory measures related to food safety, environmental standards, or labor laws in developed countries may inadvertently act as non-tariff barriers for exports from developing economies. For LDCs and SIDS, economic vulnerabilities and uncertainties in global trade further hinder progress, necessitating targeted support to adapt and implement SDG-aligned trade reforms by 2030.

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EGB FACTORS FOR THE SUSTAINABLE FUTURE OF HIGHER EDUCATION INSTITUTIONS

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Abstract

Purpose: Higher-Education-Institutions (HEIs) in India has a crucial role in promoting environmental sustainability and employees, especially faculty members play an agentic role in turning such institutions into green places. Hence, this study aims to understand the relationship between employee level factors like Green Passion (GP), Green Attitude (GA), Green Knowledge (GK) *and* forms of Employee Green Behaviour (EGB) such as In-role and Extra-role Behaviour. It also focuses to evaluate the in-sample predictive power of the proposed model, which would result in enhancing the effectiveness of both individual and institutions.

Methodology: Quantitative approach has been used to gather the data from 158 academicians of HEIs among the twin districts of Costal Karnataka namely Dakshina-Kannada and Udupi. Estimation of model in PLS-SEM is implied using R Package to test the reliability, validity of the constructs. And also structural model is tested to study the relationships and evaluate the hypotheses proposed.

Findings: Outcome of the study reveal, a significant positive relationship of GP with both the forms of EGB, whereas GK has positive relationship only with in-role green behaviour. However, GA has negative weak influence on both in-role and extra-role EGB. The model showed overall moderate in-sample predictive power.

Originality/Value: Research offers a unique practical outline that links environmental passion, attitude and knowledge to both the forms of green behaviour in the context of HEIs, which will have its varied focus on promoting green campus initiatives in India. This study will outspread the literature on EGB and Sustainability by highlighting how internal factors influence employees' behaviour in academic settings and thus encourage its sustainable future.

Keywords: Green Passion, Green Attitude, Green Knowledge, Employee Green Behaviour, Higher Education Institutions, Green Campus.

1. Introduction

Now a days, sustainability has become the utmost priority for many organisations(Hameed et al., 2022; Malik et al., 2020). The United Nation's Sustainable Development Goals define it as transforming the world while respecting the planetary limits and promoting dignity, equity and wellbeing for current and future generations. This highlights the importance of balancing economic, social and environmental goals for sustainable development (Bombiak & Marciniuk-Kluska, 2018). However, since environment plays a pivotal role in long term business continuity (Uslu et al., 2023; Z. Liu et al., 2021) ecological sustainability has now evolved from a strategic advantage to an urgent necessity for both society and organizations. The latest study conducted by Aust et al. (2020, 2024), reveals that green management a subset of sustainability management, which emphasizes enhancing employees' ecological awareness and behavior within organizational contexts. Employees are thus increasingly seen as key agents in driving environmental action, with their behaviors shaped by individual passion, attitudes and knowledge along with workplace dynamics (Fawehinmi et al., 2020). Given that substantial time employees spend at work, their environmentally responsible actions whether voluntary (extra-role) or part of formal duties (in-role) (Dumont et al. 2016; Norton et al. 2014, 2015; Bissing-Olson et al. 2013; Robertson and Barling, 2015) can significantly influence an organization's environmental performance (Safari, 2018) and its future. In this regard, Employee Green Behavior (EGB) can be defined as any observable and measurable individual action within the workplace that contributes to the

achievement of environmental sustainability goals (Andersson et al., 2013; Ones & Dilchert, 2012; Norton et al., 2015).

As like corporates, even Higher Education Institutions (HEIs) have embraced green strategies to build eco-friendly workplaces. (Lukman, Lozano, Vamberger & Krajnc, 2013; Aboramadan 2020) including public and private universities. Several researches state that HEIs function like small cities because of their extensive infrastructural facilities, large and diverse population. This would lead to high energy use and significant waste generation (Al-Zawahreh et al., 2019; Saadatian et al., 201; Gomez & Yin, 2019; Abdul-Azeez & Ho, 2016). Recognising these environmental impact, educational policies such as NEP 2020, reforms of UGC and AICTE, emphasize sustainability in Indian higher education. However, it is evident that effective implementation depends largely on the environmental behaviour of institutional actors, particularly faculty members, as they are key influencers in shaping student values (Fawehinmi et al., 2020; Lukman et al., 2013). As HEIs aim to transform the world in positive direction EGB of academicians has a very important role in promoting green initiatives in the campuses and thus build sustainable future for itself and upcoming generations. Despite growing interest in the field of EGB, especially in the emerging economies (Channa et al., 2021), there is limited empirical research within the Indian context, particularly in HEIs that provides detailed approach on internal factors of EGB (Widyanty et al., 2025).

Therefore, the purpose of this study is to know the relationship between individual EGB factors like Green Passion (GP), Green Attitude (GA), Green Knowledge (GK) *and* forms of EGB such as In-role and Extra-role Behaviour in the context of Indian Higher Education. And also to evaluate in-sample predictive power of the conceptual model proposed. By understanding these relationships and predictive power, the current study offers valuable insights on how these EGB factors helps in promoting green campus initiatives and thus can foster a culture of environmental responsibility in academic work environments.

2. Literature Review

In accordance with Self-Determination Theory (SDT), developed by Deci and Ryan (1985), when motivation is autonomous rather than controlled, individuals demonstrate greater engagement, persistence, and well-being because it can satisfy their principal psychological needs for autonomy, competence, and relatedness. Further, extending the study on SDT, Vallerand et al. (2003) proposed the Dualistic Model of Passion, distinguishing between harmonious passion i.e rooted in autonomous motivation and obsessive passion which is driven by external pressures. Harmonious green passion fosters positive affect and facilitates proactive green behavior, where eco-friendly actions are self-endorsed and meaningful (Cho & Yoo, 2021; Li et al., 2020). Green attitude acts as a cognitive mediator that links internal motivation to sustainable behavior (Mamun, 2023), while green knowledge enhances perceived competence, further supporting intrinsic motivation (Koo et.al., 2014). Thus, SDT provides a robust framework to understand how individual factors interacts with EGB in-role and extra-role to promote sustainable workplace behavior. With this background, the detailed review of literature discussed as follows-

2.1 Green Passion and EGB: GP defined as an employee's strong emotional connection and commitment to eco-friendly actions at work, is recognized as a key driver of EGB (Li et al., 2020; Jia et al., 2018; Luu, 2020; Robertson & Barling, 2013; Cho & Yoo, 2021). Here, our study reflects a positive form of passion known as harmonious passion, where individuals engage in pro-environmental behavior voluntarily and enthusiastically, even beyond formal job requirements (Afsar et al., 2016; Choong et al., 2020). Such passion fosters intrinsic motivation, leading employees to view environmentally responsible tasks as meaningful, enjoyable, and challenging. Despite its growing recognition, research on green passion remains limited, particularly across diverse cultural and organizational contexts (Ho et al., 2018; Vallerand, 2012). Hence the following hypothesis:

H1(a): There is a positive relationship between GP and EGB In- role in HEIs.
H1(b): There is a positive relationship between GP and EGB Extra-role in HEIs.

2.2 Green attitude and EGB: GA refers to an individual's beliefs, concerns, and tendency toward environmentally responsible actions (Schultz et al., 2004; Luo & Deng, 2008; Chan et al., 2014). In organizational settings, employees often lack personal financial incentives to conserve resources, making attitude a key psychological factor in driving green behaviour at work (Manika et al., 2015). While earlier studies offered mixed results regarding the link between attitude and EGB (Safari, 2018), more recent research consistently demonstrates a positive association (Bissing-Olson et al., 2013; Chan et al., 2014; Luo et al., 2023). Employees with strong environmental attitudes are more prospective about both in-role and extra-role green behaviours, making attitude a significant predictor of EGB. Therefore, following hypothesis is formed to understand the connection between GA and EGB in a new geographical setting.

H2(a): There is a positive relationship between GA and EGB In- role in HEIs.
H2(b): There is a positive relationship between GA and EGB Extra-role in HEIs.

2.3 Green Knowledge and EGB: GK defined as awareness of ecological issues, human effect on the surroundings and mitigation strategies, one of the critical antecedents of green behavior (Fawehinmi et al., 2020; Safari, 2018). Employees with higher green knowledge are more inclined to participate in eco-friendly practices, while a lack of such knowledge often acts as a barrier to implementing institutional sustainability initiatives (Chan et al., 2014; Zhu et al., 2022). Beyond individual awareness, the application and sharing of environmental knowledge within organizations fosters innovation and collective engagement in green practices Thus, GK serves as a key motivator that shapes and reinforces EGB. However, limitations persist in individuals' understanding of environmental issues which impacts their behaviour (Fawehinmi et al., 2020). Hence following hypothesis is framed:

H3(a): There is a positive relationship between GK and EGB In- role in HEIs.
H3(b): There is a positive relationship between GK and EGB Extra-role in HEIs.

In total, below conceptual model has been proposed based on the above discussions to evaluate the hypotheses.

Conceptual Model
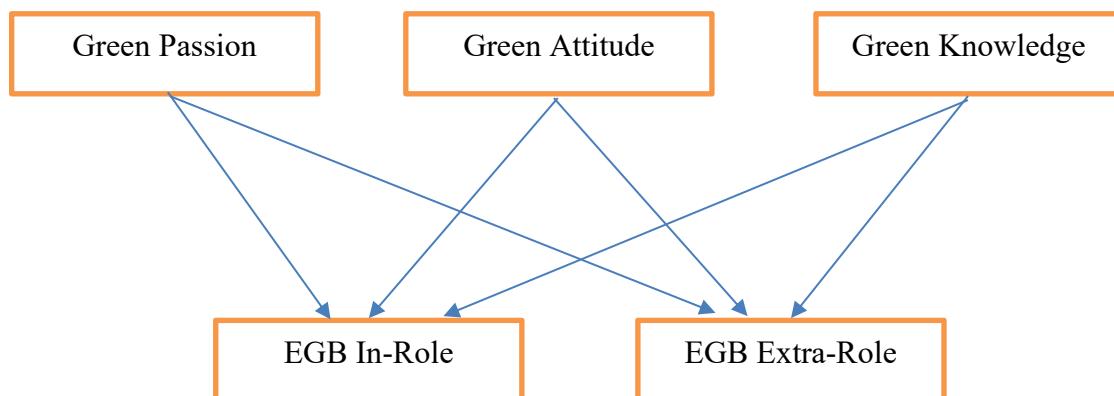
Source: Researcher's own work

3. Methodology

This study examined the framework of EGB within the context of HEIs located in the Dakshina Kannada and Udupi districts of Karnataka, India. They are called as twin districts of Coastal Karnataka. The intention for choosing these regions are firstly, as per Sustainability Livelihood Security Index, these districts have moderate sustainability and have the potential to reach higher index (Sridhara et al.,2022). Secondly, these districts hold rich academic heritage with age old institutions attracting many students across the country. 158 faculty members have been surveyed using a structured questionnaire. Respondents were assured of confidentiality and given the option to remain anonymous. A convenience sampling method was employed. The list of HEIs was sourced from the Department of Higher Education, Government of Karnataka, based on the All India Survey on Higher Education (AISHE) 2022–23.

The perception of the respondents was measured using five-point Likert scales. The items were developed on the basis of review of existing literature including demographic questions (Table I).

Table I: Respondents' Demographic Profile

Demographics	Classification	Frequency (n=158)	Percentage
Gender	Female	118	74.6
	Male	40	25.3
Age	30 years & below	28	17.9
	31 – 40 years	79	50
	41 – 50 years	41	26.3
	51 – 60 years	7	4.5
	Above 60 years	3	1.9
Qualification	Doctorate(Ph.D.)	31	19.9
	Postgraduate	123	78.8
	Graduate	3	1.9
	Professional Courses	1	0.6
Experience	5 years & below	31	19.9
	6– 10 years	37	23.7
	11 – 15 years	48	30.8
	16 – 20 years	20	12.8
	21- 25 years	12	7.7
	26- 30 years	5	3.2
	Above 30 years	5	3.2
Region	Dakshina Kannada District	80	50
	Udupi District	78	50

4. Results And Discussions

The predictive power was estimated in PLS- SEM using SeminR of R package. This was done in two key stages. First stage to examine the measurement model which evaluates the reliability, validity of the constructs. And in the second stage, structural model is tested to study the relationships between the variables and assess the hypotheses proposed.

4.1 Measurement Model Assessment:

4.1.1 Reliability Test: The internal consistency reliability of the measurement model is fulfilled as all the Cronbach's alpha values in the reflective measurement model stand above the threshold value of 0.7(Table II). Further, convergent validity is also established for most of the constructs as AVE values are above the expected value 0.5 except GA (0.433), indicating deficiency in convergent validity though it is at borderline. The average of AVE is calculated and found to be 0.663.

Table II: Measurement Model Assessment

	alpha	rhoC	AVE	rhoA
Green_Passion	0.910	0.929	0.651	0.912
Green_Attitude	0.839	0.782	0.433	2.344
Green_Knowledge	0.767	0.844	0.577	0.825
EGB_Inrole	0.902	0.939	0.837	0.906
EGB_Extrarole	0.890	0.932	0.819	0.891
Avg			**0.663**	

4.1.2 Discriminant validity: The establishment of discriminant validity specify that a construct is distinct from other constructs by practical and empirical standards. p. 115 (Hair et al., 2017). As shown in Table III, the diagonal position illustrates the highest square root of AVE compared to each row and column of the other measurement items. Thus Fornell–Larcker discriminant validity is established.

Table III: Fornell–Larcker Criterion

	Green_ Passion	Green_ Attitude	Green_ Knowledge	EGB_Inrole	EGB_ Extrarole
Green_Passion	0.807				
Green_Attitude	-0.136	0.658			
Green_Knowledge	0.535	-0.117	0.759		
EGB_Inrole	0.488	-0.145	0.389	0.915	
EGB_Extrarole	0.548	-0.260	0.363	0.665	0.905

4.1.3 Coefficient of determination (**R² value**): The table IV below, will show the value of R² and adjusted R², which are the indicators to know how much variance in each dependent constructs are described by their independent variables specified in given conceptual model. As the variances are above 25%, it is satisfactory. The average of R² calculated and found to be 0.303

Table IV: R² value

	EGB_Inrole	EGB_Extrarole	Avg
R^2	0.266	0.340	**0.303**
AdjR^2	0.252	0.328	

However, in order to know the Goodness of fit index (GFI) the geometric mean of average AVE (0.663) and R² (0.303) is calculated as recommended by Tenenhausetal (2005). For the proposed model the value found to be 0.45, which is said to be low and model do not fit the data well (Hoffmann and Birnbrich , 2012).

4.2 Hypotheses testing

Even though, GFI of the proposed model is low in this context, the hypotheses testing is done to identify the relationship between individual level EGB factors GP, GA, GK and in-role and extra-role forms of green behavior.

Table V: Relationship between Constructs

Hypothesis	Relationship	Std Beta	t-value	2.5% CI	97.5% CI	f-square	Decision
H1 (a)	Green_Passion -> EGB_Inrole	0.385	4.675	0.202	0.518	0.132	Accepted
H1 (b)	Green_Passion -> EGB_Extrarole	0.477	6.894	0.312	0.578	0.242	Accepted
H2 (a)	Green_Attitude -> EGB_Inrole	-0.072	-0.746	-0.231	0.155	0.007	Rejected
H2 (b)	Green_Attitude -> EGB_Extrarole	-0.185	-1.525	-0.317	0.185	0.050	Rejected
H3 (a)	Green_Knowledge -> EGB_Inrole	0.174	2.280	0.049	0.356	0.030	Accepted
H3 (b)	Green_Knowledge -> EGB_Extrarole	0.086	1.119	-0.040	0.259	0.008	Rejected

As mentioned in table V, H1(a), H1(b) and H3(a) hypotheses are accepted as Confidence Interval (CI) values at 2.5% and 97.5% for all the three does not include zero and std beta values show positive effect between the constructs with the medium and small effect size (0.132), (0.242) and (0.030) respectively. Conversely, hypotheses H2(a), H2(b) and H3(b) are rejected, since CI values include zero and they have negligible effect size (0.007), (0.050) and (0.008) respectively. However, it is noted that while std beta values for H2(a) & (b) show negative significance, H3(b) has positive beta value. This shows the in-sample predictive power of the proposed model is moderate as only four path predictors are under threshold values (effect size >=0.02).

In summary the discussions reveal that GP has positive influence on both in-role and extra-role EGB, indicating that people who are more passionate about environment which is purely an internal drive, are mostly to engage in both types of green actions at work. Likewise, GK significantly predict in-role green behaviors but not extra-role behavior. This might be because, despite having general basic level environmental awareness, lecturers often prioritise teaching and research over sustainability of institutions with limited knowledge of policies framed (Dyball, 2010; Derahim et al., 2012; Wals, 2014). That means, employees engage in green behaviour more often when it is in their policy framework. Therefore, knowledge alone may not be enough to go beyond the assigned roles. Nevertheless, in spite of its theoretical importance, GA did-not have significant relationship with both the forms of EGB. This implies there might be an attitude- behavior gap, potentially due to factors such as lack of recognition, increased workload, or limited psychological satisfaction. And also there might be measurement issue as AVE value for the same is noted below the threshold value (See Table II) which has its impact over the result. Over all the model needs revision in terms of (i) adding more meaningful factors to predict EGB (ii) increasing sample size to generalize the results.

5. Managerial Implication

From a managerial perspective, the discussion of the results offers invaluable insights for HEIs, seeking to enhance eco-sustainability through green campus initiatives. These initiatives may begin with individual drives rather than just institutional factors. In this regard, study reveal that passion plays very important role in EGB. However, it also noted that knowledge alone may not be enough, there required external motivation to engage in EGB and indicates that most of the times faculty members, show green behaviour when it is part of their assigned duty. Institutions aiming for long-term organizational effectiveness should invest their efforts in the development of green individual competencies such as environmental passion, knowledge and attitude. Integrating green values into the institutional culture not only encourages eco-conscious behaviour but also contributes to greater employee satisfaction.

6. Limitations And Future Directions

This study is also not without its limitations, like any other research. Firstly, study concentrated on a specific territories of Karnataka state. As the cultural norms and values have an influential concern over respondent's perceptions, future research can obtain the information from other cultural backgrounds across the country or outside. Secondly, the study collected information from only faculty members, while upcoming studies may consider non-teaching staff members too whose inputs are also valuable in terms of EGB. Further, we adopted cross sectional design here, but future exploration can think of more rigorous designs like longitudinal study or casual relations, among the variables. As GA shows low convergent validity, further studies should consider refining the measurement items for this variable. Finally, relying solely on quantitative survey methodology will omit in-depth understanding of the constructs, hence mixed methodology may be used. Additionally, there are numerous avenues to explore other antecedents of EGB and also to study the consequences of it at various levels such as individual, team, organisation and society.

Conclusion

As we move towards a more environmentally conscious future, it is essential for HEIs players like policy makers, academicians, researchers and other stakeholders to create supportive structures and green work climate that encourages sustainable practices. By positioning educators as key role models to exhibit green

behaviour for current and future generations, HEIs can serve as the foundation for promoting environmentally responsible citizens and building truly green campuses in our country.

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DESIGN THINKING IN GREEN INITIATIVES: TRANSFORMING WASTE INTO DIGNITY THROUGH THE STORY OF KRISHNA, A WASTE ENTREPRENEUR

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Abstract

This exploratory study examines the role of green initiatives in promoting sustainable development amid growing environmental challenges. Focusing on the intersection of sustainability and design thinking, it explores the case of Krishna, an informal waste worker in Bengaluru, whose grassroots efforts transformed waste management through innovative, human-centered practices. Using secondary data, the research illustrates how design thinking principles empathy, definition, ideation, prototyping, and testing—were intuitively applied to create socially inclusive and environmentally sustainable solutions.

Krishna's journey demonstrates how informal waste workers can drive systemic change when empowered with empathy-driven innovation. The study emphasizes the importance of recognizing the informal sector's contribution to circular economy models and advocates for their inclusion in formal sustainability policies. It reframes waste as a resource and a vehicle for Social Upliftment, offering a scalable, community-based model for urban environmental resilience and equity.

Keywords: Green initiatives, Sustainability, Design-thinking, Waste Management, Empathy, Definition, Prototyping, Testing, Socially Inclusive Human-Centered, Circular Economies, Innovation, Social Upliftment, Environmental Resilience

Introduction

Sustainable development is now more important than ever due to the depletion of natural resources, climate change, and increasing environmental degradation. Green initiatives, which encompass a wide range of ecologically conscious actions, have become essential tactics to reduce ecological damage and encourage a harmonious cohabitation of human development and the natural world.

Green initiatives refer to actions, strategies, or policies implemented by individuals, organizations, or governments aimed at reducing environmental impact and promoting sustainability. These initiatives are designed to conserve natural resources, reduce pollution, combat climate change, and protect ecosystems. They encourage responsible resource use, energy efficiency, waste reduction, and the adoption of renewable energy sources.

These initiatives, which cover a wide range of industries from waste management and construction to energy and transportation, are intended to lower carbon emissions, preserve natural resources, and promote sustainable consumption habits. Rising global temperatures, more frequent natural disasters, and declining air and water quality all of which are associated with environmental stress brought on by humans highlight the necessity of green measures.

As the world grapples with these challenges, both rich and developing countries are seeing the need to shift to more sustainable growth models as the world struggles with these issues. This study investigates the idea of green initiatives, looks at how they are being implemented in different industries, and emphasizes how important they are to solving the environmental problems of the twenty-first century.

Societies may move toward low-carbon economies, improve environmental resilience, and guarantee a healthier planet for future generations by incorporating green efforts into routine operations and long-term planning.

Sustainable urban development and climate action have emerged as major issues in academics, business, and policy. However, solutions frequently exclude the informal trash workers, who are at the grassroots level and are essential to the reduction, sorting, and recycling of urban waste. With a strong foundation in design thinking, Krishna's story provides a compelling account of tenacity, creativity, and community organizing. In order to show how the five stages of design thinking Empathize, Define, Ideate, Prototype, and Test—were not merely theoretical concepts but also intricately entwined with his personal experience and community initiatives, this paper examines his journey through them.

Background: Waste Management and Informal Sector in India

Every day, India produces more than 150,000 tonnes of municipal solid trash, a quantity that keeps increasing due to the country's fast urbanization, population expansion, and shifting consumption habits. Less than 30% of this garbage is efficiently handled, whereas about 70% is collected. Waste management in India is still a difficult task, even with notable advancements in infrastructure and policy. A significant amount of rubbish is dumped in open landfills, which harms the environment, poses health risks to the public, and depletes precious recyclable materials.

The informal garbage industry, which includes waste pickers, itinerant buyers, tiny scrap dealers, and informal recyclers, forms the backbone of this system. They are crucial participants in any sustainable waste management plan since they have extensive, practical knowledge of the local waste streams and recycling procedures.

These people are essential in keeping recyclables out of landfills, lessening the environmental impact of cities, and establishing a circular economy at the local level. Despite being the backbone of urban garbage management, informal waste workers many of whom come from underprivileged caste groups—continue to face social and economic exclusion. However, their labour is performed in hazardous and degrading conditions, is underappreciated, and receives inadequate pay.

Design Thinking and Green Innovation
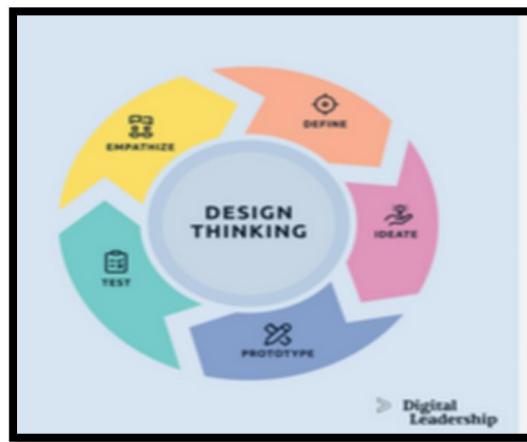
In a world where waste and environmental degradation are growing increasingly problematic, innovation and sustainability must coexist. Design thinking's human-centered approach to problem-solving offers useful resources for addressing these concerns in a creative and inclusive manner.

With the goal of improving future outcomes, design thinking is a formal approach for solving problems in a creative and practical way. In this sense, it is a type of solution-based or solution-focused thinking that, rather than focusing on solving a particular issue, begins with the objective of identifying a better future circumstance. By taking into account the problem's current and future circumstances and parameters, multiple solutions can be investigated at the same time.

Design thinking is distinct from the analytical scientific method, which begins with a thorough identification of all the problem's facets in order to formulate a solution. Design thinking examines and explores both known and unknown aspects of the existing situation in order to uncover hidden parameters and create new paths that might lead to the goal. Midway solutions are also possible beginning points of alternate approaches, such as rethinking the original problem, because design thinking is recurring.

Design thinking is an iterative, human-centered method of problem-solving that promotes creativity by thoroughly comprehending the needs of individuals and communities. Fundamentally, it encourages empathy, teamwork, and experimentation, which makes it especially appropriate for tackling the intricate, interrelated problems present in sustainability and environmental initiatives.

Design thinking is a potent framework that guarantees solutions are not only technically sound but also environmentally and socially inclusive when used in green efforts. Its five phases each provide a distinct contribution to creating comprehensive and effective interventions:

1. Empathize – Understand Human and Environmental Needs with Empathy

Understanding the detailed requirements of various stakeholder profiles is the foundation of design thinking; to apply design thinking, you must firmly place yourself in your stakeholders' shoes. Empathy is therefore an essential component of the technique. The first stage is to immerse oneself in the realities of people affected by environmental challenges.

Customers, citizens, and occasionally overlooked stakeholders including small-scale recyclers, local communities, and unpaid garbage workers are all included in the context of green projects. By hearing their stories, observing their challenges, and discovering their unmet needs, we can begin developing solutions that preserve human dignity and ecological integrity. For example, Its objective is to produce solutions that benefit all parties involved.

2. Define – Articulating the Real Problem

The following stage after obtaining insights is to combine the data in order to formulate the appropriate problem. This could entail redefining a technical problem (like the management of plastic trash) as a more general socio-environmental issue (like the under appreciation and lack of support for informal waste workers) in green projects. Targeted, effective solutions that address the underlying causes of an issue rather than just its symptoms are made possible by a well identified problem.

3. Ideate – Generating Creative and Contextual Solutions

Diverse stakeholders are encouraged to freely and cooperatively brainstorm at this level. Cross-sectoral discussions between designers, environmentalists, legislators, and community people may be a part of the ideation process for green projects. The purpose is to come up with a variety of concepts that strike a balance between social and economic realities and environmental aims, such as turning waste materials into useful products, establishing inclusive recycling programs, or producing low-tech, regionally relevant equipment.

4. Prototype – Building Realistic, Scalable Models

Making real, low-risk tests out of abstract concepts is known as prototyping. Prototypes in sustainable development can include anything from mobile apps that link garbage workers and buyers to new recyclables collection systems. Communities may evaluate what works in practice, make quick adjustments, and avoid investing in ineffective ideas by testing scaled-down versions.

5. Test – Refining Through Feedback and Iteration

Testing allows real users to interact with the prototype and provide feedback. This guarantees that solutions in green contexts are not only economically feasible but also culturally acceptable and environmentally sound. In order to improve acceptance, long-term sustainability, and constructive systemic change, it allows designers and communities to iteratively improve the solution.

By analyzing Krishna's experience, this research article aims to demonstrate how design thinking concepts might be applied to local ecological issues. Communities will be able to jointly develop solutions that are durable, scalable, and deeply rooted in local reality as a result. This story is one of hope, perseverance, and the potential to reconsider trash as a foundation for dignity.

Objectives of The Study:

1. The primary objective of this study is to explore how the principles and practices of design thinking can be effectively applied to green initiatives.

2. To demonstrate the importance of empathy and community engagement in designing effective waste management systems that uplift marginalized populations, particularly informal waste workers especially Krishna's entrepreneurial journey as a case study in grassroots innovation, resilience, and community-driven change.

Research Methodology: The research is of exploratory in nature and data used is secondary data published in the form of news articles.

Literature Review

1. The paper titled "Waste Management Initiatives in India" authored by Dr. Ravish Agarwal ,Mona Chaudhary, Jayveer Singh underscores the critical role of environmentally friendly products in India's sustainable development efforts. It reviews various initiatives and prospects aimed at promoting green practices, while also acknowledging the challenges faced in widespread adoption. The study highlights how circular economy principles and positive reinforcement mechanisms can drive the green product

movement forward. Ultimately, it advocates for embedding a green culture into India's broader development framework to achieve enduring environmental and social benefits.

2. In the research paper titled, "Eco-Innovations in Waste Management –A Review of High Point Cases" by S Manasi and Harshita Bhat Bengaluru generates massive amounts of organic waste daily, but faces systemic issues in segregation and treatment despite municipal efforts. Innovative, decentralized solutions like *Daily Dump* and grassroots initiatives such as *Eco Pens*, *Eco-friendly Ganeshas*, *Toys from Trash*, and *E-Parisara* creatively repurpose waste, promoting sustainability and environmental awareness. These models demonstrate scalable, community-driven approaches to urban waste management.

3. In the research paper "Design Thinking: A Review Paper" by Vikas T N, Vinay C T, Habeeba Amrutha Hegaddathy , Rizwan N Shaikh , Mrs. Vidya presents a comprehensive overview of the concept, methodology, and educational implications of design thinking. The paper explores design thinking as a human-centered, iterative approach to problem-solving that integrates creativity, empathy, and experimentation, making it valuable across design, business, and education. It emphasizes the importance of teaching design thinking to prepare students for complex real-world challenges and advocates for its integration into academic curriculum to enhance critical and creative thinking skills.

4. In the research paper titled , "Study On The Concepts Of Design Thinking" by Mrs P. Deep highlights that Design Thinking is more than a process—it is a mindset that combines empathy, creativity, and rationality to solve problems iteratively. Its human-centric approach helps organizations and individuals innovate effectively in an interconnected and rapidly changing world. The study reinforces design thinking as a vital, flexible, and user-centered approach that nurtures innovation through empathy, iteration, and collaboration, making it applicable in diverse real-world and business contexts.

Krishna'S Journey Through The Design Thinking Framework

The research study explores how design thinking can catalyse green initiatives by delving into the inspiring story of Krishna, a waste entrepreneur who transformed not only discarded materials but also the lives of those who collect and process them.

Krishna's journey from a marginalized background to becoming a pioneer in sustainable waste management exemplifies the transformative power of empathy, ideation, and iterative innovation. His story is not just one of environmental impact, but of human dignity reclaimed through enterprise and purpose. Through his lens, we see how waste often viewed as worthless can become a resource, a livelihood, and a symbol of change.

By unpacking Krishna's experience, this book aims to demonstrate how the principles of design thinking can be applied to grassroots ecological challenges, empowering communities to co-create solutions that are sustainable, scalable, and deeply rooted in local realities. This is a story of hope, resilience, and the potential to reimagine waste as a foundation for dignity.

By examining the inspirational tale of Krishna, a wastepreneur (trash entrepreneur) who changed not only the lives of people who gather and process rejected materials, but also their own, the study investigates how design thinking may spur green projects.

Lived experience served as the foundation for Krishna's empathy. He helped his mother in gathering and sorting rubbish after quitting school because of caste stigma and harassment. He gained a unique understanding of the socioeconomic challenges, environmental effects, and psychological toll that waste pickers endure as a result of this immersion.

Empathize: Experiencing the Problem First-Hand

His narrative demonstrates how waste, which is sometimes viewed as useless, can be transformed into a resource, a source of income, and a symbol of transformation. Krishna is a prime illustration of the transformational potential of empathy, ideation, and iterative innovation, having come from a marginalized

background to become a pioneer in sustainable waste management. His tale is one of human dignity restored via initiative and purpose, in addition to the effects on the environment.

Define: Reframing the Waste Picker's Identity

Krishna identified the fundamental issue: garbage pickers' systematic marginalization and lack of dignity. Instead of redefining waste pickers as "scavengers," he reframed them as vital members of the circular economy and collaborators in waste management.

Ideate: Envisioning New Models

With the help of groups like Hasiru Dala and mentors like Anselm Rosario, Krishna came up with innovative ideas for door-to-door waste collection services, community-owned dry waste collection centers, and eventually textile waste management. He was innovative in that he saw garbage as a resource and a chance for economic growth rather than merely a problem.

Prototype: Building and Scaling Solutions

In 2011, Krishna co-founded Domlur Ward 112, one of Bengaluru's first dry garbage collection sites. Only 20 to 30 kg of rubbish were received each day, which was a disappointing start. They therefore developed a door-to-door collection prototype, which expanded to 3,000 homes and prompted the BBMP to recognize the policy.

Test: Institutionalizing and Iterating

With the signing of an MOU between Krishna and BBMP in 2017, the role of waste pickers was formally formed. Today, the model employs 15 people, mostly women, and gathers 3 tonnes every day. His collaboration with ReTex by Enviu serves as an example of how iterative testing in the upcycling and gathering of textile waste may result in scalable and sustainable businesses.

Observations:

i) Design Thinking is Naturally Embedded in Grassroots Innovation: Although not formally trained in design thinking; Krishna intuitively followed its five stages. His iterative, problem-solving approach shaped by necessity and local knowledge demonstrates that design thinking can organically emerge in marginalized contexts.

ii) Design Thinking Enables Inclusive Circular Economy Models: The integration of waste workers into systems that prioritize reuse, recycling, and upcycling reveals how design thinking can build circular economies that are both sustainable and socially inclusive.

iii) Dignity and Sustainability Are Interlinked Goals: Krishna's story affirms that environmental innovation should not merely reduce waste, but also restore human dignity. Design thinking bridges these goals by aligning ecological solutions with social equity.

Conclusion:

i.   Krishna's story demonstrates how design thinking can be effectively applied to grassroots green initiatives, particularly in the realm of waste management. By embodying the five stages of the design thinking process empathize, define, ideate, prototype, and test Krishna developed innovative and inclusive waste solutions grounded in lived experience. His work illustrates how empathy and human-centered design can transform not just environmental outcomes, but also social realities, by restoring dignity to informal waste workers and redefining their role in urban sustainability.

ii. The case highlights the importance of involving marginalized communities in the design and implementation of green initiatives. Krishna's success shows that when informal waste workers are included as stakeholders and solution-creators, sustainable and scalable models of waste management can

emerge. His journey also emphasizes the need for policy frameworks that recognize and support grassroots entrepreneurs, ensuring that environmental goals do not come at the cost of social equity.

iii. Ultimately, Krishna's experience affirms that waste is more than a material challenge—it is also a human one. Addressing it effectively requires a shift in mindset that sees waste as a resource and waste workers as agents of change. Design thinking, when rooted in empathy and community engagement, offers a practical path toward building inclusive, circular economies that align environmental sustainability with social justice.

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GREEN STEPS: A SMART ECO-TRACKING SYSTEM FOR PROMOTING SUSTAINABLE URBAN MOBILITY

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Abstract

Green Steps is an innovative and eco-conscious system designed to promote sustainable travel behavior through smart technology and gamification. The core idea is to motivate individuals to choose environmentally friendly modes of transportation such as walking or cycling over motorized options. Using GPS tracking and motion sensors like accelerometers, the system accurately detects the mode of travel. Users are rewarded with *eco-points* for green transportation choices, while motor vehicle travel does not yield any rewards. Green Steps calculates energy savings and tracks carbon footprint reduction based on travel behavior. It provides users with real-time insights, personalized suggestions, and motivational feedback through a dedicated mobile application or dashboard. This not only raises awareness but also encourages continuous engagement and behavioral change toward sustainability. Technologically, the project incorporates Arduino-based microcontrollers, GPS modules for location tracking, and accelerometers for motion detection. These components interact with a mobile application that displays daily statistics, eco-point scores, and environmental impact summaries. The seamless integration of hardware and software ensures a smooth user experience. Green Steps is not just a personal tool it holds potential for broader applications in schools, universities, corporate wellness programs, and community sustainability initiatives. By making green behavior fun and measurable, it empowers users to take small but meaningful steps toward reducing carbon emissions and promoting a healthier lifestyle. Overall, Green Steps blends environmental responsibility with modern technology to create a powerful platform for climate-positive action.

Introduction

In recent years, the concept of environmental sustainability has emerged as a pressing global priority, driven by the alarming and escalating levels of environmental degradation, including rising pollution levels, increasing concentrations of greenhouse gases in the atmosphere, and the severe and far-reaching consequences of climate change. These environmental challenges pose significant threats to ecosystems, public health, and long-term planetary stability. Among the various human activities contributing to environmental harm, the transportation sector stands out as a major contributor to global carbon emissions. This is especially true for personal and motorized vehicles that operate on fossil fuels such as petrol and diesel, which release large amounts of carbon dioxide and other harmful pollutants into the environment. As nations and communities across the world work towards building greener, cleaner, and more sustainable futures, there is a growing need to encourage environmentally responsible behavior in day-to-day life, particularly in routine commuting and travel practices. Promoting the adoption of green mobility options—such as walking, bicycling, or utilizing energy-efficient and public transportation systems—represents a critical step in mitigating the environmental impact of transportation and fostering more sustainable urban living. In response to this need, the *Green Steps* project has been conceptualized and developed as a smart, technology-driven initiative aimed at shaping and rewarding eco-conscious travel choices. The Green Steps system is a compact and innovative digital solution that employs a combination of advanced GPS technology and motion-sensing devices such as accelerometers to accurately monitor, analyze, and interpret an individual's travel behavior. By detecting patterns in movement, the system can distinguish whether the user is walking, cycling, or using a motorized mode of transport such as a car or motorcycle. Based on this analysis, the system assigns "eco-points" a gamified incentive that reflects the environmental value of the user's chosen mode of transportation. Zero-emission activities like walking and cycling are rewarded with higher eco-points, recognizing their minimal environmental footprint and contribution to sustainability. In contrast, travel by motorized vehicles, which significantly contributes to air pollution and greenhouse gas emissions, does not earn any points. This

scoring system serves as a motivational framework, encouraging individuals to reduce their carbon footprint by transitioning from high-emission transportation modes to more sustainable, low-impact alternatives. In doing so, Green Steps not only promotes individual behavioral change but also supports broader societal goals of environmental preservation and sustainable urban development

The primary objective of Green Steps is to raise awareness of individual energy consumption and its environmental effects. It promotes physical activity, reduces the carbon footprint of everyday travel, and makes the process engaging through gamification. In real-time, the system not only tracks and records travel data but also calculates estimated energy savings and carbon emission reductions. It provides personalized feedback and suggestions, nudging users toward more sustainable transportation habits. The advantages of Green Steps are multifaceted. Firstly, it actively promotes eco-friendly behavior, directly contributing to reduced carbon emissions and improved air quality. Secondly, it supports physical health by encouraging walking and cycling, helping users integrate fitness into their daily routines. Thirdly, its gamified structure with points, levels, badges, and potential rewards makes the experience interactive and motivating, increasing the likelihood of long-term behavioral change. Moreover, the system can be implemented in various settings such as schools, colleges, corporate offices, and residential communities to organize green challenges, track collective impact, and foster environmental consciousness at a community level.

From a technical perspective, the Green Steps system includes a portable device embedded with GPS and accelerometer modules to detect user movement and travel patterns. A microcontroller (such as Arduino or Raspberry Pi) processes the data and applies logic to determine the travel mode and assign points. This data is synchronized with a mobile app or web-based dashboard, where users can track their daily, weekly, or monthly performance. The app displays eco-points, estimated energy savings, and even suggestions for improving green habits. To further incentivize users, the system can be linked to real-world rewards, such as discounts from eco-friendly brands, digital badges, or donations to environmental causes like tree planting. Despite its numerous strengths, the system does come with certain limitations. GPS-based tracking may occasionally face inaccuracies due to signal interference or device limitations, which could affect the detection of specific travel modes. Additionally, the system may not be fully inclusive of individuals with mobility challenges who are unable to walk or cycle, potentially leaving out a segment of users. Concerns regarding data privacy and battery consumption also arise, especially since the system involves continuous location tracking and real-time data transmission. Addressing these concerns through secure data handling, battery optimization, and inclusive design will be vital for widespread adoption. Nevertheless, the broader impact of Green Steps is significant. By seamlessly combining technology with environmental education, the system empowers individuals to take ownership of their environmental footprint. It builds a sense of accountability and social responsibility, especially when implemented in group settings where collective performance can be tracked and celebrated. Over time, aggregated data from the system could even support urban planners and policymakers in developing infrastructure that supports green mobility and smart city initiatives.

In conclusion, Green Steps is a forward-thinking project that harnesses the power of smart technology to make sustainable living accessible, measurable, and rewarding. It transforms everyday travel choices into opportunities for environmental action and personal growth. As awareness grows and more users engage with the system, Green Steps has the potential to spark a broader cultural shift transforming individual behavioral change into a collective movement toward a cleaner, greener future.

Objectives:

1. To design a smart system that monitors travel modes using GPS and motion sensors.

2. To reward users for choosing sustainable transport options.

3. To provide users with data-driven insights into their travel behaviour and carbon footprint.

4. To promote behavioural change through gamification and continuous feedback.

Literature Review:

The **Green Steps** project integrates both **hardware and software technologies** to create a smart, energy-aware mobility tracker. The following technologies are utilized to implement the key functionalities of the system:

Hardware Components:

Microcontroller (Arduino/Nodemcu/Raspberry Pi): Acts as the brain of the device, responsible for processing sensor data, determining travel modes, and controlling outputs.

- *Arduino Uno* – ideal for beginners and small-scale prototypes

- *NodeMCU (ESP8266)* – useful when Wi-Fi connectivity is required

- *Raspberry Pi* – for advanced processing or when additional sensors and display interfaces are needed

GPS Module (e.g., Neo-6M): Used to track the real-time location and movement speed of the user. This helps determine distance traveled and differentiate between walking and motor vehicle use.

Accelerometer Sensor (e.g., MPU6050): Detects motion, orientation, and activity patterns. Used to classify the mode of movement walking, cycling, or riding.

Battery Pack: A rechargeable power source to make the device portable and wearable.

OLED or LCD Display (Optional): Used to show real-time stats like distance walked, points earned, and energy saved without needing a smartphone.

Software Tools

Embedded C/Arduino IDE: Used to program the microcontroller for sensor integration, logic implementation, and data processing.

Python (if using Raspberry Pi): For scripting and handling sensor data, building algorithms for detection, and integrating with APIs or cloud platforms.

Mobile Application (Flutter/React Native): A cross-platform mobile app is used to display user data, eco-points, and recommendations. Flutter and React Native offer fast development and responsive UI.

Cloud Storage (e.g., Firebase, Google Sheets API): Stores user history, activity logs, and syncs data between the device and the mobile app. Enables backup and real-time analytics.

Bluetooth/Wi-Fi Module (ESP8266, HC-05): Facilitates wireless communication between the device and the smartphone app or server.

AI Recommendation System (Basic Algorithm): A rule-based or lightweight machine learning model that provides personalized tips on reducing carbon footprint based on user habits.

Working Mechanism

The GPS and accelerometer detect user motion and determine the travel mode. The data is processed and classified into walking, cycling, or vehicle-based travel. Eco-points are awarded for green travel options. The mobile app displays daily stats, eco-points, energy saved, and provides tips.

Modules of The Project:

The Green Steps system is divided into the following major functional modules:

1. User Movement Detection Module: This module utilizes GPS and accelerometer data to detect the user's mode of travel whether walking, cycling, or using a vehicle. It calculates speed and movement patterns to classify the travel type.

2. Carbon Footprint Analysis Module: Based on distance traveled and the mode of transport, this module estimates the amount of carbon emissions saved. It uses a predefined emission factor database for calculations.

3. Eco-Points Generation Module: This module applies a scoring algorithm to reward users with eco-points for sustainable activities like walking or cycling. No points are given for vehicle-based transport.

4. User Interface Module (Mobile App/Web Dashboard): Provides the user with visual feedback, including total steps taken, points earned, energy saved, and personal recommendations. It also features gamification elements such as badges, rankings, and challenges.

5. Communication Module: Handles data transfer between the device and mobile application using Bluetooth or Wi-Fi. It ensures secure and seamless syncing of user activity and scores.

6. Recommendation Engine: A rule-based or AI-assisted system that provides personalized suggestions to reduce environmental impact, such as "walk instead of using a bike for short trips" or "carpool instead of driving alone."

Conclusion:

The Green Steps project effectively combines environmental consciousness with smart technology to foster sustainable commuting habits. By leveraging GPS and motion sensors, the system identifies whether a user is walking, cycling, or using a motor vehicle, and assigns *eco-points* based on the environmental friendliness of their travel mode. Through a gamified reward system and real-time feedback, Green Steps motivates users to make greener choices by showcasing the tangible environmental benefits of their actions—such as energy savings and reduced carbon emissions. A key strength of the system lies in its simplicity and affordability. Built using cost-effective components like microcontrollers, GPS modules, and accelerometers, it can be easily developed and deployed. The straightforward logic design ensures reliable performance while enabling real-time tracking and personalized suggestions to improve eco-friendly behaviors. This makes Green Steps accessible to a wide audience, from individuals seeking to improve their personal habits to institutions aiming to promote collective sustainability. Beyond individual use, Green Steps holds great potential for community-level applications. Schools, colleges, offices, and residential societies can use the system to conduct green mobility challenges, raise environmental awareness, and build a culture of accountability and sustainability. Its data-driven insights can also inform urban planning and support smart city initiatives aimed at reducing transport-related emissions. Ultimately, Green Steps provides a scalable and practical solution to promote climate-positive behavior at the grassroots level. By transforming everyday transportation decisions into opportunities for environmental impact and personal well-being, it empowers users to contribute meaningfully to global sustainability goals one green step at a time.

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THE INFLUENCE OF SOCIAL MEDIA ON GEN Z'S SUSTAINABLE CONSUMPTION HABITS IN MUMBAI REGION

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Abstract

The researchers attempted to find out if social media influences sustainable consumption habits among members of Generation Z. The members of Generation Z gave mixed responses regarding the influence of social media influencers. A large effect size was found for Generation Z's preference for influences who discussed sustainability related topic but it had a limited influence on purchasing an eco-friendly product. User generated content emerged as an influential and trusted medium for delivering sustainability related messages for members of Generation Z. The study found that generation Z are more influenced by brands that collaborate with real users. The researcher recommend that brands should showcase real stories, testimonials, and customer review stories because user generated content had a strong influence on Generation Z's sustainable consumption habits. Brands should further collaborate with everyday users for creating more trustworthy and sustainability related content due to its perceived authenticity.

Keywords: Social Media, Sustainable Consumption, Influencers, User Generated Content, Generation Z

Introduction

Consumer behaviour particularly among Generation Z is being reshaped with the growth of social media. This generation Z are known as digital natives with strong social and environment consciousness. Social media influencers and User Generated Content (UGC) are powerful tools which can shape attitude of Generation Z. It is well known that Generation Z turns to social media platforms for entertainment. Hence, the researchers attempted to find out if social media influences sustainable consumption habits among members of Generation Z.

Scope And Significance of The Study

The researcher's study will provide insights in how social media influences sustainable consumption habit among Generation Z who have a strong social and environment conscious. The study's scope is restricted to members of Generation Z in Mumbai region to understand how social media influencers and user generated content shape attitudes of Generation Z with reference to sustainability. The findings will help marketers to help in promoting green choices by leveraging authentic communication and addressing barriers for sustainable consumption.

Research Objectives

- To find out how social media influencers are influencing Gen Z's sustainable consumption habits

- To find out how User Generated Content are influencing Gen Z's sustainable consumption habits

- To find out how social media influences Gen Z's consumption habits with reference to perceived effectiveness, real users' collaboration, and adoption challenges

Literature Review:

1. **Mudasir Ahmad Tass and Irshad Ahmad Malik (2025)** in the research study titled, "Driving Environmental Change: The Impact of Social Media on Gen Z's Sustainability Efforts," found out the factors that influence green consumption and green purchase intentions among members of Generation Z in Kashmir region. The researchers mentioned that social media is acting as a bridge between awareness

and action by converting pro-environmental attitudes into behavioural intentions. The researcher's findings indicate that green consumption behaviour is significantly driven by green purchase intentions. Hence, the researchers emphasized to design marketing strategies and digital tools that align with values of members of Generation Z. The researchers concluded by mentioning that their findings are in alignment with Theory of Planned Behaviour.

2. **K Kumar et al (2024)** in the research study titled, "The Impact of Social Media Marketing on Sustainable Consumption: A Study," found out how social media marketing has an impact on sustainable consumption by preferring ethically manufactured and environmentally friendly goods. The researcher surveyed 250 social media users across various demographic profiles for finding out how social media showing sustainable content is influencing purchasing decisions. The researchers found that people shown consistent sustainability related content are more likely to implement eco-friendly practices in their purchasing decisions. However, it was found that this impact of social media was more seen in educated and digitally active demographic respondents because these respondents were more likely to trust information which was shown through social media platforms.

3. **Allen Francis and Gopal K Sarangi (2022)** in the research study titled, "Sustainable Consumer Behaviour of Indian millennials: Some evidence," mentioned that directing behaviour of customer towards sustainable consumption is a difficult task even with initiatives and policy thrust. The researchers used the framework of Value Belief Norm and employed exploratory factor analysis. The researchers have divided millennials into five categories based on their consumer behaviour, namely, rejecters, unwilling consumers, consumers under transition, conscious consumers, and aware consumers. The researchers found that millennials in comparison to social and economic dimensions are more concerned about environmental dimension.

4. **Trinh Le Tan and Dao Thi Dai Trang (2023)** in the research study titled, "Social media's impact on Generation Z's purchasing behavior of sustainable products," attempted to find out how social networks had an effect on sustainable consumption behaviour among members of Generation Z in Vietnam. The researcher further emphasized the importance of social networks by labelling them as an unavoidable option for Generation Z. The researchers mentioned that to promote the value of sustainability among Generation Z, the marketers should use various social media marketing tactics by showing sustainable good on social media platforms, namely, Facebook, Instagram, TikTok, and Twitter.

5. **Ayush Kumar et al. (2024)** in the research study titled, "Gen Z's Ethical Revolution in Sustainable Consumption," mentioned that there is growing popularity among members of Generation Z for sustainable and ethical consumption. The researchers attempted to find out the relation between social responsibility, individual beliefs, and external factors in directing sustainable consumption practices for Generation Z. To promote sustainable consumption among Generation Z, the researchers mentioned about using new technologies. Finally, the researchers concluded by mentioning that marketers can develop strategies that align with values of Generation Z that will help in fostering a sustainable future.

Based on the literature review, it was found that no study has been carried out in Mumbai region that attempts to find out the influence of social media on Gen Z' consumption habits in Mumbai region.

Research Methodology:

The research design was descriptive in nature. The researchers have used convenience sampling to collect data from 188 respondents among members of Generation Z in Mumbai region. The questionnaire consisted of demographic questions and 5-point Likert Scale questions where 5 corresponded to strongly agree and 1 corresponded to strongly disagree. The questionnaire made on Google Forms was floated through WhatsApp among respondents of Generation Z in Mumbai city. The period of data collection was March to April 2025.

Data Analysis:

The demographic profile of the respondents was 72 female members and 116 male members of Generation Z. The researchers checked normality of data using One Sample Kolmogorov-Smirnov Test as seen in Table 1. Since, the p-values were less than 0.05, the data was not normally distributed. Hence, the researchers used non-parametric One Sample Wilcoxon Signed Rank test.

Table 1 One-Sample Kolmogorov-Smirnov Test

	Normal Parameters[a,b]		Most Extreme Differences			Test Statistic	Asymp. Sig. (2-tailed)
	Mean	Std. Deviation	Absolute	Positive	Negative		
Social media influencers impact my sustainable consumption choices.	3.13	0.898	0.273	0.243	-0.273	0.273	.000[c]
I trust influencers who promote eco-friendly products.	3.21	0.929	0.234	0.197	-0.234	0.234	.000[c]
I prefer to follow influencers who discuss sustainability-related topics	3.29	0.843	0.269	0.258	-0.269	0.269	.000[c]
I have purchased an eco-friendly product because of an influencer's recommendation.	2.82	1.044	0.202	0.151	-0.202	0.202	.000[c]
Brands that collaborate with sustainability influencers seem more credible	3.26	0.907	0.240	0.212	-0.240	0.240	.000[c]
Seeing user-generated content (UGC) about sustainability makes me more likely to adopt eco-friendly habits.	3.23	0.764	0.288	0.288	-0.287	0.288	.000[c]
I trust sustainability-related UGC more than brand advertisements.	3.38	0.739	0.270	0.270	-0.226	0.270	.000[c]

How effective do you find social media campaigns in promoting sustainable habits	3.15	0.966	0.272	0.182	-0.272	0.272	.000[c]
Brands that collaborate with real users for sustainability promotions appear more authentic.	3.46	0.790	0.248	0.248	-0.225	0.248	.000[c]
Despite social media influence, I still find it difficult to adopt sustainable habits.	2.89	0.773	0.315	0.270	-0.315	0.315	.000[c]
a. Test distribution is Normal.							
b. Calculated from data.							
c. Lilliefors Significance Correction.							

Source: Primary Data

Using One Sample Wilcoxon Signed Rank Test, the researchers found significant differences across all statement except that "social media influencers impact my sustainable consumption choices" and "despite social media influence, I still find it difficult to adopt sustainable habits" as seen in Table 2.

Table 2 One Sample Wilcoxon Signed Rank test

Research Objective	Null Hypothesis	Test Statistic	Standard Error	Standardized Test Statistic	Asymptotic Sig. (2-sided test)	Decision
RO 1	The median of social media influencers impacts my sustainable consumption choices equals 3	2504	237.696	1.729	0.084	Retain the null hypothesis
RO 1	The median of I trust influencers who promote eco-friendly products equals 3	3754	300.134	2.882	0.004	Reject the null hypothesis
RO 1	The median of I prefer to follow influencers who discuss sustainability related topics equals 3	2974.5	229.636	4.233	0.000	Reject the null hypothesis

RO 1	The median of I have purchased an eco-friendly product because of an influencer's recommendation equals 3	2872.5	373.04	-2.521	0.012	Reject the null hypothesis
RO 1	The median of brands that collaborate with sustainability influencers seem more credible equals 3	3679	284.101	3.523	0.000	Reject the null hypothesis
RO 2	The median of seeing user-generated content (UGC) about sustainability makes me more likely to adopt eco-friendly habits equals 3	2348	192.769	3.777	0.000	Reject the null hypothesis
RO 2	The median of I trust sustainability-related UGC more than brand advertisements equals 3	3872	249.126	6.198	0.000	Reject the null hypothesis
RO 3	The median of how effective do you find social media campaigns in promoting sustainable habits equals 3	6099.5	446.517	2.131	0.033	Reject the null hypothesis
RO 3	The median of brands that collaborate with real users for sustainability promotions appear more authentic equals 3	4599.5	281.917	6.816	0.000	Reject the null hypothesis

	The median of despite social media influence, I still find it difficult to adopt sustainable habits equals 3					
RO 3		1183.5	185.164	-1.928	0.054	Retain the null hypothesis

Source: Primary Data

To check if observed median is less than or greater than the hypothesized median of 3, the researcher used Rank-Biserial correlation as shown in Table 3. Standardized test statistic from Table 2 was divided by square root of N (N=188 and square root of 188 = 13.71) to obtain the values for Rank-Biserial correlation.

Table 3 Rank-Biserial Correlation

Research Objective	Null Hypothesis	Rank-Biserial Correlation	Effect Size	Interpretation
RO 1	The median of social media influencers impacts my sustainable consumption choices equals 3	0.13	Small	There was no statistically significant difference from the neutral point indicating that respondents were generally neutral in their responses. The small positive effect size suggested a slight tendency to agree, but this trend was weak and not meaningful in practical terms.
RO 1	The median of I trust influencers who promote eco-friendly products equals 3	0.21	Medium	Trust in eco-friendly influencers moderately influenced respondents
RO 1	The median of I prefer to follow influencers who discuss sustainability related topics equals 3	0.31	Large	Respondents reported a strong preference for following influencers who discussed sustainability-related topics.
RO 1	The median of I have purchased an eco-friendly product because of an influencer's recommendation equals 3	-0.18	Small	Most of the respondents disagreed that they purchased an eco-friendly product because of an influencer's recommendation
RO 1	The median of brands that collaborate with sustainability influencers seem more credible equals 3	0.26	Medium	Most of the respondents agreed that brands that collaborated with sustainability influencers seem more credible
RO 2	The median of seeing user-generated content (UGC) about sustainability makes me more likely to adopt eco-friendly habits equals 3	0.28	Medium	UGC on sustainability moderately encouraged eco-friendly habits among respondents
RO 2	The median of I trust sustainability-related UGC	0.45	Large	Respondents reported more trust in sustainability related

	more than brand advertisements equals 3			UGC in comparison to brand advertisements
RO 3	The median of how effective do you find social media campaigns in promoting sustainable habits equals 3	0.16	Small	Respondents reported a small but significant effect of social media campaigns in promoting sustainable habits
RO 3	The median of brands that collaborate with real users for sustainability promotions appear more authentic equals 3	0.50	Very Large	Real-user brand collaborations greatly increased perceived authenticity among respondents
RO 3	The median of despite social media influence, I still find it difficult to adopt sustainable habits equals 3	-0.14	Small	There was no statistically significant difference from the neutral point indicating that respondents were generally neutral in their responses. The small negative effect size suggested a slight tendency to disagree, but this trend was weak and not meaningful in practical terms.

Source: Primary Data

Summary And Conclusion:

The study found out the influence of social media on Generation Z's sustainable consumption habits in Mumbai region. The researchers received a mixed responses with reference to how social media influencers are influencing Gen Z's sustainable consumption habits. A large effect size of 0.31 was found for Generation Z's preference for influences who discussed sustainability related topic but it had a limited influence on purchasing an eco-friendly product as a limited negative effect size of -0.18 was found. A moderate positive effect size of 0.21 and 0.26 was found for trust in influencers promoting eco-friendly products and brands collaborating with them respectively. This indicated that influencer credibility did matter even if not always leading to purchase. User Generated Content had a strong influence on Gen's consumption habits. A large effect of 0.45 was found for trust in user generated content cover brand advertisements. A moderate effect of 0.28 was found for exposure to sustainability related user generated content encouraging eco-friendly behaviour. This indicated that user generated content is influential and trusted medium for delivering sustainability related messages for Generation Z. A small positive effect size of 0.16 was found for campaigns that promote sustainability. On the other hand, a large positive effect size of 0.5 was found for brand collaborations influencing perceived authenticity. These findings indicate that generation Z are more influenced by brands that collaborate with real users.

Recommendations:

Brands should showcase real stories, testimonials, and customer review stories because user generated content had a strong influence on Generation Z's sustainable consumption habits. Brands should collaborate with everyday users for creating more trustworthy and sustainability related content due to its perceived authenticity. Influencers who showcased sustainability had high engagement effects but did not influence strongly eco-friendly buying decisions. Hence, influencers who are genuinely committed to sustainability should be chosen over influencers who are just promoting products.

Limitation of The Study And Further Research:

The sample size is small compared to the size of the population of Mumbai region. Furthermore, the study is restricted to members of Generation Z in Mumbai region only. Further research can be carried outside Mumbai Region to find out how social media is influencing Generation Z's sustainable consumption habits.

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INTEGRATED REPORTING VS. SUSTAINABILITY REPORTING: A STUDY OF SELECTED INDIAN BANKS

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Abstract

Financial reporting as comprises of preparation of statements comprising of financial information whereas Sustainability reports is a reporting format which includes non-financial information related to environment, social and governance factors of an organization. A concise report comprising of both financial and non-financial information is an integrated report. This study aims to understand the disclosure practices of 10 selected Indian banking companies for financial year 2023-2024 as regards Integrated reporting and Sustainability reporting. The data for the purpose of study has been collected from secondary sources such as Integrated reports, Business Responsibility and Sustainability report, Research paper etc. The data collected has been analyzed using Descriptive statistics and Paired Sample t-Test. The findings of the study reveal that there a significant difference between the disclosure practices under Integrated Reporting and Sustainability Reporting among Indian banking companies and the selected Indian banks have shown better disclosure of content in Integrated reports than Sustainability reports.

Keywords: Integrated Reporting (IR), Sustainable Reporting (SR), Business Responsibility and Sustainability Report (BRSR), Global Reporting Initiative (GRI).

Introduction

A concise and comprehensive report which comprises of both financial and non-financial information thereby promoting transparency and value creation amongst stakeholders is an Integrated Report (IR). The adoption of Integrated reporting in India is not yet made mandatory however, the Securities and Exchange Board of India (SEBI) encourages the top listed companies for voluntary adoption.

Disclosure of an organization's environmental, social and governance performance and goals in a report forms the content matter of Sustainability Reporting. A Sustainable Report primarily comprises of a company's non-financial information. In India, it is mandatory for the top 1,000 listed companies to file a Business Responsibility and Sustainability Report (BRSR) disclosing their environmental, social and governance (ESG) information. The other listed companies and organizations may prepare the BRSR on a voluntary basis.

This study aims to analyze the disclosure practices under Integrated reporting and Sustainability reporting with respect to Indian banks. A comparative study of Integrated Reporting disclosure practices and Sustainability reporting disclosure practices of Indian banks has also been conducted.

Review of Literature

Ghosh, Priyajit Kumar & Paul, Biswajit. (2023), examined the current status, issues and challenges with respect to sustainability reporting practices in India. It also studied the influence of sustainability reporting on financial performance of selected Indian companies using panel regression analysis. It was discovered that the sustainability reporting positively influences the financial performance of companies in India.

Tailor, Dr & Goel, Sandeep & Jain, Stuti & Agrawal, Aadya & Rupali, (2023), analysed the integrated reporting practices of selected Indian banks for year 2021-2022 and compared it with year 2020-2021. The

findings of the study revealed that as compared to public sector banks, private sector banks are actively involved in Integrated reporting practices.

Treesa, Jency & Madhu, Remya & Soubhari, Tushar. (2022), compared the sustainability reporting practices of Nifty energy and top 10 constituents of Nifty 50. The study revealed that Nifty energy companies have had better sustainability reporting disclosures than the top 10 Nifty 50 constituents. It was also discovered that the GRI was followed by all companies under both categories.

Acharya, Parameshwar & S, Divyashree & Nanjundaswamy, Abhishek & Ashoka, M. (2021), evaluated the understanding and awareness level of IR practices among accountants, academicians and auditors. The level of IR compliance with GRI was also studied. The study revealed that the accountants, auditors and academicians are positive about the IR practices and there are differences in IR reporting practices and GRI guidelines among selected companies.

Objectives:

- To study the disclosure practices under Integrated reporting and Sustainable reporting among Indian banking companies.

- To compare the disclosure practices under Integrated reporting and Sustainability reporting with respect to Indian banking companies.

Hypothesis:

H01- There is no significant difference between the disclosure practices under Integrated Reporting and Sustainability Reporting among Indian banking companies.

H11- There is a significant difference between the disclosure practices under Integrated Reporting and Sustainability Reporting among Indian banking companies.

Research Methodology:

The data for the purpose of study has been collected from secondary sources such as Integrated reports, Business Responsibility and Sustainability reports, Annual reports etc. Various research papers published in journals and articles in newspapers have also been considered to gain comprehensive information.

A sample of 10 Indian banking companies for the financial year 2023-24 have been studied using Descriptive statistics and Paired Sample t-Test.

Limitations:

- The data has been collected from secondary sources only for the purpose of study.

- The sample size comprises of 10 Indian banks publishing both integrated and sustainability reports.

Data Analysis And Interpretation:

A brief profile of the Indian banks comprising of 3 public banks and 7 private banks selected for the purpose of study has been given below:

Table 01: Profile of the selected Indian Banking Companies

Sr. No.	Name of the Bank	Type	Financial Year of IR Adoption	Financial Year of BRSR Adoption
1	State Bank of India	Public	2019-2020	2013-2014
2	Union Bank of India	Public	2022-2023	2021-2022
3	Bank of India	Public	2017-2018	2022-2023
4	IndusInd Bank	Private	2017-2018	2017-2018

5	HDFC Bank	Private	2018-2019	2021-2022
6	ICICI Bank	Private	2023-2024	2022-2023
7	Axis Bank	Private	2023-2024	2023-2024
8	Yes Bank	Private	2022-2023	2022-2023
9	Kotak Mahindra Bank	Private	2020-2021	2012-2013
10	IDFC First Bank	Private	2023-2024	2023-2024

a) **To study the disclosure practices under Integrated reporting and Sustainable reporting among Indian banking companies.**

To study the above objective, the Integrated reports and Sustainable reports of the selected Indian banks for FY 2023-24 are studied. Thereafter, descriptive statistics is calculated using Jasper.

Table 02: Descriptive statistics for Integrated Reporting Disclosure

	Content Element	N	Min	Max	Mean	Median	Standard Deviation	Variance
CE1	Organizational Overview and External Environment	10	1	2	1.9	2	0.316	0.1
CE2	Governance	10	1	2	1.9	2	0.316	0.1
CE3	Business Model	10	1	2	1.7	2	0.483	0.233
CE4	Risks and Opportunities	10	1	2	1.6	2	0.516	0.267
CE5	Strategy and Resource Allocation	10	1	2	1.6	2	0.516	0.267
CE6	Performance	10	1	2	1.4	2	0.516	0.267
CE7	Outlook	10	1	2	1.2	2	0.422	0.178
CE8	Basis of Presentation	10	1	2	1.2	2	0.422	0.178

From the above table, it is observed that the content elements of Organizational Overview and Governance have been strongly disclosed (indicated by high mean and low variance) and the content elements of Performance, Outlook and Basis of Presentation are not disclosed very well (indicated by low mean) by the selected Indian banks in their respective Integrated Reports.

Table 03: Descriptive statistics for Sustainable Reporting Disclosure

Sr. No.	SEBI's BRSR Framework	N	Min	Max	Mean	Median	Standard Deviation	Variance
1	Economic Disclosures	10	1	2	1.8	2	0.422	0.178
2	Environmental Metrics	10	1	2	1.4	1	0.516	0.267
3	Social Indicators	10	1	2	1.7	2	0.483	0.233
4	Human Rights	10	1	2	1	1	0	0
5	Stakeholder Engagement	10	1	2	1.1	1	0.738	0.544
6	Governance and Ethical Disclosures	10	1	2	1.5	1.5	0.527	0.278
7	SDG Alignment	10	1	2	1.4	1	0.516	0.267
8	Assurance of Non-Financial Disclosures	10	1	2	1	1	0.816	0.667

From the above table, it is observed that Economic Disclosures and Social Indicators are disclosed strongly and consistently (indicated by higher mean) whereas Stakeholder Engagement, Human Rights and Assurance of Non-Financial Disclosures lack depth in disclosures (indicated by lower mean) in the respective Sustainability Reports of selected Indian banks.

b) **To compare the disclosure practices under Integrated reporting and Sustainability reporting with respect to Indian banking companies.**

To study the above objective, firstly Shapiro-Wilk test is conducted to check the normality of the scoring of Integrated reporting and Sustainability reporting data.

Table 04: Shapiro-Wilk Test to check normality of data

Descriptive Statistics ▼	Valid	Mean	Shapiro-Wilk	P-value of Shapiro-Wilk
IR Disclosure	10	12.500	0.942	0.580
SR Disclosure	10	10.900	0.892	0.177

From the above table, it is observed that $p > 0.05$, therefore the data is normally distributed.

To compare between the Integrated reporting and Sustainability reporting further Paired Sample t-Test is conducted.

Table 05: Paired Sample t-Test

Paired Samples T-Test ▼		t	df	p
Measure 1	Measure 2			
IR Disclosure - SR Disclosure		4.000	9	0.003

Note. Student's t-test.

From the above table, it is observed that p-value is 0.03 (less than 0.05). Therefore, it can be concluded that there is a significant difference between IR and SR disclosure practices among selected Indian banks.

H_{01}	There is no significant difference between the disclosure practices under Integrated Reporting and Sustainability Reporting among Indian banking companies.	**Rejected**
H_{11}	There is a significant difference between the disclosure practices under Integrated Reporting and Sustainability Reporting among Indian banking companies.	**Accepted**

The study also reveals that the mean score of Integrated reporting disclosure practices is 12.5 as compared to mean score of Sustainability reporting disclosure practices at 10.9. This indicated that the Indian banking companies have disclosed the content better in Integrated reports than in Sustainability reports.

Conclusion

Integrated reports and Business Responsibility and Sustainability reports (BRSR) are reports prepared by organizations to ensure transparency and long-term value creation with stakeholders. This study is directed towards analyzing the disclosure practices of the two mentioned reports and a comparison as to which report shows a better disclosure by the selected Indian banking companies.

The analysis of Integrated reporting content elements reveal that disclosures related to organizational overview and governance are well addressed but the outlook, performance and basis of preparation need to be disclosed in depth.

The BRSR based sustainability disclosures of selected Indian banking companies show stronger adherence to economic and social factors but lags behind in disclosing human rights, stakeholder engagement and assurance of non-financial disclosures.

The study also concludes that the selected Indian banking companies reveal better disclosure practice in Integrated reports than Sustainability reports.

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FACTORS INFLUENCING THE SHIFT FROM SYNTHETIC TO NATURAL PERSONAL CARE PRODUCTS– A SYSTEMATIC REVIEW

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Abstract

Purpose – Over time, environmental changes have profoundly influenced consumer behaviour, fostering increased environmental consciousness and a positive attitude toward sustainable products. Customers are increasingly purchasing and consuming organic products due to their growing awareness of environmental issues and rising concerns for their health. As people become more informed about the benefits of organic products over their synthetic counterparts, the demand for organic items has grown significantly. This article examines the literature on environmental challenges arising from industrial production, sectoral constraints, health risks, and consumer perceptions of these risks.

Design/methodology/approach – This paper employs the systematic literature review (SLR) approach, a suitable research method for conducting a literature review to gather relevant articles and produce better insights by reviewing existing works of literature. The literature has been sourced from ProQuest, EBSCO, and other online journals. The PRISMA technique has been used to review the literature and has been organised into a pattern to arrive at logical conclusions.

Findings – Environmental concerns, health consciousness, and perceived behavioural control influence consumers' attitudes towards organic personal care products. Perceived quality significantly influences purchase intentions for organic personal care products, with customers more inclined to purchase and invest more money in products when they perceive the quality as superior.

Practical implications – The paper explored the literature on the shift from synthetic to organic purchase intentions. As consumers' awareness towards sustainability increases, materials derived from plants produced with good agricultural and manufacturing practices align with the bio-circular-green economy theme. Herbal products are more popular in the global market due to the adverse effects of synthetic products. Indian women have historically utilised plants such as sandalwood and turmeric for skincare, henna for dyeing their hair, and natural oils for fragrance. Industry will have to adapt accordingly.

Originality/value – This is an original systematic review work with numerous implications for industrial strategies.

Keywords: Cosmetics, nanotechnology, organic cosmetics, synthetic cosmetics, law for synthetics.

Paper type: Conceptual Paper.

1. Introduction

The personal care products industry encompasses a wide range of items designed to enhance personal hygiene, grooming, and aesthetics. This industry includes subcategories such as skincare, haircare, oral care, body care, personal hygiene, nail care, shaving and hair removal, fragrances, sun care, eye care, foot care, speciality and medical personal care, natural and organic personal care, personal care like beauty products and men's grooming products. (Moslehpour et al, 2021)

Over time, environmental changes have profoundly influenced consumer behaviour, fostering increased environmental consciousness and a positive attitude toward sustainable products. Customers are increasingly purchasing and consuming organic products due to their growing awareness of environmental issues and rising concerns for their health (Moslehpour et al., 2021). As people become more informed about the benefits of organic products over their synthetic counterparts, the demand for organic items has grown significantly. The convergence of health considerations and environmental protection has become pivotal, leading to increased consumer interest in organic products. While the green market seeks to address environmental and social issues, the organic market prioritises addressing consumers' health concerns.

2.   Objectives and Methodology:

This article examines the literature on environmental challenges arising from industrial production, sectoral constraints, health risks, and consumer perceptions of these risks. The literature has been extracted from peer-reviewed journals and organised systematically. Section 3 of this article examines the literature on environmental concerns in the production of personal care products. Section 4 examines the literature on organic products, whereas Section 5 analyses the literature regarding consumer sentiments. Section 6 addresses critical concerns about consumer perceptions of these products. Section 7 concludes. References have been compiled at the conclusion.

3.   Industrial issues in the production of personal care products:

3.1 Nanomaterials in Personal Care Products

Rathnasinghe et al. (2024) state that nanotechnology is applied across diverse scientific disciplines, including health, technical gadgets, and, more recently, cosmetics, collectively referred to as nanocosmetics. Nanotechnology has a significant impact on the cosmetic industry due to enhanced particle characteristics, including colour, transparency, and solubility, achieved at the nanoscale. The physicochemical properties of nanoparticles, including stiffness, hydrophobicity, size, and charge, significantly influence the mechanism of skin penetration. Cosmetics formulated using nanotechnology offer product diversity, improved bioavailability of active ingredients, and an aesthetically beautiful look with enduring benefits.

3.2 Nanotechnology in Skincare Products

Nanotechnology-based cosmetic delivery technologies which utilise nanotechnology-based cosmetic delivery technologies, encompass a range of formulations including nanoemulsions, nanocrystals, nanocapsules, liposomes, niosomes, dendrimers, solid lipid nanoparticles, and carbon nanotubes. Submicron emulsions (SME), which have uniform and tiny droplet sizes, are the most recent nanoparticulate systems for skin care (20–500 nm). In the cosmetics industry, demand is expanding. The industry employs various procedures with reduced environmental risks, including nanomedicine development, antioxidant utilisation, and nanocarrier modification.

3.3 Plants' Saponins

Kanlayavattanakul et al. (2024) emphasise that plants are industrially cultivated and processed for specific sectors, including human consumption, such as cosmetics and personal care products. Consumer awareness of sustainability is increasing year by year. Among these, materials derived from plants produced with good agricultural and manufacturing practices that adhere to bio-circular-green economy themes are notable. Cosmetic and personal care sectors are the major industries where natural and sustainable demands are increasing; the industrial crops are regarded as the reliable sources supplying the demands for these materials (Bravo et al. 2020 in Kanlayavattanakul et al. (2024)) including those surface-active ones that are vastly applied in household detergent and cleansing products particularly saponins (Jolly et al. 2023 in Kanlayavattanakul et al. (2024)), which natural materials are emerging among consumers' preferences towards sustainability and conceivable safety awareness, with multidirectional activity of industrial crop-derived cosmetic substances. Thus, crops producing saponins are of significant importance to explore in order

to achieve their applicability for high-value products serving specific industries, such as fast-moving consumer goods (FMCGs), where consumers' expectations for naturally derived products sustainably implied from oriental crops are emerging.

3.4 Cosmetic Ingredients as Plant Extracts

Choi et al. (2024) examine the literature about cosmetic constituents, encompassing plant extracts, antioxidants, peptides, and probiotics. These components have been recognised for their ability to enhance skin health through various mechanisms, meeting consumer demand for effective and safe treatments. Plant extracts, characterised by their abundant bioactive components, offer numerous advantages, including antioxidant, anti-inflammatory, and antibacterial effects, making them essential in skin care formulations. Antioxidants, sourced from plants and other natural origins, are essential in safeguarding the skin against oxidative damage, thus averting premature ageing and enhancing skin vitality. Bioactive peptides have attracted interest due to their multifunctional properties, including stimulating collagen production, blocking enzymes that cause skin deterioration, mitigating inflammation, aiding skin regeneration and anti-ageing.

3.5 What Law Says

Elisha (2024) states that the India Drugs and Cosmetics Act of 1940 and its 1945 Rules govern cosmetics. Section 3 (aaa) defines cosmetics as "*articles intended to be rubbed, poured, sprinkled, or sprayed on, or introduced into, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance, and includes any article intended for use as a component in cosmetics.*" The United States Food and Drug Administration (FDA) defines cosmetics as "articles for beautification, cleansing, or altering the physical appearance." "Cosmetovigilance" refers to the activities involved in collecting, assessing, and monitoring unsolicited reports of adverse events occurring during or following a cosmetic product's regular or anticipated use. Vigan was the first individual to introduce the concept of cosmetovigilance. It pertains to the industry's post-marketing surveillance. The French health products safety agency initiated cosmetovigilance in conjunction with pharmacovigilance to monitor adverse effects associated with the use of cosmetics. Assessing the toxicity of cosmetic products is increasingly regarded as an integral component of the public health system.

3.6 Behaviour of the Cosmetic Industry

Hea and Ki (2023) assert that the cosmetics and personal care sector inherently contributes to global environmental challenges, including climate change, waste generation, water scarcity, habitat destruction, and air and water pollution. Consequently, it is becoming increasingly imperative for the cosmetics and personal care industries to operate responsibly and proactively in addressing environmental concerns. Simultaneously, the intricacy of the cosmetics and personal care sector has reached unprecedented levels. The responsibilities of brand firms are becoming increasingly significant, with the barriers between them diminishing. Despite the pressing nature of environmental concerns, the literature lacks specific and pragmatic environmental practices in the cosmetics and personal care industries. In contrast, the environmental obligations of OEM/ODM firms and merchants have been neglected. Hea and Ki (2023) conducted a literature review and identified the need to examine the cosmetics industry's environmental behaviour comprehensively. They contribute to analysing cosmetics companies' environmental initiatives by proposing the use of non-financial performance reports to evaluate their environmental activities. Cosmetics and personal care companies (brands, OEMs/ODMs, retailers) are being increasingly urged to assume responsibility for environmental issues and propose a future path for the entire sector. The three firm groups possess unique characteristics, necessitating specific environmental roles and a more proactive approach. It is essential to ensure future-oriented objectives, transparency in progress, and objectivity in outcomes.

3.7 Short-term Consequences

A significant proportion of cosmetic product consumers are more focused on the short-term consequences for their appearance and do not consider the long-term effects on their overall health. Cosmetic products available

in the commercial market are considered safe and tolerable. Nowadays, there is a greater emphasis on testing cosmetic products to determine their potential harmful effects. Numerous studies have demonstrated that the various chemicals found in commercially accessible cosmetic products pose a health risk to users. The adverse effects can range from a minor hypersensitive reaction to a severe, potentially fatal anaphylactic reaction. The side effects can appear soon after using the cosmetic goods or take a long time to manifest. (Elisha, 2024)

The primary objective of cosmetovigilance is to gather and evaluate adverse side effects experienced by individuals using cosmetics, enabling the systematic reporting of adverse reactions, the execution of routine laboratory quality control tests, and the resolution of public health issues.

4. Organic Products

4.1 Organic personal care products

Ezlika et al. (2017) investigated customers' intentions to repurchase organic personal care products (PCP). The research expanded the notion of planned behaviour by incorporating perceived value dimensions as precursors of attitude into the model.

The results indicated that most of the proposed linkages were validated between consumer-perceived value components (health, safety, hedonic, and environmental) and attitudes towards repurchasing organic products. Enhanced product knowledge regarding organic PCP would foster more favourable opinions towards repurchasing the product.

Conversely, social value was found to be insignificant in predicting attitude. The impact of subjective norms on repurchase intention was not substantiated. Regarding the hierarchy of significance in forecasting repurchase intention, attitude emerged as the most significant predictor, followed by perceived behavioural control, product knowledge, hedonic value, environmental value, and safety value.

4.2. Botanical Cosmetics

The global popularity of Indian herbs and their significance is notable. Herbal cosmetics are increasingly sought after globally and represent a precious natural offering. Herbal cosmetics are formulations that incorporate active bioactive ingredients, nutraceuticals, or medicinal compounds. Botanicals typically offer a range of vitamins, antioxidants, diverse oils, essential oils, hydrocolloids, proteins, terpenoids, and other bioactive compounds. Sushma et al. (2017) examined traditional knowledge regarding the use of plant resources as outlined in Ayurveda and investigated the phytochemicals relevant to skin and body care formulations.

4.3 Herbal Pharmaceuticals – India

Yu Shi et al. (2021) examine the context and perceptions of herbal medicine, as well as the strategies to be implemented worldwide to promote Indian herbal products. "Individuals have utilised herbal medicines for centuries due to their safety, efficacy, cultural acceptability, and reduced side effects." Plants and plant-derived products have been employed with varied degrees of efficacy to treat and prevent diseases throughout history.

Herbal products are comparatively more prevalent in the global market due to the adverse effects of synthetic products. Despite extensive expertise in herbal medicine and the prevalence of numerous medicinal plants, India's contribution to the global market remains inadequate.

4.4 Botanical Cosmetics for Dermatological and Capillary Applications

Kumar et al. (2012) reported on the introduction, classification, and frequently utilised herbs in cosmetics. The notion of beauty and cosmetics is as old as humanity and civilisation. Women are preoccupied with achieving beauty. They utilise various herbal cosmetic products to enhance their appeal and youthfulness. The significance of Indian plants lies in their global renown. Herbal cosmetics are seeing increasing demand in the

global market and represent a priceless offering from nature. Herbal formulations have garnered significant interest due to their efficacy and relatively minimal or absent adverse effects compared to synthetic medications. Herbs and spices have been utilised to preserve and enhance human beauty. Indian women have historically utilised plants like sandalwood and turmeric for skincare, henna for dyeing hair, and natural oils for fragrance.

5. Consumers' Attitude

5.1 Millennial attitude

Lupindo et al. (2024) employed partial least squares structural equation modelling to demonstrate that environmental concerns, health consciousness, and perceived behavioural control significantly influence millennials' attitudes toward organic personal care products, while the perceived quality of these products markedly affects their purchase intentions. Environmental accountability acknowledges that their consumption patterns directly and indirectly impact the environment and their health (Taghikhah et al., 2021; Lupindo et al., 2024). Perceived behavioural control, attitudes, and perceived quality significantly influence purchase intentions for organic personal care products. A notable association exists between perceived quality and attitudes toward organic personal care products, as well as purchase intentions and willingness to pay a premium. Customers are more inclined to purchase and willing to invest additional funds in products when they perceive the quality as superior.

5.2 Branding of products

Yun-Fei and Fang-Suey (2024) argue that by deliberately implementing sustainable practices, firms can enhance their public image and encourage consumers to purchase environmentally friendly products. The COVID-19 epidemic has transformed brand perceptions and consumer behaviours, affecting packaging materials, product life cycles, corporate social responsibility, and sustainability. Individuals use personal care products daily, underscoring the need to consider multiple indicators when developing brand image initiatives for sustainable development

5.3 Green Market

The environmental friendliness of the items being sold is being increasingly emphasised by green marketing, which includes modifying the supply chain to make products more environmentally friendly. Notwithstanding the significance of green production, a business must inform its customers of the initiatives it has taken to reduce its environmental impact. Moslehpour et al. (2021) state that "green marketing consciousness becomes crucial for brands in showing their efforts to care for the environment."

5.4 Adolescent Girls

Adolescence is a period when a person begins a new chapter in life, marked by physical and emotional changes, a new lifestyle, and altered consumption requirements, according to Sutinah & Putri (2024), who studied teenage girls. Teenagers start using skincare products, for example, when teenage ladies start to take care of their facial skin. Since many over-the-counter (OTC) skincare products are readily available and do not require a prescription, many teenage girls struggle to determine which skincare products are most suitable for their needs.

5.5 Lifestyle and Financial Literacy

Halimatussakdiyah et al. (2019) examined the impact of lifestyle and financial literacy on consumption patterns among college students. The study's findings revealed that consumer behaviour was motivated by the pursuit of enjoyment, disregarding the utilisation of these items and services. This conduct can be ingrained in the lifestyle of adolescents without proper guidance, leading them to become self-destructive adults. The study used self-control as an intervention variable to examine student consumption behaviour, lifestyle, and financial literacy. The research findings indicated that lifestyle and financial literacy affected customer

behaviour, with self-control as a mediating factor. Social activities in the digital age occur through direct physical interaction and within the virtual realm.

5.6 Media Influence

Wilcox and Laird (2020) found that media influence is one of the factors that can affect a person's internalisation of the concept of ideal beauty. The media often presents images of beauty through visual advertisements that shape people's perceptions of beauty standards. Apriyani and Herawati (2021) indicated that racist attitudes were quite influential in the construction of beauty standards through media, particularly for teenagers. Angel (2021) also documented a similar finding in his study, stating that the media has played a decisive role in the social construction of beauty amongst the masses, which is difficult to revise.

5.7 Oral Health Care

Guarnizo-Herreño et al. (2024) emphasise that dental care should be fully integrated with primary healthcare initiatives, overcoming the historical separation of dentistry from medicine that was further strengthened by medical insurance practices.

6. Discussion on Various Issues

The India Drugs and Cosmetics Act of 1940 and its 1945 Rules govern cosmetics, with Section 3 (aaa) defining cosmetics as "Products designed for application to the human body or its parts for purposes of cleansing, beautification, enhancing attractiveness, or modifying appearance."

The US FDA defines cosmetics as "articles for beautification, cleansing, or altering the physical appearance."

Nanotechnology is applied across various scientific disciplines, including health, technical gadgets, and cosmetics, collectively referred to as nanocosmetics. Nanotechnology has a significant impact on the cosmetic industry due to enhanced particle characteristics, including colour, transparency, and solubility, achieved at the nanoscale

Plants are industrially cultivated and processed for various sectors, including cosmetic and personal care products. As consumers' awareness towards sustainability increases, materials derived from plants produced with good agricultural and manufacturing practices align with the bio-circular-green economy theme. Saponins, biosurfactants that do not cause detrimental effects on the environment, are considered sustainable sources of these cosmetic substances. Plants that produce saponins are important to explore for their applicability in high-value products serving specific industries, such as fast-moving consumer goods (FMCGs).

Hea and Ki (2023) argue that the cosmetics and personal care sector contributes to global environmental challenges, including climate change, waste generation, water scarcity, habitat destruction, and air and water pollution. They suggest examining the environmental behaviour of the industry comprehensively and proposing the use of non-financial performance reports to evaluate actual environmental activities.

Herbal cosmetics, a significant part of the global beauty industry, are gaining popularity due to their efficacy and widespread use in enhancing and maintaining the appearance of skin and the body. Herbal products are more popular in the global market due to the adverse effects of synthetic products. Indian women have historically utilised plants such as sandalwood and turmeric for skincare, henna for dyeing their hair, and natural oils for fragrance.

Environmental concerns, health consciousness, and perceived behavioural control influence consumers' attitudes towards organic personal care products. Perceived quality significantly influences purchase intentions for organic personal care products, with customers more inclined to purchase and invest more money in products when they perceive the quality as superior.

7. Concluding Remarks

Environmental concerns, health consciousness, and behavioural control influence consumer attitudes towards organic personal care products. Quality and sustainability are key strategies for corporate advancement. The COVID-19 pandemic has impacted brand perceptions and consumer behaviours. Adolescent girls, lifestyle, and media influence consumer behaviour, shaping beauty standards and healthcare rights.

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THE PSYCHOLOGICAL AND SOCIAL FACTORS IMPACTING THE ADOPTION AND MAINTENANCE OF A VEGAN LIFESTYLE

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Abstract

Vegetarianism and veganism's histories and underlying ideologies demonstrate the complex interactions between cultural, ethical, environmental, and health factors that have shaped these dietary preferences from their ancient origins to current trends. The growing popularity of plant-based diets around the world underscores the complex nature of this changing way of life by highlighting its effects on social movements, environmental sustainability, and individual well-being in addition to larger societal systems. The objective of this research is to analyse the psychological aspects that impact the initial decision to adopt a vegan lifestyle and to uncover the social forces that impact sustainability and decision-making.

Keywords: Vegan lifestyle, psychological factors, social factors, correlation, social support, perceived barrier.

1. Introduction:

Vegetarianism has its origins in ancient Egypt and India, where it was associated with the worship of cows and the notion of reincarnation (Hargreaves *et al*., 2021). Many types of vegetarianism, including flexitarianism and strict veganism, are becoming more and more common in contemporary Western countries as a result of a combination of personal circumstances, cultural influences, economic considerations, and habits (Séré de Lanauze *et al*., 2022). Many health and environmental advantages of the vegan lifestyle are promoted, such as decreased consumption of animal products, prevention and treatment of chronic illnesses, and possibly even longer life spans (Williams *et al*., 2023). Proponents contend that eating meat raises the risk of conditions including colorectal cancer, cardiovascular disease, and type 2 diabetes even though it is a good source of nutrients, vitamins, and minerals. By 2050, switching to a vegan diet is expected to save 8 million lives, reduce greenhouse gas emissions by two thirds, and save $1.5 trillion in climate-related expenses (Ngo *et al*., 2021).

A vegetarian diet is frequently chosen for socially acceptable reasons, such as environmental conscience, ethical issues, and health concerns. One common cause is weight control (Hanras *et al*., 2022). A lower risk of obesity, hypertension, cardiovascular disease, diabetes, and arthritis are among the benefits of vegetarianism. The diet makes up for its potential deficiencies in protein, saturated fat, and some vitamins with high quantities of protective minerals such antioxidants, fibre, magnesium, folic acid, and vitamins C and E (Antonovici *et al*., 2021). In contrast to the 1.9% of vegans and 3.1% of vegetarians, the flexitarian diet has grown in popularity, as selected by 22.9% of consumers due to its health benefits and ability to reduce carbon impact (Kemper *et al*., 2021). The benefits of the Mediterranean diet on mental health are well-established. It lowers the risk of heart disease, breast cancer, and improves cognitive function (Iguacel *et al*., 2021). Due to ethical and health reasons, more Italian families are choosing to feed their kids vegan diets, albeit they may find it difficult to communicate with medical specialists (Bivi *et al*., 2021).

Individuals who become vegans or vegetarians frequently list a variety of reasons for doing so. Their food choices are often influenced by environmental concerns, animal welfare concerns, a dislike of animal products, and personal health concerns (Ploll *et al*. 2020).

2. Literature Review:

Recent research on vegan diets highlighted their increasing popularity, with Bakaloudi *et al*. (2021) stress that these diets don't contain any animal products. But because vegans don't consume fat, there have been worries about possible deficits in vitamins B2, B12, D, iodine, zinc, calcium, potassium, and selenium. Parents began

asking questions regarding the effects of vegetarian diets on their children's development after Simeone *et al*. (2022) investigated how common vegetarian diets are in developed countries. Bryant *et al*. (2022) found that social variables had a substantial impact on views towards veganism, with animal advocates playing a role in changing norms and reducing meat consumption. In their discussion of the move to plant-based diets motivated by ethical, social, medical, and environmental factors, Bublitz *et al*. (2023) urged more research. According to Lee *et al*. (2023), vegans and vegetarians may be more susceptible to depression, but they may also be able to reduce symptoms with a high-quality plant-based diet. They also highlighted the importance of social interactions for overall wellbeing. Cooper *et al*. (2022) supported the use of vegan food in a sustainable manner, in line with consumer preferences for value propositions that emphasise health.

2.1. Problem Statement

As a result of Western cultural values, an increasing number of people throughout India's diverse environment are embracing a lifestyle centred upon not consuming animal products (Fourat *et al*. 2018). In spite of this, very few people consciously identify as vegan, defying the popular belief that there has been a significant change. It is clear that this phenomenon has not received enough thorough investigation, particularly in a country whose traditional livelihoods are closely linked to animal husbandry. It becomes imperative to investigate the market dynamics and demand for vegan products in this distinct socio-economic setting.

2.2. Objectives

The purpose of the study is to discover important psychological aspects in order to analyse the complexities of the early adoption of a vegan lifestyle. In addition, it aims to dissect the social variables that shape the decision-making process involved in selecting and maintaining a vegan lifestyle. Furthermore, the study aims to examine the influence of perceived obstacles on the sustenance of this kind of lifestyle.
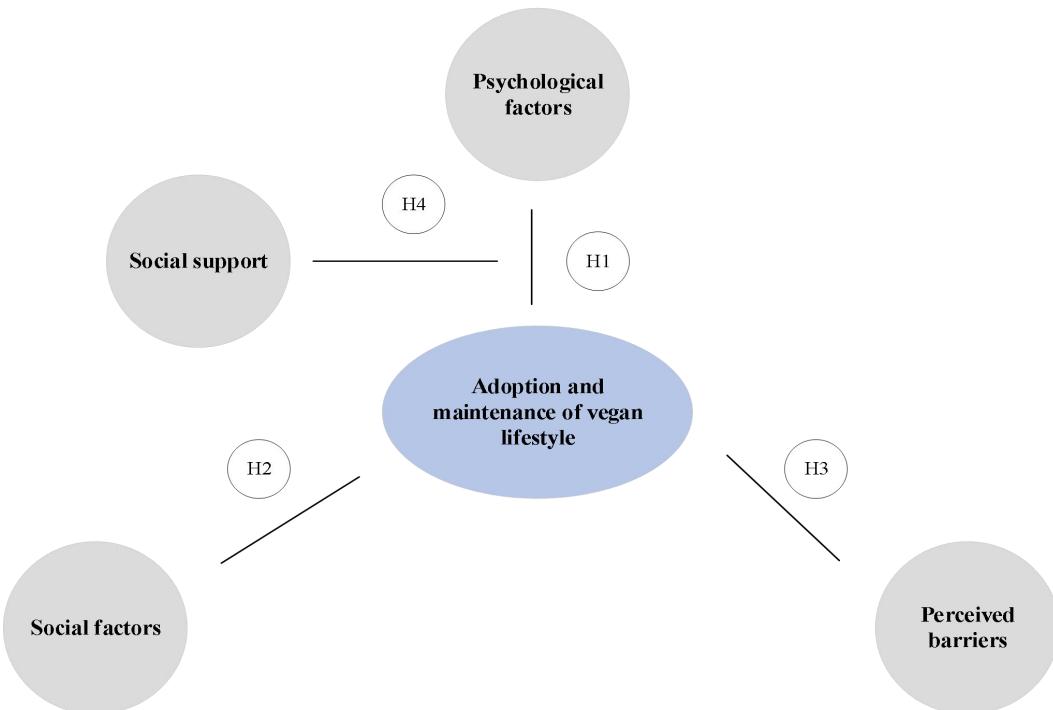
Figure 1: Proposed model

2.3. Hypotheses (Figure 1)

H01: There is no significant relationship between psychological factors and the initial adoption of a vegan lifestyle.

Ha1: There is a significant relationship between psychological factors and the initial adoption of a vegan lifestyle.

H02: There is no significant relationship between social factors and the decision to become and remain a vegan.

Ha2: There is a significant relationship between social factors and the decision to become and remain a vegan.

H03: There is no significant relationship between perceived barriers and the maintenance of a vegan lifestyle.

Ha3: There is a significant relationship between perceived barriers and the maintenance of a vegan lifestyle.

H04: Social support does not mediate the relationship between psychological factors and the adoption and maintenance of a vegan lifestyle.

Ha4: Social support mediates the relationship between psychological factors and the adoption and maintenance of a vegan lifestyle.

3. Research Methodology:

The study was conducted under the positivist paradigm, which maintains that human knowledge is acquired by reasoning and the process of giving an objective interpretation to one's experiences and perceptions. As a result, this study was quantitative in character, and its design made it possible to collect data on the use of vegan diets, subjective standards, health consciousness, perceived value, product qualities, and attitudes towards veganism. The study model's hypotheses were examined using data from participants who were purposively sampled across India. Participants were chosen via an online meal delivery platform and continuously shortlisted according to their vegetarian cuisine preferences. By offering a mail indication, a survey carried out via the meal delivery network was used to gather data. 500 people who adopt a vegan lifestyle in total replied to the study. The options on the five-item scale were "strongly disagree" and "strongly agree." A Likert scale, with 1 denoting a strong disagreement and 5 denoting a strong agreement, was used to gather the quantitative data (Joshi *et al*., 2015).

4. Results:

4.1 Sociodemographic information

Table 1: Frequency table on sociodemographic information.

S.No	Demographic factors		Frequency (%)	Skewness	Kurtosis
1	Age	18-24	28.8	0.076	-1.410
		25-34	23.4		
		35-44	23.8		
		>44	24.0		
2	Gender	Male	51.8	0.072	-2.003
		Female	48.2		
3	Education	High school	37.4	0.675	-0.664
		Bachelor degree	35.2		
		Master's degree	15.2		
		Others	12.2		

4	Income	<20000	15.2	0.094	-0.770
		20000 to 30000	38.6		
		30000 to 40000	32.8		
		>40000	13.4		
5	Geographic location	Rural	15.6	-0.365	-0.938
		suburban	45.2		
		urban	39.2		
6	Marital status	single	44.4	0.458	-1.122
		married	36.6		
		divorced	19.0		
7	Reason for adoption of vegan lifestyle	Initial habit	25.0	0.038	-1.291
		health issues	26.2		
		changing lifestyle	27.0		
		others	21.8		
8	Social factors influence the vegan lifestyle	Social norms and influence	19.6	0.126	-0.816
		Cultural and religious beliefs	20.4		
		Health trends	37.8		
		Environmental and ethical awareness	22.2		
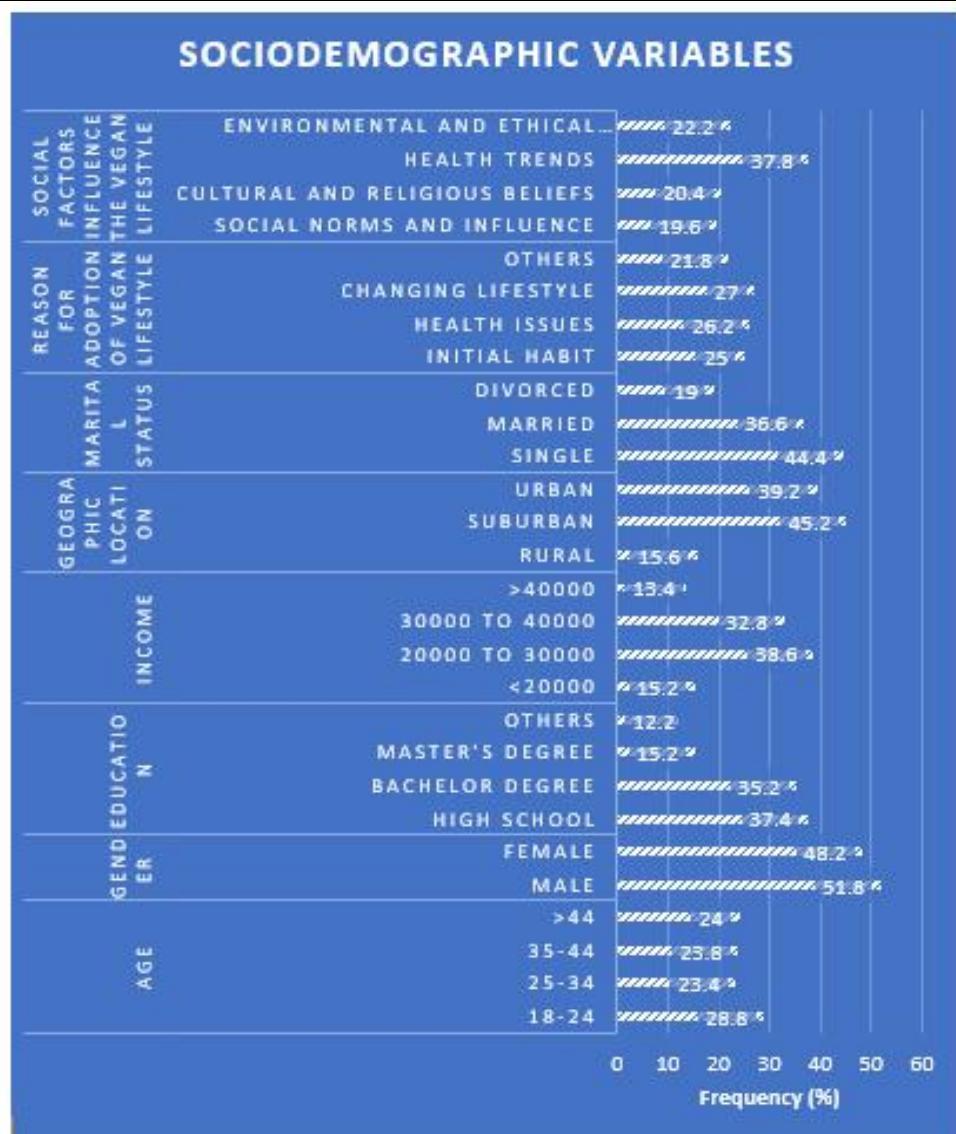
Figure 2: Frequency distribution of sociodemographic variables.

4.2 Factors influencing the adoption and maintenance of vegan lifestyle and the participants perception about the factors.

Table 2: Questionnaire responses

	Mean	SD
Perceptions regarding adoption of vegan lifestyle (AVL)	4.02	0.95
Perceptions regarding maintenance of vegan lifestyle (MVL)	3.99	0.94
Influence of psychological factors (PF)	3.96	0.94
Influence of social factors (SF)	3.96	0.93
Perceived barriers (PB)	3.95	0.95
Social support (SS)	3.87	1.02

Table 3: t-test

	One-Sample Test
	Test Value = 0
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference
					Lower	Upper
AVL	118.247	499	0.000	4.01600	3.9493	4.0827
MVL	118.799	499	0.000	3.99440	3.9283	4.0605
PF	120.005	499	0.000	3.96320	3.8983	4.0281
SF	121.593	499	0.000	3.95880	3.8948	4.0228
PB	116.701	499	0.000	3.95080	3.8843	4.0173
SS	113.263	499	0.000	3.86720	3.8001	3.9343

The findings show that, with p-values of 0.000, all mean differences for perceptions of the adoption and maintenance of a vegan lifestyle (AVL and MVL), the influence of social factors (SF), the influence of psychological factors (PF), perceived barriers (PB), and social support (SS) are statistically significant (Table 3). This suggests a high degree of confidence that the differences that have been noticed are not the result of chance. The range of the mean differences, which is 3.86720 to 4.01600, provides insight into the direction and size of these variances. In essence, respondents' assessments were noticeably positive in every category, with ratings considerably higher than the fictitious value of 0. This shows that adopting and maintaining a vegan lifestyle is strongly supported overall, with a focus on the significant impact of psychological and social aspects and an acknowledgement of the role that perceived barriers and social support have in influencing people's attitudes and decisions.

Table 4: Factors Influencing Vegan Lifestyle Adoption and Maintenance: A Correlational Analysis.

Dependent variables	Independent variables	Correlation	Covariance	R^2	F	
Adoption of vegan lifestyle	Psychological factors	0.804**	0.451	0.744	359.296	p<0.005
	Social Factors	0.768**	0.425			
	Perceived barriers	0.787**	0.452			
	Social support	0.722**	0.419			
Maintenance of vegan lifestyle	Psychological factors	0.842**	0.467	0.763	398.515	p<0.005
	Social Factors	0.756**	0.414			
	Perceived barriers	0.785**	0.447			
	Social support	0.700**	0.402			
**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 gives a thorough summary of the correlation, covariance, R-squared (R2), and F-values that exist between several aspects of adopting and sustaining a vegan diet. The correlation coefficient of 0.804 for the first hypothesis defies the null hypothesis. The significant positive association indicates that psychological aspects are important when adopting a vegan lifestyle for the first time. This link is further supported by the covariance of 0.451. As a result, Ha1 is validated, suggesting a strong correlation between psychological variables and the early adoption of a vegan lifestyle. The null hypothesis is refuted by correlation coefficients ranging from 0.768 to 0.700 (Hb0). These coefficients show that adopting and maintaining a vegan lifestyle are strongly positively correlated with social factors. As a result, Ha2 is validated, demonstrating a strong correlation between social influences and the choice to adopt and maintain a vegan diet.

H03's null hypothesis that there is no meaningful association between perceived barriers and maintaining a vegan lifestyle is refuted by the correlation coefficients of 0.787 and 0.785. These results show a strong positive association that supports Ha3 and points to a meaningful connection between perceived obstacles and the upkeep of a vegan diet. Barriers did not, however, stop many from adopting a vegan lifestyle. The adoption (0.842) and maintenance (0.763) of a vegan diet have substantial correlations with psychological characteristics, indicating a causal relationship. H04 proposes that the association between psychological characteristics and adopting and sticking to a vegan diet is mediated by social support. A possible mediation role is suggested by the substantial associations found between social support and adopting (0.722) and maintaining (0.700) a vegan diet. The table backs up Ha1, Ha2, and Ha3, showing important connections between perceived barriers, social factors, psychological variables, and adopting and maintaining a vegan diet. Based on the available data, H04 and Ha4 are still unclear since more research is needed to ascertain the mediating function of social support in the association between psychological characteristics and the adoption and upkeep of a vegan lifestyle.

5. Discussion:

The bulk of respondents come between the 18–44 age range, indicating a well-balanced representation in terms of age. It's interesting to note that the proportion of male and female participants is almost equal, defying the myth that only one gender embraces veganism. A considerable percentage of participants own high school and bachelor's degrees, indicating a varied educational background among them. The income distribution shows that people with moderate salaries are more likely to become vegans, with a higher proportion in the 20,000–40,000 range. Geographically, the prevalence is higher in suburban and urban areas, which may indicate that these areas have better access to plant-based food options. One factor is marital status; a significant percentage of unmarried people embrace a vegan lifestyle. A vegan lifestyle can be adopted for a variety of reasons, the main ones being habit changes, health issues, or lifestyle modifications. A growing knowledge of the health benefits associated with plant-based diets is indicated by the study's notable influence of health trends on veganism. Environmental and ethical concerns are the next most important social elements influencing the vegan lifestyle, after health trends. Less obviously, but still, cultural and religious views are important. The research emphasises the need for a comprehensive understanding that takes into account social, economic, and demographic aspects in order to fully appreciate the complexity of factors driving the adoption of a vegan lifestyle.

The results offer intriguing new perspectives on the variables affecting the decision to embrace and stick to a vegan diet. It turns out that psychological elements are crucial, and a strong positive connection suggests that they played a big part in the early adoption. Social factors also have a significant impact and are positively correlated with the choice to adopt and sustain a vegan diet. Additionally, there is a significant positive association between perceived hurdles and the preservation of a vegan diet. Although the table suggests that social support may play a mediating effect, more research is necessary to provide definitive proof.

6. Conclusion:

This study clearly shows how varied and multifaceted the elements are that impact people's decision to embrace a vegan lifestyle. Stereotypes are challenged by the study's fair representation of ages and genders. The intricacy of vegan choices is influenced by a number of factors, including education, income, and marital status, with health trends being a major factor. It becomes clear that psychological and social elements are essential for adopting and sticking to a vegan lifestyle. The study sheds light on the reasons behind and difficulties people encounter while adopting and maintaining a vegan lifestyle by highlighting the complex interactions between psychological, social, and perceptual barriers.

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REIMAGINING MATHEMATICS EDUCATION: INTERDISCIPLINARY APPROACHES AND TECHNOLOGY FOR SUSTAINABILITY

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Abstract:

Mathematics education can tackle today's sustainability challenges by transcending traditional boundaries, preparing students as informed, responsible citizens. This paper analyzes recent research on interdisciplinary, technology-enhanced approaches that embed sustainability into mathematics learning. Project-Based Learning (PBL), mathematical modeling, and integration of the United Nations Sustainable Development Goals (SDGs) are strategies to include to develop students' critical thinking and data literacy.

The paper emphasizes the transformative role of technology through tools like GeoGebra, simulations, and big data platforms in helping students analyze real-world environmental and social phenomena. These approaches make mathematics more relevant, equitable, and impactful in addressing issues like climate change, resource management, and social inequality.

Equally important is teacher capacity. Effective professional development that combines sustainability knowledge, pedagogical innovation, and technological skills is crucial for bridging the gap between policy and classroom practice.

Findings highlight that with the right strategies and support, mathematics education can become a powerful engine for sustainability, equity, and global citizenship. The paper advocates for systemic reforms that position math educators as key actors in advancing educational and societal transformation aligned with the SDGs.

1. Introduction:

Integrating sustainability into mathematics education has become imperative to address urgent global challenges and to foster responsible citizenship aligned with the UN's Sustainable Development Goals (SDGs) (Vasquez et al. ,2023; Mustini, 2024). Mathematics, as a foundational discipline, offers unique opportunities for students to engage with environmental, social, and economic data, fostering analytical skills vital for sustainable decision-making. This paper reviews interdisciplinary strategies linking sustainability and mathematics education, emphasizing the roles of technology, data analysis, and teacher preparedness.

2. Literature Review:

2.1 Interdisciplinary Approaches

- It is becoming more widely acknowledged that interdisciplinary teaching methods in mathematics education are crucial for developing sustainability competencies. One such effective tactic is project-based learning (PBL), which allows students to apply mathematical ideas to practical sustainability problems including resource optimization, waste management, and climate modeling (Vásquez et al., 2023; Mustini, 2024). Students participate in inquiry-based, group learning activities through PBL that enhance their comprehension of the material as well as their civic engagement and environmental awareness.

- This objective is further supported by mathematical modelling, which links abstract quantitative thinking to intricate global issues. It converts theoretical knowledge into useful tools for problem-solving by enabling students to model patterns of resource consumption, forecast climatic trends, or optimize transportation networks (Karjanto, 2023). These models foster the development of

multidisciplinary thinking and systems analysis, two abilities essential to solving sustainability problems.

- Students are encouraged to examine real data pertaining to clean energy (SDG 7), responsible consumption (SDG 12), and climate action (SDG 13) when the United Nations Sustainable Development Goals (SDGs) are incorporated into the mathematics curriculum. This increases the contextual relevance of learning (Vásquez et al., 2023; Mustini, 2024). With this method, students can observe how mathematical abilities are directly applied to improve social and environmental resilience.

- Additionally, critical mathematics education and ethnomathematics offer transformative pathways by embedding local cultural knowledge, issues of equity, and political consciousness within mathematics instruction. Such approaches resonate with social justice aims and expand the role of mathematics as a tool for empowerment (Hamilton & Pfaff, 2014). For instance, Kunalkumar (2025) advocates for the inclusion of caste-based and gender-disaggregated data in classrooms to reflect Ambedkarite principles of equity and to nurture critical perspectives among marginalized learners. This blending of quantitative analysis with ethical inquiry helps to democratize access to mathematics education and instill values essential for a more just and sustainable future.

2.2 Technology and Data Analysis

- Digital technologies significantly enhance mathematics education by enabling visualization, simulation, and interaction, especially in sustainability contexts. Tools like GeoGebra improve students' conceptual and spatial understanding and foster representational fluency, helping them connect abstract mathematical ideas with real-world phenomena (Bayaga, 2024; Samsudin et al., 2024; Solvang, 2021).

- The growing availability of authentic datasets such as climate models, population statistics, and resource distribution allows students to apply mathematical skills to real sustainability issues. This promotes data literacy, critical thinking, and interdisciplinary inquiry, linking mathematics to science, social studies, and ethics (Mustini, 2024; Yaro et al., 2024).

- Technology also nurtures adaptive and collaborative learning. Digital tools personalize instruction and support teamwork on real-world projects, increasing motivation and engagement (Bayaga, 2024; Meylani, 2025). Meylani's (2025) systematic review highlights how dynamic software, robotics, and AI-driven platforms align with SDG 4 (Quality Education) by promoting critical thinking and inclusive learning environments.

- While challenges like unequal access and insufficient teacher training persist, integrating technology meaningfully into mathematics education holds enormous promise for preparing students to address global sustainability challenges.

2.3 Teacher Training and Curriculum Development

- Despite the growing recognition of the importance of education for sustainable development (ESD) within mathematics, teacher training remains a core challenge. Numerous studies have demonstrated that many educators report limited knowledge, insufficient practical resources, and uncertainty about how to implement sustainability in mathematics classrooms (Vásquez et al., 2023). This gap affects not only teaching efficacy but also the capacity of mathematics educators to serve as agents of social change—a role considered fundamental when equipping students for sustainable development (Alsina & Mulà, 2019 as cited in Vásquez et al., 2023).

- Initial and ongoing professional development are thus critical. Effective programs integrate content mastery, pedagogical strategies, and technological proficiency, enabling teachers to confidently embed real-world sustainability themes and interdisciplinary approaches into their curricula (Vásquez et al., 2023; García-Alonso et al., 2023 as cited in Vásquez et al., 2023). Emerging evidence highlights the effectiveness of approaches such as STEAM-based training, which develop both disciplinary and

transversal competencies for sustainability (Alsina & Calabuig, 2019 as cited in Alsina & Calabuig, 2019; Alsina & Mulà, 2019). Moreover, professional learning communities and reflective practice have shown promise in shifting both attitudes and classroom practices regarding ESD (Alsina & Mulà, 2019 as cited in Vásquez et al., 2023; Alsina & Silva-Hormazábal, 2023 as cited in Vásquez et al., 2023).

- Research underscores the need to integrate ESD not only in pre-service teacher education but also throughout teachers' careers, with tailored support to bridge theory and classroom practice. Such professional development strengthens teachers' ability to design realistic tasks, encourage creativity and critical reflection, and foster students' sustainability skills (Paredes et al., 2020 as cited in Vásquez et al., 2023; Coles, 2023 as cited in Vásquez et al., 2023; Alsina & Calabuig, 2019 as cited in). Only through systemic investment in teacher training and curriculum renewal can mathematics education effectively contribute to sustainable and resilient societies.

3. Methodology:

The results of a thorough review of academic material published between 2010 to the middle of 2025 are summarized in this study. Peer-reviewed research on the intersections of mathematics education, sustainability, interdisciplinary teaching approaches, technology integration, and teacher professional development was found by conducting a systematic search across several academic databases, including Scopus, Web of Science, ERIC, and pertinent open-access repositories.

To maintain relevance and rigor, only theoretical and empirical research that specifically addressed sustainability-oriented approaches in mathematics education was included. Articles examining secondary and tertiary education levels were given priority during the selection process, with a focus on curriculum reforms and pedagogical innovations in line with the Sustainable Development Goals (SDGs), particularly goal 4 on Quality Education (Vásquez et al., 2023; Meylani, 2025).

To focus the scope, the review process used explicit inclusion and exclusion criteria in accordance with accepted methodological frameworks for scoping reviews (Levac, Colquhoun, & O'Brien, 2010). Articles discussing mathematics for sustainable development (MSD), multidisciplinary approaches that connect math to social and environmental concerns, and the use of technology to improve learning outcomes were found during the initial screening (Husamah et al., 2022; Mustini, 2024).

Curriculum reform, teacher continuous professional development (CPD), interdisciplinary teaching tactics, assessment procedures, and the incorporation of real data sets were among the major themes that emerged from the thematic analysis. The results also point to implementation issues such as inadequate teacher readiness and resource limitations (Vásquez et al., 2023; Meylani, 2025).

By consolidating global research trends and case studies across diverse educational contexts, this review aims to present a holistic overview of effective practices, gaps, and future directions for embedding sustainability within mathematics education. The insights serve as an evidence base to inform policymakers, curriculum designers, and educators striving to cultivate learners' competencies for sustainable development through mathematics.

4. Interdisciplinary Strategies In Practice:

4.1 Project-Based and Contextual Learning

Empirical studies consistently demonstrate that Project-Based Learning (PBL) greatly enhances students' comprehension of mathematics while also fostering sustainability skills. PBL engages students in meaningful, real-world projects such as analyzing school waste patterns or modeling energy consumption which naturally integrate mathematics with environmental science, geography, and social studies, thereby reinforcing interdisciplinary learning (Himmi, Armanto, & Amry, 2025; Mustini, 2024).

By working collaboratively in teams to solve authentic problems, students enhance critical 21st-century skills including communication, critical thinking, creativity, and technological literacy, all of which are vital for tackling sustainability challenges (Himmi et al., 2025; Cruz, Viseu, & Lencastre, 2022). The PBL process encompasses clearly outlined stages, including problem presentation, project planning, team formation, ongoing teacher support, alignment with curricular objectives, utilization of visual aids, presentations, and reflective evaluation. These components collectively contribute to creating a more engaging and contextualized mathematics learning environment (Himmi et al., 2025; Sánchez-García, 2025).

Investigations carried out in various cultural settings, such as Spain, Indonesia, Russia, Serbia, and Finland, indicate that PBL enhances student motivation and academic success by enabling learners to recognize the significance of mathematics in addressing real-life sustainability issues (Luque-González et al., 2025; Himmi et al., 2025). However, challenges such as rigid school schedules and the requirement for enhanced teacher professional skills still need to be addressed to fully realize PBL's benefits (Himmi et al., 2025).

Moreover, studies indicate that although project-based learning significantly enhances university students' understanding of the Sustainable Development Goals (SDGs), its influence on their views regarding the relevance of SDGs in their future careers and personal lives may be restricted. This highlights the necessity to investigate additional teaching methods in conjunction with project-based learning to achieve a more comprehensive sustainability education (Luque-González et al., 2025).

Overall, PBL not only supports deeper conceptual learning but also cultivates the collaboration, problem-solving, and motivation necessary for students to become active contributors to sustainable development.

4.2 Embedding SDGs and Real-World Data

By integrating social and environmental facts into classroom activities, curricula that specifically incorporate the Sustainable Development Goals (SDGs) encourage meaningful mathematical learning. Students actively engage with statistics and modeling tools to quantify pressing issues such as carbon emissions and climate trends, which facilitates a deeper understanding of the societal impact of mathematical decisions (Yaro et al., 2024; Mustini, 2024).

Beyond environmental metrics, incorporating social indicators—such as caste-based wage inequalities, unequal access to welfare programs, and patterns of land distribution—into mathematics tasks fosters critical engagement with equity issues that are deeply rooted in local and national contexts. Incorporating data that is culturally appropriate and justice-focused supports SDG 10, which aims to lessen inequality, and equips students to apply mathematical inquiry as a means of identifying and correcting social injustices (Kunalkumar Shelar, 2025).

This approach to authentic problem-solving not only strengthens students' motivation but also enhances the relevance of mathematics education by connecting abstract concepts with real-world challenges that matter to students and their communities. Research indicates that when learners work with genuine, contextually meaningful data, their ability to think critically about sustainability and social equity is significantly enhanced (Vásquez et al., 2023; Kim & Pang, 2022).

Such interdisciplinary and justice-centered pedagogies contribute to the ongoing shift toward mathematics education that prepares students to participate actively and thoughtfully in promoting sustainable development within their societies (Coles, 2023; Hamilton & Pfaff, 2014). This development demonstrates how mathematics is increasingly seen as a crucial instrument for just and sustainable social change, rather than only as a technical field.

4.3 Technology-Enhanced Learning

In mathematics classrooms, technology is essential to making sustainability data and concepts understandable and interesting. Interactive simulations and data analysis platforms enable students to actively explore climate models, energy systems, and population dynamics, thereby nurturing both mathematical proficiency and

sustainability literacy (Karjanto, 2023; Yaro et al., 2024). These digital tools help students visualize complex, dynamic systems, making abstract concepts concrete and promoting deeper conceptual understanding.

Meylani (2025) conducted a review highlighting the benefits of emerging technologies—such as virtual simulations, adaptive learning platforms, and dynamic geometry tools like GeoGebra—in mathematics education. The review found that integrating these technologies into lessons focused on sustainability leads to higher student engagement and fosters critical thinking skills consistent with Sustainable Development Goal 4 (Quality Education). According to teacher reports, the successful use of technology in these contexts not only strengthens students' conceptual understanding, but also boosts their motivation and self-confidence.

Moreover, technology facilitates personalized learning pathways through AI-enabled adaptive tutoring systems that adjust to learners' individual strengths and weaknesses, ensuring scaffolded support and continuous progress (Srilatha & Sen, 2024). Collaborative digital environments—such as virtual whiteboards and online discussion forums—also encourage peer interaction and collective problem-solving on sustainability challenges, contrasting favorably with more isolated, traditional approaches.

Despite these strong benefits, challenges remain. Technology's effective adoption in a variety of educational settings can often be hindered by accessibility issues and inadequate training for educators (Meylani, 2025). For optimal use of technology in upgrading mathematics education for sustainability, these obstacles must be removed through inclusive policies, professional development, and infrastructure development.

5. Teacher Training And Professional Development:

Effective integration of sustainability into mathematics education depends heavily on comprehensive teacher training and ongoing professional development. Studies regularly show that many math teachers lack the tools and knowledge required for successfully integrating Education for Sustainable Development (ESD) into the classroom (Vásquez, Sánchez Bello, & Ortega Ruiz, 2023; Alsina, 2024). The effective adoption of sustainability-oriented pedagogy is severely impeded by this knowledge gap, which also prevents teachers from accomplishing their more general professional obligations to promote fairness, critical thinking, and global citizenship (Li & Tsai, 2021).

Professional development programs must go beyond traditional content delivery to incorporate interdisciplinary strategies, pedagogical innovation, and technological integration in order to meet these challenges. This will enable teachers to create lessons that incorporate sustainability themes and real-world data.

Collaborative professional networks and STEAM-oriented approaches have shown promise in sustaining teacher motivation and facilitating the exchange of best practices for teaching sustainability in mathematics (Alsina & Silva-Hormazábal, 2023; Su, 2023).

Moreover, recent models such as the Transformational Professional Competence Framework emphasize reflective learning and the transformation of teachers' prior knowledge into professional competencies aligned with sustainability goals (Alsina & Calabuig, 2019). This involves engaging teachers in critical dialogues around their professional identity and the interdisciplinary nature of sustainability, supporting their development as change agents capable of fostering inclusive and socially responsive mathematics education (Hormazábal, 2023; Bulut, 2025).

However, systemic issues such as lack of institutional support, insufficient training time, and resource limitations continue to slow scalable implementation. Addressing these barriers requires coordinated efforts from educational policymakers, school leaders, and teacher educators to embed sustainability competences within both initial teacher education and continuous professional development (Vásquez et al., 2023; Su, 2023).

In summary, professional development that integrates content knowledge, pedagogical strategies, and technological proficiency within a sustainability framework is crucial to empower mathematics teachers to

facilitate transformative learning experiences that prepare students to navigate and address complex sustainability challenges.

6. Discussion:

The integration of interdisciplinary pedagogy, technology, and authentic data analysis emerges as a robust framework for advancing sustainable mathematics education. By embedding mathematics within real-world sustainability contexts such as environmental management, social equity, and climate action students cultivate not only transferable mathematical skills but also a strong sense of agency to engage with global challenges critically and creatively (Vásquez et al., 2023; Mustini, 2024; Hamilton & Pfaff, 2014).

A growing body of research illustrates how interdisciplinarity enriches mathematical learning by connecting it with environmental science, geography, social studies, and ethics, enabling students to analyze complex problems like solid waste management, carbon emissions, and resource optimization (Skovsmose, 2001; ARACÊ MAGAZINE, 2024). For example, hands-on projects measuring and categorizing solid waste, coupled with modeling environmental impacts, empower learners to apply concepts such as percentages, proportionality, and statistics meaningfully (ARACÊ MAGAZINE, 2024). Programs like Mathematics for Planet Earth provide inspiring models by leveraging real data to expose students to pressing ecological concerns (ARACÊ MAGAZINE, 2024).

Technology serves as a catalyst by bringing abstract data to life through simulations and dynamic visualization tools that foster sustainability and mathematical literacy (Karjanto, 2023; Yaro et al., 2024). Interactive platforms, such as GeoGebra and big data analysis tools, allow students to engage with climate models, population trends, and energy systems, fostering deep understanding and critical thinking (Meylani, 2025). Teachers report increased student motivation, engagement, and conceptual clarity when technology-enhanced instruction is integrated with sustainability themes (Yaro et al., 2024).

However, realizing this integrated model at scale requires addressing key challenges. Curriculum reform that explicitly incorporates sustainability and technology is essential to bridge theory and classroom practice effectively (Vásquez et al., 2023; Mustini, 2024). Additionally, teacher training and professional development must focus on equipping educators with interdisciplinary knowledge, pedagogical strategies, and technological proficiency to design and facilitate meaningful sustainability-focused math lessons (Alsina & Calabuig, 2019; Vásquez et al., 2023).

The lack of resources, unequal access to technology, and disparities in teacher readiness remain to be key barriers to broad adoption (Vásquez et al., 2023). To guarantee that every student benefits from a technology-rich, sustainability-focused mathematics education, equity must be given top priority. Furthermore, curriculum designers, school leaders, and policymakers need to collaborate proactively to develop standards, materials, and supports that sustain long-term, effective implementation (Mustini, 2024; Hamilton & Pfaff, 2014).

In conclusion, an interdisciplinary mathematics education underpinned by technology and authentic data equips students with the critical skills and values needed to become proactive agents of sustainable development. Through contextualized learning, this method coincides with the global mandate to educate for sustainability in the twenty-first century by promoting intellectual abilities, creativity, and ethical reflection.

7. Conclusion:

When combined with technology, real-world information, and cross-disciplinary methods, mathematics education can be a powerful tool to enhance students' abilities to deal with difficult sustainable development problems. Integrating real-world environmental, social, and economic contexts fosters not only quantitative reasoning but also critical, systems, and ethical thinking skills essential for informed global citizenship (Vásquez et al., 2023; Meylani, 2025).

Students can examine and address urgent issues like inequality and climate change when curricula incorporate the SDGs and make use of digital tools like modeling software, simulations, and big data platforms (Mustini,

2024; Kunalkumar Shelar, 2025; Yaro et al., 2024). By integrating mathematics to real-world issues, research demonstrates that mathematical modeling and Project-Based Learning (PBL) promote deep involvement and collaborative problem-solving (Himmi et al., 2025; Salim, 2023; Karjanto, 2023; Bulut, 2025).

Though their success depends on adequate teacher preparation, technology facilitates these practices by making abstract concepts interactive and relevant (Meylani, 2025; Bayaga, 2024). Educators need pedagogical, technological, and interdisciplinary skills, fostered through sustained professional development and STEAM-based collaboration (Alsina & Calabuig, 2019; Su, 2023; Vásquez et al., 2023; Bulut, 2025).

Ultimately, the transformative potential of mathematics education in achieving sustainable development lies in aligning curriculum, technology, and teacher capacity to prepare students as socially responsible, mathematically literate, and sustainability-minded citizens.

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CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL ACCOUNTABILITY OF AUTOMOBILE INDUSTRY COMPANIES IN INDIA: A CASE STUDY

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Abstract

The main purpose of this paper is to contribute to the existing body of knowledge on CSR and Environmental Accountability of Automotive Companies in India. The paper attempts to determine to what extent the financial and non-financial Annual Reports showcase the car manufacturers concern and commitment for the environment. This can be understood through their CSR initiatives and CSR spends. The approach applied in the paper is of descriptive-empirical nature using Annual reports of 2 car manufacturing companies, TML and M&M in India. The research methods involved in this paper are: induction, deduction, literature studies, data analysis, content analysis and case-study.

The paper has evaluation of both the companies individually. The paper ends with a critical and comparative analysis, of research findings while discussing to understand the impact of CSR initiatives and Environmental Accountability.

The results of the research discussed in the paper have a theoretical and a few practical implications. It builds on the awareness of vision of the car manufacturing industry for various stakeholders. When businesses engage in CSR, it encourages various stakeholders – including consumers – to adopt more responsible and thoughtful consumption patterns. This, in turn, leads to a more sustainable and ethical marketplace.

Keywords: CSR, Environmental Accountability, Automotive Industry, Sustainability

1. Introduction:

As of 2025, India is the world's fourth-largest automobile producer and the third-largest by sales. The Indian automotive industry accounts for 7.1% of the total GDP and 49% of the manufacturing GDP. Despite this strong foundation, India's share in the globally traded auto components market is only 3% ~ ₹ 1,72,200 crore (US$ 20 billion), indicating significant untapped potential. The NITI Aayog report titled 'Automotive Industry: Powering India's Participation in Global Value Chains,' launched on April 11, 2025, outlines strategic reforms to enhance this footprint. The Vision 2030 roadmap aims to scale production to ₹ 12,48,450 crore (US$ 145 billion), raise exports to ₹ 5,16,600 crore (US$ 60 billion). It is possible for India to grow its global trade share from 3% to 8% and build a ₹ 2,15,250 crore (US$ 25 billion) trade surplus by 2030.

The automotive industry is undergoing a transformative shift towards hybrid and electric vehicles (EVs), reducing consumption of fossil fuels, regulatory pressures to reduce carbon emissions, and advancements in technology. EV sales have risen globally, reshaping the automotive manufacturing landscape. As concerns regarding environmental degradation and social impact continue to rise the concept of Corporate Social Responsibility (CSR) has gained prominence as a framework for businesses to go beyond profit-making and address their broader responsibilities (Lin, 2023).

Global Reporting Initiatives (GRI) were introduced as set of guidelines for producing voluntary sustainability reports worldwide on economic, environmental and social performance by businesses. The GRI framework supports corporate sustainability goals by providing a globally recognized structure for consistent, transparent, and stakeholder-relevant ESG reporting. SEBI introduced the requirement of ESG reporting in India in 2012, termed the Business Responsibility Report (BRR). By 2021, BRR evolved into BRSR, a mandatory report for the top 1,000 listed companies in India, based on market capitalization. This means that companies falling

within this threshold must file BRSR reports as part of their annual reports. The reporting requirement started on a voluntary basis for FY 2021-22 and became mandatory from FY 2022-23.

The BRSR has managed to get the essence in terms of accuracy and depth of reporting for transparency and accountability. This framework in India pushes it to the forefront and makes it an integral ally in addressing social and environmental issues and leads by example in setting strict regulatory measures and policies so that organisations conduct business responsibly and sustainably.

Sustainability has become a strategic priority for automotive industry due to growing concerns of climate change and environmental degradation (Janik and Ryszko, 2017).

The key objective of the paper is to provide and explore the interplay between CSR and environmental aspects within the automotive industry by studying prominent companies.

2. Literature Review:

Car is a very complex product not only due to thousands of components used in a production process and many people involved in this process but especially for the reason that, it creates threats for the environment at each stage of its life cycle (Golinska-Dawson, Paulina & Kosacka, Monika, 2014). The automotive manufacturing industry is associated with various environmental challenges due to its reliance on intensive resource consumption, energy-intensive production processes, concerns include air and water pollution, greenhouse gas emissions, energy consumption, waste generation, and ecosystem degradation (Giampieri et al., 2020). The proliferation of automobiles powered by internal combustion engines contributes to urban air pollution, leading to health problems such as respiratory diseases, cardiovascular disorders, and premature mortality (Madhav et al., 2022). By integrating Environmentally Health and Safety (EHS) practices into manufacturing processes and addressing environmental challenges proactively, the automotive industry can mitigate its ecological footprint and contribute to a more sustainable future (Staniszewska, 2020).

According to Hohnen (2012), sustainability reporting allows companies to demonstrate progress in sustainability-supporting activities that were previously often not transparent. It highlights areas for improvement and allows companies to track their progress, which in turn can enhance their reputation and build trust with stakeholders (Kolk, 2005). Companies can adopt national and international codes/certifications/labels/ standards frameworks such as ISO 1400, United Nations Global Compact ('UNGC'), Carbon Disclosure Project (CDP) on Climate Change & water, S&P Global Corporate Sustainability Assessment (CSA). These frameworks have been made to ensure that companies address key sustainability topics reliably and consistently. However, companies face practical challenges when selecting and implementing the most appropriate framework. Many businesses may struggle with the cost and complexity of the standard reporting systems. Dealing with sustainability reporting and communication requires to take a strategic and value-centric approach which is crucial to avoid unnecessary expenditure and inefficiencies (Rhoden, Ball, Vögele, Kuckshinrichs, 2023). Russo-Spena et al. (2018) and Chandrasekaran (2022) highlight increasing accountability for environmental and social issues in the industry. Rising CO2 emissions, corporate scandals, and the shift to electric vehicles have pushed industries to adopt more sustainable practices (Golinska, 2014; Wellbrock et al., 2020). Regulations, political pressure, and growing demand from employees and customers for sustainable and ethical business practices drive ESG trend (Sukitsch et al., 2015).

3. Overview of Reports of Leading Indian Car Manufacturers:

3.1 Introduction to the research:

The main purpose of this paper is to analyze CSR strategies and the reporting of different aspects of Environmental Accountability. This part of paper examines the Annual Reports for the financial year ending 31st March, 2025, of two listed automobile companies in India: Tata Motors Limited (TML) and Mahindra &

Mahindra (M&M). The selection of the mentioned companies for this research was based on their status as some of the oldest and largest car manufacturers in India.

Tata Motors was established in 1945 under the Tata Group. It is one of the world's leading manufacturers of automobiles. It is present in multiple segments like cars and utility vehicles, trucks and buses, defence vehicles, and electric vehicles. The company has extended its presence internationally through Joint Ventures (JV) like the strategic alliance with Fiat and Marcopolo. TML is present in about 175 countries with Research and Development (R&D) centres in UK, Italy, India, and South Korea. (*Tata Motors*, n.d.)

Established in 1945 by JC and KC Mahindra and Ghulam Mohammed, Mahindra & Mohammed began as a steel trading firm and later ventured into manufacturing and selling larger MUVs. It was renamed Mahindra & Mahindra in 1947. Today, Mahindra Automotive is one of India's leading manufacturers of passenger and commercial vehicles. has a widespread global presence in regions like APAC, Africa & Middle East, and South-Central America. Mahindra Automotive offers an extensive lineup of Mahindra vehicles which include SUVs, electric SUVs, Pik-ups, Electric Vehicles, Trucks, Small Commercial Vehicles, and buses.

These automakers have a significant influence on the global economy, transportation networks and environmental impact as pioneers and leaders in the automobile industry of India. Automotive manufacturers have embraced CSR practices to match their business objectives with societal and environmental demands as they become more and more important. The described companies have become market leaders, garnering a sizable following and market share. Their commitments, achievements and upcoming goals in relation to CSR, environmental stewardship, community participation and ethical practices may all be learned by reviewing their financial and non-financial reports.

In case of TML, the Annual Report for FY ending 2025 for non-financial data in the 'Sustainability Review' section covers for Tata Motors Limited (TML), Tata Motors Passenger Vehicles Limited (TMPVL), Tata Passenger Electric Mobility Limited (TPEML) and a select set of indicators for JLR. The BRSR Section covers TML disclosures on a standalone basis.

Annual Report of M&M for FY ending 2025, includes core operations across the Automotive Sector, Farm Equipment Sector, Spares Business Unit, Mahindra Research Valley, Two-Wheeler Division, Construction Equipment Division, and Powertrain Business Division.

The research report for each company is divided into 4 parts, viz, CSR initiatives, CSR spends, Future perspectives and Conclusions. The research paper ends with brief presentation of research findings with respect to CSR and environmental aspects of both the companies.

3.2 The case study of Tata Motors:

(A) CSR Initiatives:

CSR of TML initiatives is organized under five core thrust areas, along with a focused Rural Development programme. The thrust areas include: Health (Aarogya), Education (Vidhyadanam), Employability (Kaushalya), Environment (Vasundhara) and Rural Development. They have also multiple Water Projects. The Tata Affirmative Action Programme (TAAP) is an initiative by the Tata Group for greater inclusion of disadvantaged sections of society. It focuses on groups which have been socially and economically disadvantaged due to historical reasons/displacement. Their access to opportunities, services and benefits in society are limited and therefore they are socially excluded.

(B) CSR spends:

Between FY21 and FY25, the Tata Group invested over ₹ 7,550 crore ($1 Bn) in CSR initiatives. Due to losses sustained in earlier years, the Company was not legally obligated under Section 135 of the Companies Act, 2013 to allocate funds for the CSR initiatives. Yet it has spent ₹ 26.31 crore in both Ongoing Projects and other than Ongoing Projects towards CSR.

(C) Future perspectives:

Under their Sustainability Report for the year 2024-25, TML has outlined Project Aalingana. This project has three interlinked pillars of action that resonate with the Tata Group's vision of environmental stewardship.

Pillar I: Driving net zero - Driving a low-carbon transition	Pillar II: Pioneering circular economies - Applying a systemic, circular economy approach to reduce resource use and waste	Pillar III: Preserving nature and biodiversity - Implementing a comprehensive, science driven approach to biodiversity management
Sourcing 100% renewable electricity by 2030	Zero Waste to Landfill by 2030	Aligning to global biodiversity framework
Following a science-based approach to emissions reduction, PV by 2040, CV by 2045	Water Neutral by 2030	Aligning with science to map and set targets across our value chain
	Water Positive by 2040	Taking up flagship projects for nature-based-solutions
	Deployment of TATVA framework at enterprise level	

(D) Conclusion:

In conclusion the analysis of TML, Annual Report showcases the company's strong commitment to CSR and sustainability. It has contributed to almost all the SDGs in spite of incurring losses in the previous years. In terms of environmental sustainability, TML is dedicated to mitigating climate change and reducing its ecological footprint. The company speaks of use of recycled materials in commercial vehicles as the automobile industry seeks to reduce its environmental impact. As part of end-of-life product management, they are working on improving product's circularity. This involves working on different levels of the process from designing the vehicle for recyclability, selecting sustainable materials by studying their environmental impact, and designing vehicle assemblies/components that are easy to dismantle, etc. With the launch of Re.Wi.Re., TML aims to offer better value capture in downstream businesses, generate employment, and support the minimization of environmental pollution caused by aged vehicles. Overall TML's report reflects its commitment to addressing social and environmental challenges while driving innovation in the automobile industry.

3.3. The case study of Mahindra & Mahindra:

(A) CSR Initiatives:

As per the Company's CSR Policy and in alignment with the core purpose, the CSR mission is to: Empower Girls, Empower Women and Environment Conservation. Few of the initiatives are described here:

1. **Project Nanhi Kali:** The Company's flagship CSR initiative has empowered underprivileged girls across India by supporting their education.

2. **Mahindra Pride Classroom:** The Mahindra Pride Classrooms provides 40 to 120 hours training modules with the help of expert trainers to final year female students studying in Government Colleges, ITIs and Polytechnic Institutes.

3. **Prerna:** The flagship intervention, PRERNA is an integral part of various projects which includes training and advisory services like soil health, access to gender friendly farm equipment, linkages to Government. welfare support initiatives, resource efficient agriculture methodologies for enhancing crop productivity. The project focusses on female farmers. In FY25, this initiative reached out to 1,75,989 women across 20 states. This initiative of Project Kaabil has enabled women farmers to use regenerative agricultural practices and undergo bio-diversity training to improve soil fertility and increase productivity.

4. **Water Conservation projects:** Various water conservation projects across diverse geographies have been undertaken to prevent soil erosion, improve soil health, and increase water tables through water structure enhancement and creation. Jal Samriddhi (Water conservation) has been a flagship CSR initiative across the business locations of the Company. The focus is on capacity building of farmers and community in creating/rejuvenating water harvesting structures for water conservation, soil erosion prevention, improving soil health, and crop diversification.

(B) CSR Spends:

From April 1st, 2014, in line with the new Companies Act 2013, M&M pledged to contribute at least 2% of the average net profits of the Company made during the 3 immediately preceding financial years specifically towards CSR initiatives. The average net profit of the company as per sub-section (5) of section 135 for the financial year 2024-25 was ₹ 7,611.58 crores of which 2% comes to ₹ 152.23 crores. Mahindra has spent a total of ₹ 152.36 crores including amount spent on administrative overheads and Impact Assessment. M&M has managed to spend an amount which was legally required.

(C) Future perspectives:

The Annual Report of M&M is divided in 3 parts: Rise to Create Value, Rise to be Future Ready and Rise for a More Equal World. Their ESG philosophy is rooted in 3 pillars of positivity: Planet Positive, People Positive and Trust Positive.

Planet Positive	People Positive	Trust Positive
100% Renewable Energy: Electrical Energy by 2030	**Nanhi Kali:** Continue supporting Girl Child Education	**Gold Standard:** Maintain best-in-class compliance and disclosures across the Group
2040 Carbon Neutral (Scope 1 & 2): Targets set via SBTi	**Women Empowerment:** Continue providing Skills Training to women	
Water Positive at Group Level: Committed to returning more water than we consume		
100% Energy Productivity: Ongoing improvements in energy productivity		
100% Zero Waste to Landfill: Sites to be ZWL Certified by 2030		
Afforestation Green cover through large-scale plantation initiatives		
Carbon Pricing Emphasis in businesses		

(D) <u>Conclusion</u>:

M&M company has a vision of building a future where inclusive growth and environmental stewardship coexist, empowering communities, transforming industries, and fostering resilient ecosystems. Their green product portfolio includes manufacturing Electric Vehicles (EV), which are the future of clean mobility—delivering zero-emission performance without compromising efficiency, affordability, or design. Among others ESG commitments, is to utilise secondary steel sourced from recovered materials to reduce reliance on virgin resources.

Mahindra has committed to achieving carbon neutrality across their operations by 2040, underpinned by rigorous targets aligned with the Science-Based Targets initiative (SBTi). The company is dedicated to protecting the environment and investing in future technologies for sustainable mobility. A resilient and efficient supply chain is central to M&M's Planet Positive vision. The company is building an agile, cost-effective, sustainable, inclusive, and ethically governed value chain. By integrating ESG principles into procurement, logistics, and sourcing and collaborating closely with suppliers, they want to reduce carbon footprint across all tiers of the supply chain.

4. Conclusions

CSR is about businesses being accountable for their impact on society, not just their profits. The amounts spent by organisation on CSR indicate their commitment towards the society. Environmental accountability can be assessed by evaluating a company or organization's practices across various dimensions, including their impact on the environment, their transparency in reporting, and their commitment to remediation and prevention. Key metrics like carbon footprint, water usage, and waste generation, energy consumption and biodiversity impact should be tracked and measured by utilizing established frameworks like the Global Reporting Initiative (GRI), Task Force on Climate-related Financial Disclosures (TCFD), and Science Based Targets initiative (SBTi) to guide their reporting and performance measurement.

Both TML and M&M utilize internationally recognized frameworks such as the Sustainable Development Goals (SDGs) and GRI indicators to structure their reports and provide a clear understanding of their CSR initiatives.

Both companies have used the Double Materiality Assessment (DMA), introduced by the Corporate Sustainability Reporting Directive (CSRD), a European Union initiative, to prioritise their key environmental topics which include Carbon Emissions, Climate Action, Water Security & Conservation, Waste Management and Circularity, Biodiversity Protection.

TML speaks of future-ready portfolio embracing a range of sustainable technologies, including Battery Electric Vehicles (BEVs), Hydrogen Fuel Cell Vehicles and Hydrogen Internal Combustion Engine (ICE) Vehicles.

M&M uses cutting-edge technologies, including data & AI, Generative AI, cloud computing, and cybersecurity solutions, to optimize processes, unlock growth opportunities, and deliver exceptional customer experiences.

Mahindra AI Revolution in Industry X.O. **(**MATRIX) is an organization-wide program embedding multimodal, scalable AI into every manufacturing layer like AI-driven scheduling for real-time supply chain disruption management.

TML is actively engaged in biodiversity conservation measures. The Company has launched a wetland project that includes 1,800 wetlands across four states and is working on exploring Nature-based solutions linked to the sale of products. TML has joined the corporate engagement program of Science-Based Targets for Nature which is created by the Science Based Targets Network, or "SBTN". The Network is developing Science-Based Targets for Nature for companies to address their environmental impacts across terrestrial, freshwater, and marine realms, in addition to climate.

There are a few similarities in how both the car manufacturing companies have addressed their environmental responsibilities. At the same time both companies stand out in their approach towards giving back to the environment through their CSR initiatives. Their Annual Reports demonstrate their commitment towards SDGs, which can be seen through their comprehensive and well-prepared approach to CSR. Each company presents a distinct focus in different spheres, reflecting its priorities and strategies. Together, these automotive manufacturers play a significant role in driving the industry toward a more sustainable and socially responsible future.

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GREEN HORIZONS IN EDUCATION : DIGITAL LEARNING AS A CATALYST FOR SUSTAINABILITY AND INNOVATION

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Abstract

The 21st century has seen a significant shift in the delivery of education, with digital learning emerging as a transformative force. This study explores how digital learning enhances educational access and quality and serves as a sustainable alternative to traditional education models. Under the umbrella theme 'Green Horizon: Sustainability and Innovation,' this paper examines the environmental, social, and economic impacts of digital learning and its potential to contribute to the United Nations Sustainable Development Goals (SDGs), particularly in the areas of quality education, climate action, and responsible consumption.

Keywords: Digital, Learning, Sustainability, Environment, Social , Economic

Introduction:

Education is a vital pillar of sustainable development (SD). As global populations grow and environmental concerns escalate, there is an urgent need to reimagine education in ways that are inclusive and sustainable. Digital learning, which encompasses online education, virtual classrooms, and e-learning platforms, offers an innovative solution. This study examines how digital learning aligns with sustainability principles and addresses the evolving educational demands of the 21st century.

"UNESCO's ESD Framework and Its Contribution to Achieving the UN Sustainable Development Goals"

UNESCO's Education for Sustainable Development (ESD) initiative plays a crucial role in integrating sustainability into educational systems worldwide. ESD empowers learners with the knowledge, skills, values, and attitudes necessary to make informed decisions and take responsible actions that promote environmental stewardship, economic resilience, and social equity. By fostering critical thinking, interdisciplinary learning, and active global citizenship, ESD equips individuals to tackle pressing challenges such as climate change, inequality, and the overuse of natural resources. Through global frameworks, policy guidance, and capacity-building efforts, UNESCO advances ESD as a central pillar of quality education and sustainable development. By embedding sustainability principles into curricula, teacher education, and institutional practices, ESD transforms education into a dynamic force for creating greener, more inclusive, and future-ready societies.

Review of Literature:

Digital Learning as a Transformative Educational Model

Anderson (2008) outlined how digital learning, grounded in constructivist theory, shifts the educational experience from passive knowledge absorption to active knowledge construction. This aligns with the goals of sustainability, emphasizing learner autonomy and continuous engagement.

Selwyn (2016) further argued that digital learning enables educational democratization, especially in underprivileged communities, by lowering geographic and economic barriers to quality content.

Environmental Impact of E-Learning

Roy et al. (2020) conducted a comparative study of energy consumption in online versus traditional classroom models, showing that e-learning reduces carbon emissions by minimizing travel, paper usage, and energy consumed in maintaining physical infrastructures.

Weiss (2019) noted that organizations adopting e-learning solutions as part of corporate sustainability initiatives saw measurable reductions in their carbon footprint.

Economic Accessibility and Digital Inclusion

UNESCO (2020), digital platforms offer scalable solutions that can reach marginalized populations, making education more equitable. The report emphasizes the role of national platforms like India's SWAYAM and their role in addressing educational inequality.

Aung and Khaing (2015) emphasized the cost-effectiveness of digital learning, citing lower tuition, reduced material costs, and flexible learning paths as vital for long-term economic sustainability.

Social Sustainability and Digital Pedagogy

Kirkwood & Price (2014) explored how digital learning can foster inclusivity when grounded in Universal Design for Learning (UDL) principles. Their work supports the notion that digital platforms must be tailored to meet the needs of diverse learners, including those with disabilities.

Greenhow & Lewin (2016) argued that social learning networks and online communities promote peer learning and engagement, building a sense of global citizenship critical for sustainability education.

Challenges in Implementation

Van Dijk (2020) highlighted the persistent digital divide as a major hindrance to achieving universal access. Infrastructure, device availability, and digital literacy remain barriers, especially in developing countries.

Bolliger & Wasilik (2009) studied faculty perspectives on online education and found concerns around workload, engagement, and effectiveness—issues that must be resolved for digital learning to become a long-term sustainable solution.

Digital Learning and the SDGs

United Nations (2021) linked digital education explicitly to several Sustainable Development Goals (SDGs), including SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action), reinforcing digital learning's critical role in the global sustainability framework.

Objectives of The Research Paper:

1. This study explores how digital learning serves as a catalyst for sustainable development in the context of 21st-century education.

2. It aims to analyze the alignment of digital learning practices with environmental, economic, and social sustainability principles.

3. This study evaluates digital education as a transformative force that supports the realization of global goals, particularly the United Nations Sustainable Development Goals (SDGs), with a focus on SDG 4 (Quality Education).

Scope of The Research Paper:

This study focuses on the intersection of digital education and sustainable development by examining the role of digital learning in promoting environmental sustainability (e.g., reduced carbon emissions and minimal paper usage). Its contribution to economic equity and efficiency in education (e.g., cost reduction and scalability). Its capacity to enhance social inclusivity and educational access (e.g., through assistive technologies, online platforms, and lifelong learning). The study also analyzes policy frameworks, case

studies, and global best practices, particularly in countries such as India, and discusses how governments and institutions can harness digital learning for long-term sustainability.

Research Methodology:

The researcher has collected the data from the secondary sources i.e. journals, articles, google scholar, and research papers.

Digital Learning With Environmental, Economic, And Social Sustainability

Digital learning has evolved into a vital educational model with the potential to contribute significantly to sustainable development. By evaluating digital learning through the three core pillars of sustainability—environmental, economic, and social–it can be better understood through its transformative role in shaping education systems for the 21st century.

1. Environmental Sustainability:

Digital learning reduces the need for physical infrastructure, commuting, and printed materials, leading to a marked decrease in resource consumption and greenhouse gas emissions. Online education minimizes energy usage in school facilities and transportation, thereby promoting a low-carbon model of knowledge delivery. According to various life cycle analyses, the carbon footprint of digital learning is significantly lower than that of traditional classroom-based learning. By shifting to virtual platforms, institutions can also reduce e-waste through cloud computing and centralized digital resources, aligning with sustainability goals, such as **SDG 13: Climate Action.**

Case Study: Open University (UK) The Open University in the United Kingdom conducted a lifecycle assessment comparing its distance learning model with traditional classroom-based education**.**

- **A 90% reduction in energy consumption** per student.

- **There were 85% fewer CO_2 emissions** due to minimal travel and infrastructure use.

Digital learning platforms significantly reduce environmental footprints by eliminating the need for daily commuting, physical buildings, and printed textbooks.

2. Economic Sustainability:

Digital learning enhances economic sustainability by making education cost-effective and scalable. It lowers the barriers to entry for both learners and institutions by reducing expenses related to travel, accommodation, infrastructure, and materials. Open educational resources (OER), MOOCs, and government-supported platforms such as India's SWAYAM or the U.S.-based Coursera and edX allow learners from diverse socioeconomic backgrounds to access high-quality education at little or no cost. Furthermore, digital learning supports workforce development through flexible, skill-based programs that encourage continual learning and economic resilience in a rapidly changing job market.

Case Study: The **SWAYAM (Study Webs of Active–Learning for Young Aspiring Minds)** platform launched by the Government of India offers over 2,000 free online courses from top institutions such as IITs and IIMs.

Impact.

- High-quality education is available to anyone with Internet access, **free of cost**.

- Millions of rural and semi-urban learners can access higher education without relocating or incurring major expenses.

- Digital learning reduces educational costs for learners and institutions, making it economically sustainable and inclusive.

3. Social Sustainability:

From a social perspective, digital learning contributes to educational equity by reaching underserved, marginalized, and remote populations. It facilitates inclusive education by offering customizable content, multilingual interfaces, and support for learners with disabilities through the use of assistive technologies. It promotes lifelong learning, digital citizenship, and global collaboration, which are key competencies in the modern world. Through Universal Design for Learning (UDL) frameworks and community-driven online platforms, digital education fosters engagement, empowerment, and social cohesion, directly supporting **SDG 4: Quality Education,** and **SDG 10: Reduced Inequalities**.

Case Study

India's efforts to promote social sustainability through digital education became more pronounced during and after the coronavirus disease (COVID-19) pandemic. The urgent need to maintain educational continuity for millions of students led to the accelerated adoption of virtual learning platforms at all levels—school, college, and lifelong learning–during the pandemic. A prominent example is the integration of socially inclusive practices into platforms such as **DIKSHA**, **SWAYAM**, and **e-Pathshala**.

Over **3 crore (30 million+) students** accessed the DIKSHA content during school closures.

SWAYAM saw a **sharp increase in enrollment** from learners in Tier 2 and Tier 3 cities.

Enhanced participation of students from **scheduled tribes and rural backgrounds**, who previously had limited access to quality content.

Alignment with Social Sustainability:

India's digital education model helps realize the **social pillar of sustainability** by:

- Promoting **inclusive and equitable education** (SDG 4).
- Reducing **regional and socioeconomic disparities**.

Role of Policies And Innovation: **Government Policies Supporting Digital Education: Nep 2020, Digital India:**

The Government of India has undertaken significant policy initiatives to integrate digital learning into the national education framework, notably through the National Education Policy (NEP) 2020 and Digital India campaign. The NEP 2020 envisions a technology-integrated, flexible, and inclusive education system that promotes lifelong learning and skill development. It emphasizes the use of digital platforms such as SWAYAM, DIKSHA, and the National Digital Library to provide high-quality e-content in multiple regional languages, catering to learners across socioeconomic backgrounds. "Additionally, the National Education Policy (NEP) envisions the creation of a National Educational Technology Forum (NETF) to foster dialogue and collaboration on the effective integration of digital technologies in education, both within and beyond the classroom." Complementing this, the Digital India initiative, launched in 2015, aims to transform India into a digitally empowered society by enhancing digital infrastructure, ensuring Internet connectivity in rural areas, and promoting digital literacy. Through schemes such as BharatNet, the government is bridging the urban-rural digital divide, enabling even remote learners to access educational resources. Together, these policies lay a strong foundation for digital education as a sustainable, inclusive, and future-ready model, contributing to national development and global sustainability goals.

Recommendations:

1. Investment in digital infrastructure and green edtech

To ensure that digital learning contributes meaningfully to sustainability, there must be increased investment in robust digital infrastructure and environmentally responsible EdTech solutions. Governments and institutions should prioritize expanding broadband access, especially in rural and remote areas, and support the use of solar-powered learning centers, energy-efficient devices, and cloud-based platforms with lower carbon footprints. Encouraging public-private partnerships can accelerate the development of green educational technologies that are scalable, affordable, and eco-conscious, ensuring that digital learning is both accessible and aligned with environmental sustainability goals.

2. Government Support for Open Educational Resources (OER)

Governments should actively promote the creation, adoption, and dissemination of Open Educational Resources (OER) to ensure equitable and sustainable access to quality learning. By funding and standardizing open-access materials in multiple languages and formats, policymakers can reduce dependency on costly textbooks and commercial content. Integrating OER into national digital platforms like SWAYAM and DIKSHA not only supports inclusive education but also encourages collaborative knowledge sharing, curriculum innovation, and lifelong learning—all essential elements of a sustainable digital education ecosystem.

3. Promoting partnerships between education, technology, and environmental sectors

To maximize the impact of digital learning on sustainability, it is essential to foster collaborative partnerships between the education, technology, and environmental sectors. Such cross-sector alliances can drive innovation in green EdTech, support the co-creation of environmentally focused curricula, and ensure that digital tools are developed with both pedagogical and ecological integrity. By bringing together educators, technologists, and environmental experts, these partnerships can accelerate progress toward a holistic and sustainable education model, aligned with national priorities and global climate goals.

Limitations of The Study:

While this research highlights the critical link between digital learning and sustainability, it is subject to certain limitations. Firstly, the study is largely qualitative in nature and draws upon secondary data, case studies, and policy reviews; the absence of extensive empirical or field-based research may limit the generalizability of its conclusions. Secondly, the rapidly evolving landscape of digital technologies and EdTech tools means that some referenced platforms and initiatives may become outdated or replaced by emerging alternatives. Thirdly, the paper primarily focuses on India and select global trends; a broader comparative analysis with other regions or countries. Lastly, aspects such as digital divide, infrastructure challenges, and varying levels of digital literacy have been acknowledged, but not explored in depth. Future research could benefit from quantitative studies, user-level data analysis, and cross-cultural comparisons to build a more comprehensive understanding of how digital learning contributes to sustainable development.

Conclusion:

In the pursuit of a sustainable future, digital learning emerges as a transformative force that not only redefines education but also aligns with the core principles of environmental, social, and economic sustainability. As highlighted throughout this study, digital platforms, when supported by inclusive policies, innovative technologies, and collaborative ecosystems, can democratize access to quality education, reduce ecological footprints, and foster lifelong learning across diverse populations. The integration of government initiatives such as NEP 2020 and Digital India, coupled with the rise of Open Educational Resources (OER) and green EdTech innovations, illustrates the growing synergy between education and sustainable development goals. However, to truly harness the potential of digital learning, strategic investments, policy coherence, and strong partnerships among the education, technology, and environmental sectors are imperative. As we stand at the

crossroads of educational transformation and ecological responsibility, digital learning presents a powerful opportunity to nurture informed, empowered, and sustainability-conscious global citizens for the 21st century and beyond.

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AWARENESS AND ADOPTION OF GREEN FINANCE AMONG RETAIL INVESTORS IN INDIA

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Abstract

With rising concerns about climate change and the urgent need for sustainable development, green finance has become an increasingly important area in the financial sector. Green finance refers to financial products and services that are specifically designed to promote environmentally friendly initiatives, such as renewable energy, energy efficiency, and pollution control. This includes instruments like green bonds and ESG (Environmental, Social, and Governance) funds, which are gaining popularity globally. However, in India, especially among retail investors, the level of awareness and adoption of green finance still appears to be limited. This research paper aims to study the extent to which retail investors in India are aware of green financial products and whether they are investing in them. A survey-based method was used to collect primary data from individuals of different age groups, professional backgrounds, and investment experiences. The study focuses on understanding the factors that influence retail investors' decisions related to green finance, the barriers that prevent them from investing, and their overall perception of the environmental and financial benefits of such investments. Preliminary observations suggest that although awareness about green finance is slowly increasing, actual participation remains quite low. Most investors are either unaware of the available options or unsure about the credibility and returns of these products. The findings of this research highlight the need for better financial literacy, clearer communication from financial institutions, and supportive government policies to encourage retail investors to engage in sustainable investing. Strengthening awareness and access to green finance can play a crucial role in aligning individual investment choices with long-term environmental goals.

Keywords: Green Finance, Retail Investors, Sustainable Investing, ESG Funds, Financial Literacy.

1. Introduction

Climate change remains a pressing global issue and is increasingly gaining public attention. The financial sector's contribution to fully embracing sustainability is vital now more than ever. A new trend focusing on Responsible Investing is emerging where financial choices are made alongside social and environmental considerations. The concept of sustainable finance is now emerging in India. Nevertheless, retail investors, a substantial portion of the market, are still trying to catch up. Many of them remain either unaware or are sceptical of the benefits and credibility of green financial products. Understanding what retail investors know regarding green finance, the barriers they face, and what incentivizes or disincentivizes their decisions is important to encourage adopting more sustainable finance and investing.

1.1 Definition:

Green finance comprises the financing activities and instruments that support environmentally sustainable development. This encompasses funding for renewable energy, energy efficiency, clean transport, pollution abatement, and other environmental projects. Typical instruments of green finance are green bonds, ESG (Environmental, Social and Governance) funds, and sustainable ETFs, which seek both positive environmental impact and financial returns. Green finance facilitates the harmonization of personal and institutional investment decisions with sustainable development and climate objectives spanning decades.

1.2 Importance of the Study:

This research is important because it looks into the level of understanding and the adoption of green finance by retail investors in India, who are crucial for the country's economy. With the growing concern for the environment and the need to meet the sustainable development goals, green financing is the need of the hour. Still, green finance will only work with the right policies and institutions if it is matched by understanding and participation from individual investors. This research can address the gap between trust and the veil of green finance by understanding the factors that shape the investment decisions of retail investors and the barriers they encounter. It can aid financial educators, institutions, and policymakers in addressing the gaps to foster environment-friendly investment participation.

1.3 Research Focus and Objectives:

This research investigates the scope of awareness, comprehension, and the adoption of green finance by retail investors in India. It investigates the awareness of individuals on green financial instruments like green bonds and ESG funds, how their investment decisions are made, and the challenges confronting them in accessing or in having confidence in these options. This study also attempts to highlight the importance of financial literacy in fostering environmentally friendly investment behaviour and to make recommendations aimed at facilitating individual participation in sustainable finance.

2. Research Framework:

2.1 Objectives:

   i.   To understand the level of awareness about green finance among retail investors in India.

   ii.   To identify the factors that influence retail investors decisions to invest or not invest in green finance.

   iii.   To find out the challenges faced by retail investors in accessing or understanding green finance options.

   iv.   To suggest ways to improve awareness and encourage adoption of green finance in India.

2.2 Hypothesis:

Hypothesis 1:

- **Null Hypothesis (H_0):** Retail investors in India have a high level of awareness about green finance.

- **Alternative Hypothesis (H_1):** Retail investors in India have a low level of awareness about green finance.

Hypothesis 2:

- **Null Hypothesis (H_0):** Factors like environmental concern, financial returns, and government incentives have no significant influence on retail investors' decisions regarding green finance.

- **Alternative Hypothesis (H_1):** Factors like environmental concern, financial returns, and government incentives significantly influence retail investors' decisions regarding green finance.

Hypothesis 3:

- **Null Hypothesis (H_0):** Retail investors do not face significant challenges in accessing or understanding green finance options.

- **Alternative Hypothesis (H_1):** Retail investors face significant challenges in accessing or understanding green finance options.

2.3 Research Methodology:

A descriptive study was conducted to assess the awareness of green finance among 101 retail investors in the Mumbai Metropolitan Region using a structured, close-ended questionnaire administered both online and offline; primary data on demographics, recognition of green finance terms and products, attitudes via Likert-scale items, and information sources were collected alongside secondary data from journals, industry and regulatory reports, and financial databases. Respondents were selected through a combination of random sampling online and convenience sampling offline. Ethical protocols were strictly followed: informed consent was obtained, anonymity and confidentiality were maintained by reporting only aggregate findings, and participants retained the right to withdraw at any stage. Hypotheses Testing was done using MS Excel by applying T-Test and Regression analysis.

3. Review Of Literature:

1. Pradhan and Venkat Krishna (2024) studied India's green finance ecosystem, including regulations, green bonds, and sustainable investment instruments. The paper discussed challenges such as policy uncertainty, information gaps, and low investor awareness while suggesting institutional strengthening for effective adoption. However, it largely focuses on a macro-policy framework and does not analyse behavioural factors such as values, risk perception, or financial literacy influencing retail investor decisions.

2. Singh (2025) conducted a bibliometric study tracing the evolution of green finance, explaining its definitions, motives, barriers, and future directions. The paper highlighted the need for unified terminology and global policy alignment to meet climate objectives. While insightful in mapping research trends, it lacks empirical evidence on investor behaviour and provides no analysis of factors affecting individual investment choices.

3. Kumar and Shobana (2024) analysed challenges and opportunities in implementing green finance in India. They identified regulatory hurdles, weak market infrastructure, and low awareness, while emphasising the role of public–private partnerships in improving adoption. However, the study provides little discussion on behavioural aspects such as perceived risk, trust, or personal values influencing investment behaviour.

4. Climate Policy Initiative (2024) presented empirical data on sector-wise green finance flows in India, including clean energy and biodiversity projects. The report quantified the financing gap and highlighted measures for mobilising both domestic and foreign capital. Despite its strong data focus, the study does not examine investor psychology or factors affecting retail-level participation in green finance.

5. Chhaochharia (2021) assessed the progress and challenges of green finance in India, focusing on financing options, public awareness, and coordination gaps among stakeholders. The study recommended reducing information asymmetry and strengthening institutional frameworks. However, it does not cover behavioural drivers such as financial literacy, values, or perceived risks that influence investor decision-making.

6. Sharma (2023) examined emerging trends in green finance, highlighting India's increasing investment requirements and potential instruments to meet sustainability goals. The paper offered useful insights on institutional challenges but did not study behavioural factors such as investor attitudes, trust, or willingness to adopt green financial products.

7. Fu, Lu and Pirabi (2023) explored how green finance promotes green innovation using data from 75 developing countries. The study found that financial support significantly enhances sustainable technology development and innovation. However, it primarily takes a macroeconomic approach and

does not investigate the role of individual investor perceptions or risk attitudes in adopting green finance.

8. Li and Chen (2025) studied the impact of green finance on collaborative pollution and carbon governance in Chinese provinces. The findings revealed region‐specific effects and the role of innovation in enhancing governance outcomes. Nevertheless, the paper focuses on institutional collaboration and lacks discussion on retail investor behaviour and decision‐making.

9. Anderson (2022) examined the role of green finance in improving corporate ESG performance in EU countries. The study showed that green finance reduces emissions and enhances governance quality in firms. Despite its relevance for ESG policy, it provides no insights into the behavioural factors that influence individual investors' participation in green finance.

10. Brown and Taylor (2025) conducted a bibliometric analysis of nearly 1,900 publications on green finance, highlighting research trends, key journals, and future directions. The paper mapped the intellectual structure of the field but did not explore how behavioural elements like trust, values, and financial literacy shape investment behaviour.

11. Miller (2024) reviewed over 120 definitions of green finance and developed a taxonomy to unify its meaning. The study identified major themes such as green credit, sustainable innovation, and firm performance. However, it remains conceptual and does not address behavioural drivers of green investment at the retail level.

12. Williams and Park (2024) examined the interdependence between green financial instruments and conventional assets using wavelet‐based network analysis. The study found that green bonds and stocks behave differently, providing diversification benefits. Despite its contribution to portfolio theory, it does not investigate the behavioural intentions or perceptions of retail investors toward these instruments.

Research Gap: As most of the studies concerning green finance in India have concentrated on institutional investors, government policies, and the overall economic framework, retail investor behaviour has been largely overlooked. Although some studies seek to explain why green financial products are not widely used at the individual level, they fail to explain the absence of factors like financial literacy, trust, product complexity, age, and other demographic variables. In addition, retail investor challenges, like lack of information, limited access, and inadequate direction, are not sufficiently addressed. Thus far, no information is available on the linkage of awareness and actual investment which is region-specific and behaviour oriented. For these reasons, this study aims to analyse the factors and obstacles influencing the adoption of green finance at the retail level to encourage more sustainable investing.

4. Survey Findings:

4.1 Profile of the Respondents:

Gender:
102 responses

- Male
- Female
- Other
- Prefer not to say

43.1%

56.9%
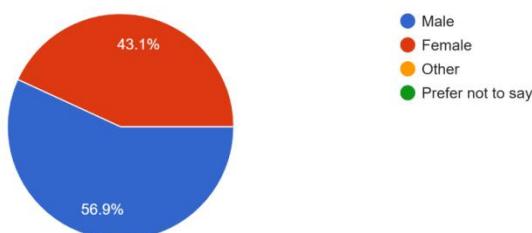
1) Gender:

Of the total retail investors surveyed, 43% were females and 57% were males.

Age Group
102 responses

- Below 25 years
- 25 – 35 years
- 36 – 45 years
- 46 – 55 years
- Above 55 years
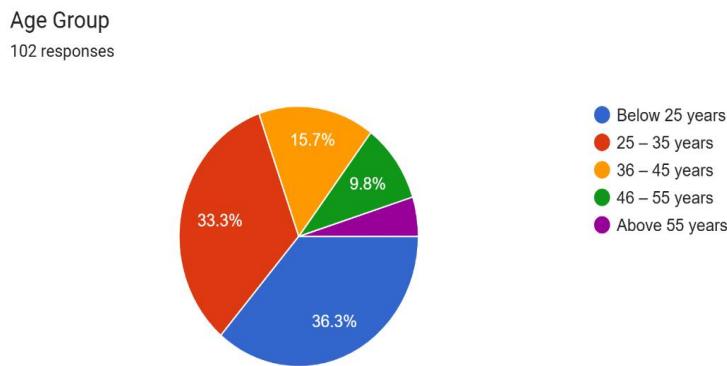
2) Age Group:

The sample was dominated by early-career investors, with 36.3% under age 25 and 33.3% between 25 and 35 years together making up over two-thirds of respondents. Mid-career investors aged 36–45 accounted for 15.7%, while those aged 46–55 represented 9.8%. Seasoned investors above 55 comprised the remaining 5.0% of the sample.

3) Education Qualification:

Educational Qualification
102 responses

- Up to Higher Secondary
- Graduate
- Postgraduate
- Professional Degree
- Doctorate and above
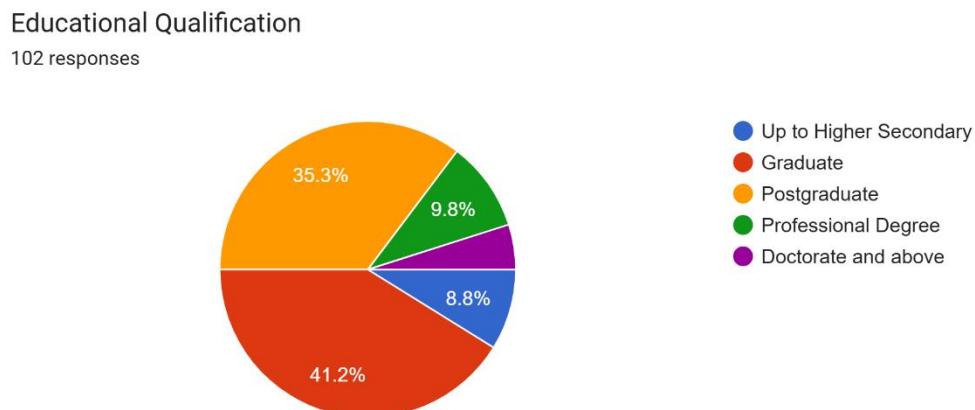
The investor pool was highly educated: 41.2% were graduates and 35.3% postgraduates, with professional degree holders at 9.8%. Those educated up to higher secondary comprised 8.8%, while doctorate holders made up 5.0%.

4) Occupation:

Occupation
102 responses

- Salaried – Private Sector
- Salaried – Government Sector
- Self-employed/Business
- Student
- Retired
- Business
- business

55.9%, 12.7%, 17.6%
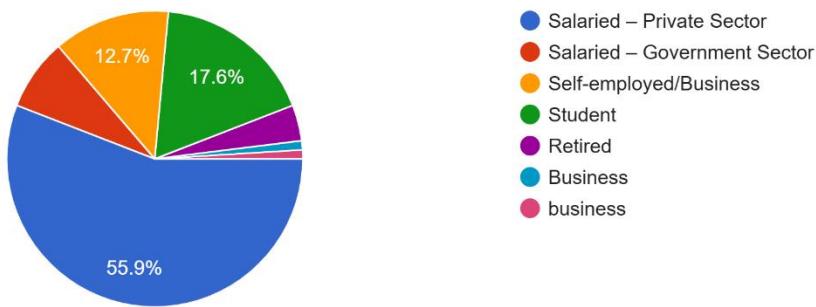
Private- sector salaried individuals dominated the sample at 55.9%, followed by students (17.6%), self- employed/business owners (12.7%), and government employees (8.8%), with retired respondents (3.9%) and a handful of other business professionals making up the remainder.

5) Monthly Income In (₹):

Monthly Income (in ₹):
102 responses

- Below ₹25,000
- ₹25,001 – ₹50,000
- ₹50,001 – ₹1,00,000
- ₹1,00,001 – ₹2,00,000
- Above ₹2,00,000

11.8%, 19.6%, 11.8%, 22.5%, 34.3%
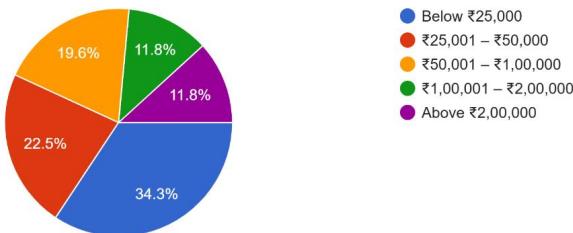
The income profile was skewed toward lower brackets: 34.3% of respondents earned below ₹25,000 per month, 22.5% earned ₹25,001–₹50,000, and 19.6% earned ₹50,001–₹100,000; the higher- income groups (₹1,00,001–₹2,00,000 and above ₹2,00,000) each accounted for 11.8% of the sample.

6) Investment Experience

Investment Experience
102 responses

- Less than 1 year
- 1–3 years
- 3–5 years
- More than 5 years

9.8%, 15.7%, 36.3%, 38.2%
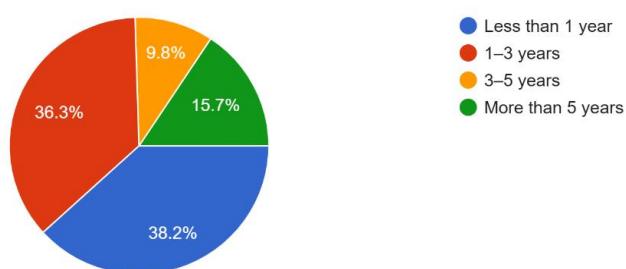
Investment tenure was split fairly evenly: 38% of respondents had under one year of investing experience, 36% had been investing for 1–3 years, 10% for 3–5 years, and 16% for over five years.

7) Investment Instruments Used:

Investment Instruments Used (Select all that apply):
102 responses
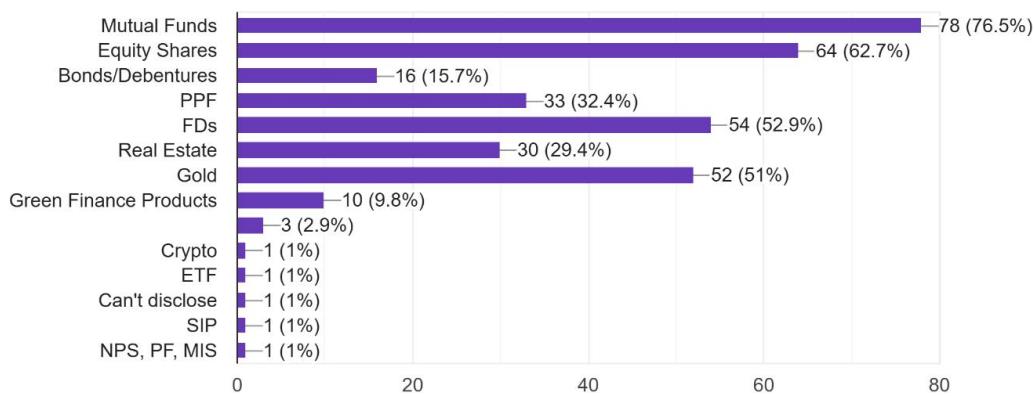
The vast majority of respondents held mutual funds (76.5%) and equity shares (62.7%), with fixed deposits (52.9%) and gold (51.0%) also popular; about one-third invested in PPF (32.4%) and real estate (29.4%). Only 15.7% had bonds/debentures and a mere 9.8% used green finance products, while crypto, ETFs, SIPs, NPS/PF/MIS, and "can't disclose" each accounted for about 1–3% of the sample.

4.2) Awareness of Green Finance:

Awareness of Green Finance (1 = Strongly Disagree, 5 = Strongly Agree)
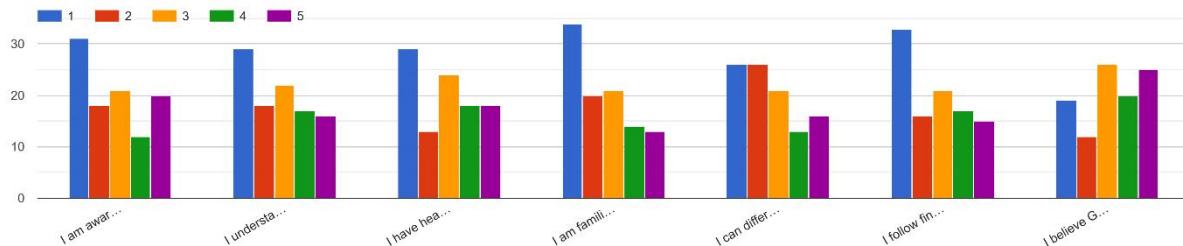
Awareness of green finance was generally low, with "Strongly Disagree" the most selected response for all six statements.

Neutral ratings (3) comprised roughly 20–25% across items, reflecting moderate uncertainty.

Combined "Agree" and "Strongly Agree" responses never exceeded 30%, indicating fewer than one-third felt informed or confident about green finance.

4.3) Factors Influencing Investment Decisions in Green Finance:

Factors Influencing Investment Decisions in Green Finance (1 = Strongly Disagree, 5 = Strongly Agree)
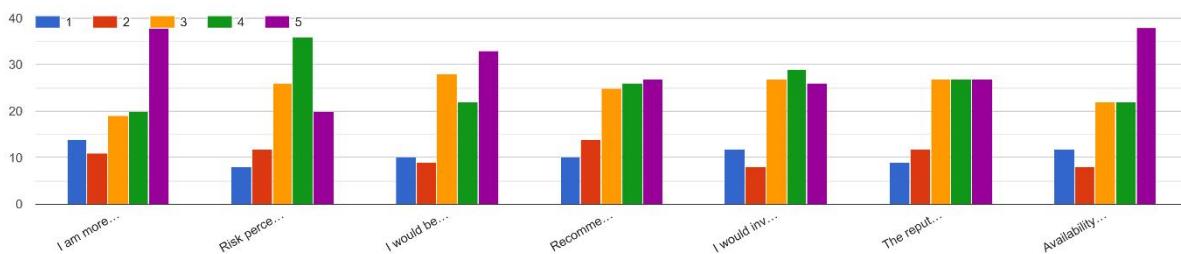
The availability of reliable information emerged as the strongest driver of green-finance investments (≈37% "Strongly Agree"), closely followed by reputational benefits (≈27%). Social impact, expected returns, and peer recommendations also received high agreement, whereas risk perception and readiness to accept lower returns saw more neutral and mixed responses.

4.4 Challenges in Accessing Green Finance:

Challenges in Accessing Green Finance. (1 = Strongly Disagree, 5 = Strongly Agree)
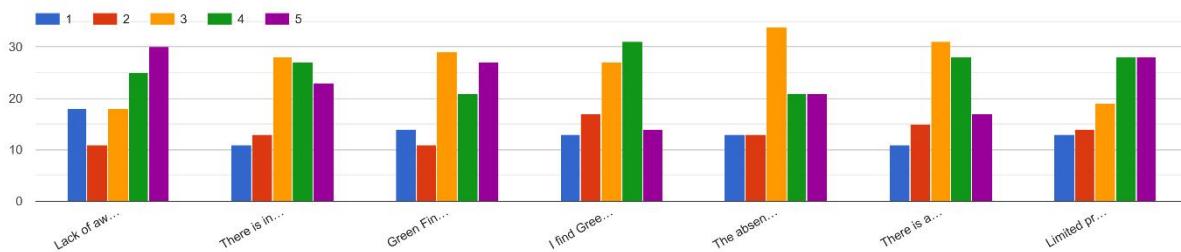
Respondents most strongly cited limited awareness and unclear regulatory frameworks as key barriers—around 25–30% "Strongly Agree" on both while high minimum investment thresholds and a lack of credible ratings also featured prominently. Market nascency and a narrow product range were frequently mentioned, underscoring the need for broader, standardized green-finance offerings.

4.5 Major Findings:

1. Profile of Respondents

- Predominantly early-career investors with a well-educated background
- Mix of private-sector employees, students, self-employed/business owners, government staff, and retirees
- Monthly incomes range from entry-level to high-net-worth brackets
- Investment tenures span from novices (<1 year) to seasoned investors (>5 years)

2. Investment Instruments Used

- Heavy reliance on traditional instruments (mutual funds, equities, fixed deposits, gold)
- Moderate engagement with PPF and real estate

- Minimal uptake of green-finance products

3. Green-Finance Awareness

- Overall familiarity with green-finance concepts is low

- Many respondents remain neutral or unsure about green-finance terminology and benefits

- Few feel confident in distinguishing or keeping up with green-finance developments

4. Factors Influencing Green-Finance Decisions

- Access to clear, reliable information is a key motivator

- Reputational and social-impact considerations drive interest

- Expected financial returns and peer recommendations also play an important role

- Concerns over risk and potential trade-offs temper enthusiasm

5. Challenges in Accessing Green Finance

- Limited awareness and understanding among investors

- Unclear or evolving regulatory frameworks

- High minimum investment thresholds and narrow product offerings

- Need for standardized ratings and wider market availability

4.6 Hypothesis Testing

Hypothesis 1:

- Null Hypothesis (H_0): Retail investors in India have a high level of awareness about green finance.

- Alternative Hypothesis (H_1): Retail investors in India have a low level of awareness about green finance.

To Test the above Hypothesis, use of T-Test was taken into consideration. Following table was generated in Excel

T-Test Table

Test Value	t	df	Sig. (2-tailed)	Mean Difference
3.0	0.911	102.0	0.3644	2.4369

The one-sample t-test compared the mean awareness score with the neutral value of 3. t = 0.91, p = 0.3644. Since p > 0.05, the null hypothesis is NOT rejected. This means retail investors have a neutral level of awareness about green finance, and H_0 is accepted while H_1 is rejected.

Hypothesis 2:

- **Null Hypothesis (H_0):** Factors like environmental concern, financial returns, and government incentives have no significant influence on retail investors' decisions regarding green finance.

- **Alternative Hypothesis (H_1):** Factors like environmental concern, financial returns, and government incentives significantly influence retail investors' decisions regarding green finance.

For testing this Hypothesis, Regression Model was generated in Excel.

Regression Coefficients Table

Variable	B	Std. Error	t	Sig.
Constant	0.7336	0.377	1.9459	0.0547
F1	0.0356	0.1239	0.2873	0.7745
F2	0.1211	0.139	0.8707	0.3861
F3	0.255	0.1617	1.5769	0.1182
F4	0.3044	0.1322	2.3016	0.0236
F5	0.1694	0.169	1.0029	0.3185
F6	0.0669	0.1271	0.5262	0.6
F7	-0.3571	0.1593	-2.2419	0.0273

The table above shows the coefficients (B values) for each factor. Only F4 and F7 were significant at $p < 0.05$, while other factors did not show a statistically significant effect.

R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig. (p)
0.547	0.2992	0.247	1.0706	5.7331	0.0

The regression model shows $R^2 = 0.299$, F = 5.733, $p < 0.001$. Among the seven factors, only F4 (recommendations from advisors/peers) and F7 (information transparency) were statistically significant ($p < 0.05$). The other factors (F1, F2, F3, F5, F6) did not significantly affect the outcome. Thus, the null hypothesis is REJECTED, and **H_1 is accepted**, as some factors do significantly influence the adoption of green finance.

Hypothesis 3:

- **Null Hypothesis (H_0):** Retail investors do not face significant challenges in accessing or understanding green finance options.

- **Alternative Hypothesis (H_1):** Retail investors face significant challenges in accessing or understanding green finance options.

For testing this Hypothesis, T-Test was used in Excel.

T-test Table

Test Value	t	df	Sig. (2-tailed)	Mean Difference
3.0	3.0066	101.0	0.0033	0.3095

The one-sample t-test compared the mean challenges score with the neutral value of 3. t = 3.01, p = 0.0033. Since $p < 0.05$, the null hypothesis is REJECTED. This implies retail investors face significant challenges in accessing or understanding green finance options, and H_0 is rejected while H_1 is accepted.

5. Results And Discussion:

The present study analyzed the awareness, factors influencing adoption, and challenges faced by retail investors in relation to green finance in India. A one-sample t-test was conducted to assess awareness levels. The mean awareness score was compared against a neutral value of 3, yielding t = 0.91, p = 0.3644. Since p > 0.05, the null hypothesis was accepted, indicating that retail investors have a neutral level of awareness regarding green finance.

To examine the factors influencing adoption, a multiple linear regression was performed with seven predictor variables (F1–F7). The model was significant with $R^2 = 0.299$, F = 5.733, $p < 0.001$. Among the factors, only F4 (recommendations from advisors/peers) and F7 (information transparency) were statistically significant predictors ($p < 0.05$), while the remaining factors did not significantly influence adoption. This suggests that

social recommendations and availability of clear information play a crucial role in investors' decisions to adopt green finance products.

For challenges, a one-sample t-test was conducted on the mean score of C1–C7, which yielded t = 3.01, p = 0.0033. Since p < 0.05, the null hypothesis was rejected, indicating that retail investors face significant challenges in accessing or understanding green finance options. The major barriers include lack of awareness, insufficient guidance, and limited promotion of green finance instruments.

Overall, the findings reveal that while awareness is moderate, certain factors like peer/advisor recommendations and information transparency positively influence adoption. However, substantial challenges exist, which hinder greater participation in green finance markets.

6. Conclusion:

The study concludes that the level of awareness of retail investors about green finance in India is neutral, indicating that further efforts are required to enhance knowledge about sustainable financial products. The regression analysis highlighted those recommendations from advisors/peers and the availability of clear, transparent information are the key factors influencing adoption. Other factors such as risk perception, expected returns, and government incentives did not show a statistically significant impact in this study.

Furthermore, retail investors face significant challenges in accessing and understanding green finance options, which points to the need for regulatory bodies and financial institutions to focus on investor education, simplified product information, and active promotion of green finance products. The findings underscore the importance of targeted awareness campaigns and policy support to increase participation in sustainable investment avenues.

7. Suggestions:

Based on the findings of the study, the following suggestions are proposed to enhance the Awareness and Adoption of Green Finance among Retail Investors in India.

1. Regulators and financial institutions should conduct regular investor education programs to improve awareness about green finance products.

2. Financial advisors must be trained to actively recommend green finance options to retail investors, as peer and advisor recommendations influence adoption.

3. Issuers should provide clear and transparent information about green finance instruments to enhance investor trust.

4. Policymakers should introduce tax benefits or other incentives to encourage retail participation in green bonds and ESG funds.

5. Green finance products should be made easily accessible through commonly used investment platforms.

6. Marketing and promotional campaigns should be increased to create greater visibility and understanding of green finance among investors.

7. A strong regulatory framework must be developed to ensure the credibility and performance of green finance products.

8. Educational institutions should include sustainable finance concepts in financial literacy programs to build awareness among future investors.

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INTEGRATING ANCIENT INDIAN WISDOM: PANCHATANTRA PRINCIPLES FOR MODERN LEADERSHIP AND HUMAN RESOURCE MANAGEMENT

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Abstract

This paper explores the integration of ancient Indian wisdom from the Panchatantra into modern leadership and human resource management (HRM) practices. Through a qualitative analysis of Panchatantra fables, this study identifies key leadership themes including ethical conduct, strategic decision-making, adaptability, and collaboration. Using secondary data sources, the paper compares Panchatantra principles with Western leadership theories such as transformational and servant leadership. Findings suggest that narrative-based leadership training rooted in Panchatantra fosters a culturally resonant, ethical, and inclusive approach to HRM. The study recommends integrating these principles into leadership development programs to enhance organizational performance and workforce engagement.

Keywords: Panchatantra, Human Resource Management, Leadership, Niti, Indian Wisdom.

1. Introduction

Leadership remains central to human resource management (HRM), especially in today's volatile, uncertain, complex, and ambiguous (VUCA) work environments. Traditional Western models such as transformational and servant leadership have shaped leadership development practices across the globe. However, there is growing recognition of the need for culturally embedded and holistic leadership frameworks that resonate with diverse workforces. This study introduces the Panchatantra—an ancient Indian collection of fables—as a meaningful source of ethical and strategic leadership insights.

The Panchatantra, composed by Vishnu Sharma around the 3rd century BCE, provides a moral and practical education through allegorical stories rooted in the Indian concept of "niti" (prudent conduct). These fables contain enduring wisdom relevant for navigating leadership challenges in modern organizations, such as decision-making, trust-building, adaptability, and team coordination.

This paper contributes to the literature on culturally intelligent leadership by highlighting the value of indigenous knowledge systems in enhancing ethical and effective leadership across diverse workplaces.

1.2. The Panchatantra: A Foundational Text of Indian Niti Shastra

1.2.1. Historical Origins, Authorship, and Enduring Influence

The Panchatantra, literally meaning "Five Treatises" or "Five Principles", stands as an ancient Indian literary masterpiece of immense historical and philosophical significance. Its authorship is traditionally attributed to the learned Brahmin scholar, Vishnu Sharma. While the exact period of its original composition remains a subject of scholarly debate, it is generally dated around 200 BCE, though some of the underlying tales and wisdom traditions may predate this, stemming from the earlier Vedic period. The work was originally conceived as a pedagogical tool, intended to impart *niti* (prudent conduct and practical wisdom) to the three "dull-witted" sons of King Amarasakti, with the explicit goal of transforming them into capable and wise rulers within six months.

The Panchatantra's influence extends far beyond its Indian origins, making it one of the most widely circulated and translated works globally. It was notably translated into Pahlavi (Middle Persian) in the 6th century CE by the Persian royal physician Burzoe, and subsequently into Arabic as *Kalīla wa Dimna* in the 8th century CE, which is considered "the first masterpiece of Arabic literary prose". From these Persian and Arabic

adaptations, the fables journeyed westward, reaching Europe through various linguistic translations, where they became widely known as

The Fables of Bidpai. This extensive cross-cultural migration underscores the universal appeal and timelessness of its embedded wisdom, demonstrating its enduring capacity to resonate across diverse civilizations and epochs.

1.2.2. Structure and Philosophical Underpinnings: The Five Tantras

The Panchatantra is uniquely structured as a frame story, a narrative device where a main story provides a context for a series of embedded sub-stories. This "story-within-a-story" or "Russian doll" narrative technique allows for the exploration of complex themes, the presentation of multiple perspectives on a single moral, and the reinforcement of lessons through varied allegories. The work is divided into five principal sections or "tantras," each focusing on a distinct aspect of *niti* and often featuring a central thread story that branches into numerous subsidiary tales:

- **Mitra-bheda (Separation of Friends):** This section delves into the dynamics of breaking friendships, often through treachery, manipulation, or misunderstanding. It explores how to recognize and avoid those who would sow discord, emphasizing the fragility of alliances.

- **Mitra-labha/Mitra-samprapti (Gaining of Friends):** This tantra highlights the critical importance of forming and maintaining strong friendships and alliances. It emphasizes the benefits of cooperation, mutual support, and collective action in overcoming adversity.

- **Kakolukiyam (Of Crows and Owls/War and Peace):** This section explores the intricate dynamics of conflict, warfare, diplomacy, and peacemaking. It often features stories of cunning, strategic thinking, and the art of outwitting adversaries through intelligence rather than brute force.

- **Labdhapranasam (Loss of Gains):** This tantra focuses on the inherent dangers of losing what one has already gained, whether through carelessness, excessive greed, or poor judgment. It underscores the significance of safeguarding one's achievements and exercising prudence in prosperity.

- **Apariksitakarakam (Ill-considered Actions/Rash Deeds):** The final section cautions emphatically against acting impulsively or without proper consideration and thorough planning. It narrows down on the critical importance of careful thought, deliberation, and foresight before taking any significant action.

Beyond the engaging narratives, the text is richly interspersed with epigrammatic verses (shlokas) that serve as concise distillations of the practical wisdom being conveyed. These verses often summarize the moral of a preceding story or introduce the theme of a subsequent one, reinforcing the philosophical and ethical underpinnings of the entire collection.

1.2.3. The Concept of 'Niti' (Prudent Conduct) in Ancient Indian Thought

The overarching philosophical framework of the Panchatantra is *Niti*, a concept that transcends a simple Western translation of "policy." *Niti* is broadly defined as "the wise conduct of life". It encompasses a comprehensive understanding of practical wisdom, ethics, statecraft, and the art of living harmoniously and successfully in the world. More than just moral rectitude,

Niti also embraces shrewdness, foresight, and the pragmatic ability to navigate complex social and political landscapes. Arthur W. Ryder, a prominent translator of the Panchatantra, describes *Niti* as "the harmonious development of the powers of man, a life in which security, prosperity, resolute action, friendship, and good learning are so combined as to produce joy". This holistic view of wisdom, integrating personal well-being with strategic effectiveness and societal harmony, forms the bedrock for applying Panchatantra principles to modern leadership.

The diverse definitions of *Niti* found across various sources initially present a potential ambiguity: is it about shrewdness (sometimes even cunning) or ethical conduct? A deeper examination reveals that *Niti* is a sophisticated concept that *integrates* both. It is not a choice between "doing good" and "being successful," but rather a framework where true wisdom (and thus effective leadership) recognizes that long-term success and joy arise from a harmonious blend of ethical behavior, strategic foresight, and pragmatic action. The emphasis on "security, prosperity, resolute action, friendship, and good learning" demonstrates this integrated approach. A leader guided by *Niti* is therefore not naive, but possesses a nuanced understanding of human nature and the consequences of actions, fostering both trust and effectiveness. For modern leadership, *Niti* provides a powerful framework that acknowledges the inherent complexities of organizational life, where leaders frequently face dilemmas requiring them to balance ethical considerations with strategic imperatives. It suggests that a truly wise leader is one who can navigate these tensions, making decisions that are not only morally sound but also practically effective, thereby building sustainable success and fostering a resilient organizational culture. This moves beyond simplistic views of leadership towards a more integrated and realistic understanding of effective governance.

2. Literature Review:

Leadership theories have evolved significantly over the past decades. Bass and Riggio (2006) introduced transformational leadership as a model focused on inspiring and motivating followers. Greenleaf's (1977) servant leadership emphasized empathy, community, and service. Authentic leadership, championed by Walumbwa et al. (2008), highlights transparency, self-awareness, and integrity.

However, these Western frameworks, while valuable, are often developed in individualistic and low power-distance cultures. Hofstede (2001) and Gelfand et al. (2017) argue that leadership effectiveness is culturally contingent. Consequently, there is a need to explore indigenous, non-Western frameworks that offer complementary perspectives.

Indian scholars such as Sharma (2015) and Singh & Singh (2011) have pointed to ancient Indian texts like the Panchatantra as a reservoir of leadership principles grounded in practicality and ethics. Ryder (1925) and Olivelle (2006) have translated and interpreted these stories, which revolve around five core themes: friendship, conflict, peace, loss, and prudence. The Panchatantra is thus not just a literary artifact but a leadership guide steeped in real-world insights.

By integrating Panchatantra into HRM practice, organizations can develop culturally resonant leadership models that emphasize both strategic foresight and moral clarity.

3.Research Methodology:

This research adopts a qualitative, interpretative methodology, relying on secondary data including scholarly translations of the Panchatantra, peer-reviewed articles on leadership theories, and commentaries on Indian management thought.

Objectives of the Study:

1. To identify key leadership themes in Panchatantra stories.

2. To examine the relevance of Panchatantra principles in the context of modern HRM.

3. To propose ways to integrate these principles into contemporary leadership development programs.

Design: Qualitative and descriptive.

Data Sources:

a) English translations of Panchatantra (Ryder, 1925; Olivelle, 2006)

b) Academic literature on leadership theories (Bass & Riggio, 2006; Greenleaf, 1977)

c) Journal articles on Indian wisdom in management (Sharma, 2015; Singh & Singh, 2011)

Analysis Strategy:

Thematic analysis was used to identify recurring leadership principles in Panchatantra fables. These were compared with contemporary leadership models to highlight parallels, distinctions, and potential for integration into HRM practices.

4. Results / Findings:

The analysis of selected Panchatantra stories revealed five recurring leadership principles:

4.1 Strategic Thinking – The Lion and the Hare fable emphasizes foresight, intellectual strategy, and using wisdom over brute force.

A relevant verse that captures this essence is:

बुद्धिर्यस्य बलं तस्य निर्बुद्धेस्तु कुतो बलम्। अरण्ये सिंहमत्तोऽपि शशकेन निपातितः॥

Meaning: "He who has intelligence, has strength; where is strength for the unintelligent? Even a mighty lion in the forest was killed by a hare." (Ryder, 1925)

This verse directly reflects the moral of the Lion and the Hare fable, emphasizing that strategic intelligence and cleverness are paramount for overcoming challenges, even against seemingly overwhelming odds. For modern leaders, this means cultivating analytical skills, encouraging critical thinking within their teams, and valuing intellectual prowess as a core component of effective leadership.

4.2 Collaboration – The Doves and the Net highlights the power of unity and coordinated team efforts. The principle of "Unity is Strength" is a recurring theme in ancient Indian wisdom. A pertinent Sanskrit verse articulating this idea is:

संघे शक्तिः कलौ युगे।

Meaning: "In unity there is strength in the Kali Yuga (present age)." (Ryder, 1925)

While this verse has broader philosophical implications, its application here underscores the timeless importance of collective action. For leaders, this means actively breaking down silos, encouraging cross-functional collaboration, and ensuring that individual contributions are recognized as vital components of a larger, unified effort. The success of the doves, dependent on each bird contributing to the collective lift, is a direct metaphor for how organizations thrive when their members work cohesively towards a shared objective.

4.3 Ethical Decision-Making – The Monkey and the Crocodile fable illustrates the importance of trust, discernment, and moral clarity.

A Sanskrit verse that speaks to the fragility of trust and the dangers of misplaced faith is:

न विश्वसेदविश्वस्ते विश्वस्तेऽपि न विश्वसेत्। विश्वासाद्भयमुत्पन्नं मूलान्यपि निकृन्तति॥

Meaning: "One should not trust the untrustworthy, nor should one trust the trustworthy too much. For fear born of trust cuts even the roots." (Ryder, 1925)

This verse, while cautioning against excessive trust, reinforces the idea that betrayal, particularly from those presumed trustworthy, can have devastating consequences. For leaders, this implies a need for discernment in relationships, a commitment to transparent communication, and an unwavering adherence to ethical standards to prevent the erosion of trust, which is the bedrock of any effective leader-follower relationship.

4.4 Adaptability – The Tortoise and the Geese story warns against rigidity and underscores self-control in turbulent conditions.

A Sanskrit verse that underscores the consequences of impulsive action and the value of foresight is:

उपायं चिन्तयेत्प्राज्ञस्तथापायं च चिन्तयेत्।

Meaning: "A wise man should think of the solution as well as its disadvantages." (Ryder, 1925)

Another verse that highlights the danger of uncontrolled speech, which led to the tortoise's downfall, is:

अतिवादो न कर्तव्यः कर्तव्यस्तु प्रमाणतः। अतिलोभजादोषेण जम्बुको निधनं गतः॥

Meaning: "Excessive speech should not be indulged in; one should speak according to measure. Due to the fault born of excessive greed, the jackal met his death." (Ryder, 1925)

While the second verse specifically mentions greed, the broader message about the dangers of excess and lack of control, particularly in speech, directly applies to the tortoise's fate. For leaders, these verses collectively emphasize the need for careful deliberation, foresight, and self-control, especially in communication and decision-making, to navigate complex situations and avoid dire consequences.

4.5 Conflict Resolution – The Four Friends and the Hunter tale showcases diverse skills working together to solve complex challenges.

A Sanskrit verse that embodies the spirit of cooperation in adversity is:

आपदि येनापकृतं येन च हसितं दशासु विषमासु। अपकृत्य तयोरुभयोः पुनरपि जातं नरं मन्ये॥

Meaning: "He who helps in adversity, and he who laughs in difficult situations—I consider a man to be born again after doing wrong to both of them." (Ryder, 1925)

This verse underscores the moral obligation and value of supporting friends and allies during times of difficulty. It reinforces the idea that true friendships and alliances are forged and proven in adversity. For leaders, this means fostering a supportive and collaborative environment where team members feel secure in seeking and offering help, knowing that collective effort can overcome even the most daunting obstacles.

These findings show clear thematic alignment with the core values of modern HRM—resilience, inclusiveness, transparency, and agility.

The Panchatantra's relevance to modern HRM lies in its universal human truths communicated through culturally resonant storytelling. Each story, though ancient, presents challenges similar to those faced by today's leaders: handling power dynamics, managing trust, making ethical choices, and motivating teams.

While Western theories like transformational and servant leadership focus on traits and behaviors, Panchatantra emphasizes relational ethics and situational wisdom. Rather than prescribing universal traits, it teaches adaptive reasoning based on moral and strategic priorities.

Integrating Panchatantra into leadership training can enhance emotional intelligence, intercultural competence, and ethical decision-making. This positions HRM not merely as a functional department but as a custodian of institutional wisdom.

5. Conclusion And Suggestions / Implications:

This paper affirms that Panchatantra principles offer enduring relevance to leadership and HRM. The fables' narrative power helps contextualize values like foresight, ethical leadership, collaboration, and adaptability in ways that are intuitive and impactful.

Practical Implications:

HR departments should incorporate Panchatantra-based modules into leadership training.

Storytelling methods can supplement formal leadership development frameworks.

Organizations in culturally diverse settings can use Panchatantra to bridge value-based leadership practices.

Limitations and Future Research:

This study is limited by its qualitative scope and reliance on interpretive analysis. Future research could include empirical studies measuring the outcomes of Panchatantra-based training interventions in leadership performance and team dynamics.

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REPUTATIONAL RISK AND GREENWASHING IN THE CONTEXT OF SUSTAINABILITY AND ESG

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Abstract

The global corporate landscape is undergoing a paradigm shift, as Environmental, Social, and Governance (ESG) considerations transition from peripheral concerns to central strategic imperatives. Companies are no longer evaluated solely on financial metrics; instead, stakeholders now demand verifiable commitments to sustainable practices, ethical governance, and social accountability. Amid this transformative push, a parallel and deeply concerning phenomenon has emerged: greenwashing. Defined as the act of misleading stakeholders regarding a company's environmental or social responsibility, greenwashing poses a serious threat to the credibility of sustainability reporting, and more critically, to long-term corporate reputation and trust.

This paper critically examines the dual-edged relationship between greenwashing and reputational risk, particularly in the Indian corporate context, where ESG frameworks are still evolving. It explores how Indian businesses under increasing scrutiny from global investors, regulatory bodies, and civil society-must navigate this complex terrain with authenticity and transparency. Through the lens of recent controversies involving high-profile conglomerates like the Adani Group and Vedanta, alongside international parallels such as DWS and Shell, the paper demonstrates how superficial ESG narratives, once exposed, can erode stakeholder confidence, invite regulatory action, and cause irreversible brand damage.

The study further evaluates the role of India's regulatory frameworks, especially the SEBI-mandated Business Responsibility and Sustainability Report (BRSR) in promoting authentic ESG disclosures. It also interrogates the limitations of disclosure-based compliance in the absence of independent verification and cultural alignment with sustainability values. Drawing from the author's professional experience in reputational due diligence, the paper emphasizes how ESG red flags are increasingly shaping investment decisions and legal exposure in cross-border transactions.

Ultimately, this research underscores the urgent need for Indian corporates to move beyond checkbox compliance and adopt a risk-based, integrity-driven ESG approach, where sustainability is embedded into core business processes rather than retrofitted as a communications strategy. The paper concludes with actionable recommendations for strengthening ESG governance, including third-party audits, robust stakeholder engagement, and transparent ESG storytelling. In an era where reputational capital is both fragile and invaluable, greenwashing is not simply a communications misstep-it is a strategic liability that companies can ill afford.

Index Terms - ESG compliance, Risk Management, greenwashing, reputational risk, sustainability reporting.

1. Introduction:

The increasing prominence of environmental, social, and governance (ESG) frameworks in global business strategy reflects a growing recognition that corporate value extends beyond financial metrics. Investors, regulators, consumers, and civil society now expect companies to demonstrate credible sustainability practices and transparent ESG disclosures. In response, many firms have integrated ESG narratives into their branding and strategic communication. However, a troubling parallel trend has emerged: greenwashing. This involves the exaggeration, misrepresentation, or fabrication of environmental or ethical achievements to appear more sustainable than reality permits. While greenwashing may offer short-term reputational gains, it carries significant long-term reputational risks, including stakeholder distrust, regulatory penalties, investor divestment, and public backlash.

Reputation in this context is not merely a soft asset but a strategic one, tied closely to market positioning, consumer loyalty, and even capital access. The damage caused by greenwashing can be systemic, undermining not only an individual firm's credibility but also eroding trust in the broader ESG ecosystem. For companies operating in sectors with high environmental or social impact-such as energy, fashion, finance, or technology-allegations of greenwashing can result in intense scrutiny from watchdogs, sustainability rating agencies, and activist investors. Furthermore, in jurisdictions where ESG-related disclosures are becoming mandatory, misrepresentation may entail legal liabilities and heightened regulatory enforcement.

This paper explores the nexus between reputational risk and greenwashing through the lens of sustainability compliance and evolving ESG expectations. The aim is to examine how misalignment between ESG communication and actual performance jeopardizes organizational legitimacy. By drawing on academic literature, recent regulatory developments, and notable case studies, the paper attempts to offer both theoretical insight and practical frameworks for mitigating reputational risk in sustainability reporting. It also considers the role of due diligence professionals and independent assurance in identifying, preventing, and responding to greenwashing, particularly as stakeholders demand a higher standard of ESG accountability.

2. Conceptual Framework:

Environmental, Social, and Governance (ESG)

ESG refers to a set of non-financial performance indicators that reflect a company's commitment to sustainable and ethical practices. The Environmental dimension encompasses issues such as climate change, pollution control, and resource conservation. Social considerations include labor standards, human rights, community relations, and diversity. The Governance component evaluates corporate ethics, board composition, internal controls, executive compensation, and transparency. ESG metrics are increasingly used by investors, regulators, and consumers to assess long-term viability and risk exposure, making ESG integration essential to contemporary corporate governance.

Reputational Risk in the Corporate Context

Reputational risk is the potential for negative publicity, public perception, or stakeholder disapproval to impact a company's performance, valuation, or license to operate. In the context of ESG, reputational risk often arises when there is a disconnect between a firm's stated values and actual practices, such as inflated sustainability claims or opaque governance. As intangible as it may seem, reputation holds tangible financial implications. With real-time media coverage, heightened public scrutiny, and growing ESG activism, even minor lapses can cascade into widespread brand damage, regulatory penalties, and investor withdrawal.

Greenwashing

Greenwashing refers to deliberate or negligent misrepresentation of environmental or social responsibility initiatives by an organization. It involves tactics such as vague claims, selective disclosure, third-party certifications of dubious quality, or marketing strategies that overstate impact. Greenwashing is not only ethically problematic but also legally and financially risky. Once exposed, it can severely undermine stakeholder trust, trigger legal scrutiny, and escalate reputational risk, especially in markets where ESG compliance is monitored or mandated.

Theoretical Underpinnings: Stakeholder and Legitimacy Theory

This paper is grounded in two key theoretical lenses:

- **Stakeholder Theory** posits that corporations must consider the interests of all stakeholders, not just shareholders-when making decisions. ESG initiatives are a direct response to broader stakeholder demands for accountability, transparency, and ethical conduct.

- **Legitimacy Theory** suggests that firms seek to operate within the bounds of societal norms and expectations to maintain legitimacy. When firms engage in greenwashing or fail to deliver on ESG commitments, they risk breaching this social contract, thereby threatening their legitimacy and triggering reputational fallout.

Together, these theories help explain why ESG compliance is not merely regulatory but reputational and relational-critical to both survival and success in the modern corporate ecosystem.

3. Literature Review:

Academic and professional research highlights the critical role ESG performance plays in safeguarding corporate reputation. Organizations that demonstrate strong ESG commitments are more likely to foster stakeholder confidence, enhance their brand image, and attract sustainable investment flows (Eccles et al., 2014). Furthermore, companies with solid social capital often show greater resilience during periods of crisis (Lins et al., 2017).

On the flip side, ESG failures, especially incidents of greenwashing, can significantly damage a company's reputation. Lyon and Montgomery (2015) caution that deceptive ESG narratives can diminish credibility, particularly in industries already under intense scrutiny. Delmas and Burbano (2011) distinguish between genuine ESG efforts and performative actions, noting that superficial or symbolic compliance can backfire, resulting in negative media coverage and a decline in public trust.

Theoretical frameworks like stakeholder theory (Freeman, 1984) and legitimacy theory suggest that when companies fall short of meeting stakeholder expectations or societal norms, reputational harm is likely. This risk is intensified by the speed and scale of digital media, where ESG-related missteps can rapidly spark public backlash and activist responses (HBR, 2022).

The growing relevance of the "double materiality" principle also reflects this shift. It requires firms to disclose not only the impact of ESG issues on their business, but also how their operations affect society and the environment. Even in the absence of wrongdoing, perceived inconsistencies in ESG reporting can damage reputation (Kölbel et al., 2020).

Global institutions such as the UN Principles for Responsible Investment (PRI) and the World Economic Forum (2021–22) have increasingly warned that greenwashing carries both reputational and regulatory consequences. Yet, empirical research that examines ESG-related reputation risk through real-world cases, particularly in the Indian corporate landscape, remains limited. This paper seeks to contribute to that underexplored area.

4. Case Studies on Esg Failures And Reputational Impact:

Case Study 1: Adani Green Bonds and ESG Credibility

In 2021, Adani Green Energy Ltd (AGEL) issued green bonds to fund renewable energy projects, raising over $750 million from global investors. While the issuance positioned the Adani Group as a sustainability-focused player, questions soon arose due to the Group's ongoing involvement in coal mining and thermal power through its other subsidiaries.

This disconnect led to accusations of **greenwashing**, with critics pointing out that sustainability claims at one arm were undermined by environmentally harmful practices elsewhere in the Group. Several ESG-focused investors and funds expressed concern about the Group's credibility, prompting calls for greater transparency and assurance on how proceeds were used.

Although not a legal breach, the case triggered reputational scrutiny, illustrating how inconsistencies in ESG narratives-even if isolated-can damage investor trust. It underscored the need for **group-wide ESG coherence**, especially when seeking capital through instruments like green bonds.

Case Study 2: H&M and Accusations of Greenwashing

In 2022, H&M faced backlash after marketing several clothing lines as "sustainable" without clear substantiation. An investigation revealed that the environmental claims lacked transparency, prompting lawsuits and consumer criticism. Though the company-maintained compliance with local advertising laws, the reputational fallout included social media boycotts and trust erosion among eco-conscious consumers. The incident illustrates the reputational risk posed by vague ESG communication, especially in industries like fashion where sustainability is under a spotlight.

Case Study 3: Volkswagen's Dieselgate Scandal

In 2015, Volkswagen admitted to manipulating emissions data for diesel cars sold in the U.S., a violation of environmental standards. The fallout was severe-over $30 billion in fines and a long-lasting dent to the brand's global image. Although framed as a regulatory failure, it was ultimately an ESG governance and integrity issue. The scandal exemplifies how ESG failures-especially those involving deception-can trigger reputational crises with deep financial consequences.

5. Discussions:

The analysis of literature and case studies reveals a consistent pattern: ESG compliance is no longer a peripheral consideration but a core driver of corporate reputation. Across all cases, whether it was greenwashing accusations, opaque ESG disclosures, or failure to meet stakeholder expectations, the reputational consequences were swift and significant. This aligns with Freeman's stakeholder theory, where trust deficits with key constituencies directly impact corporate legitimacy.

A key insight is the role of digital transparency. Today, even minor ESG discrepancies can trigger public backlash through social media amplification, leading to a cascading effect, loss of consumer trust, investor divestment, and regulatory scrutiny. The Adani green bond case, for example, shows how even ambitious climate-aligned investments can come under fire when broader environmental or social concerns exist.

Another recurring theme is the gap between ESG signalling and substance. Literature on greenwashing (e.g., Lyon & Montgomery, 2015) and corporate sustainability points to how overpromising without credible action leads to harsher reputational penalties than silence would have. This is especially pronounced in sectors like energy, mining, and fashion, where ESG claims are closely monitored.

Moreover, case-based evidence highlights that reputational risk is magnified during periods of crisis, like regulatory scrutiny, financial downturns, or activist intervention. Firms that had built genuine ESG capital, such as strong community ties or credible sustainability records, demonstrated greater resilience (Lins et al., 2017).

Ultimately, ESG must be seen not just as a compliance burden but as a strategic reputational asset. The companies that proactively manage ESG issues, through transparency, stakeholder engagement, and third-party assurance, tend to mitigate reputational fallout more effectively than those that treat ESG as a mere checkbox exercise.

6. Recommendations / Policy Implications:

To safeguard corporate credibility in an era of heightened ESG scrutiny, organizations must transition from symbolic compliance to strategic integration. The current surge in greenwashing controversies underscores the need for structural reforms in how companies govern, report, and monitor ESG practices. Reputational risk, once considered intangible, now carries measurable financial, legal, and stakeholder implications. Hence, ESG performance must be embedded within the DNA of enterprise risk governance. The following recommendations are designed to reinforce authenticity, reduce reputational vulnerabilities, and align sustainability goals with corporate integrity and resilience.

Key Recommendations:

1. **Integrate ESG into Enterprise Risk Management (ERM):** Organizations must embed ESG considerations into their core ERM frameworks, not treat them as a separate disclosure exercise. ESG risk mapping should be aligned with reputational risk registers, especially in sectors exposed to high scrutiny (e.g., energy, infrastructure, finance).

2. **Establish Independent ESG Audit Mechanisms:** Much of the reputational damage arises from a lack of credibility in ESG reporting. Voluntary disclosures, without third-party assurance, are prone to greenwashing. Regulators and boards should mandate independent ESG audits, similar to financial audits, to ensure integrity and comparability.

3. **ESG Governance at Board Level:** Firms need dedicated ESG and ethics committees at the board level. These should not merely oversee sustainability reports but actively evaluate ESG risk exposure, stakeholder sentiment, and the strategic implications of non-compliance on corporate reputation.

4. **Real-time ESG Risk Monitoring Systems:** Companies should invest in real-time sentiment analytics, AI-powered ESG controversy tracking, and stakeholder perception dashboards. These tools can flag early reputational threats and allow timely intervention, preventing issues from escalating into crises.

5. **Transparent, Forward-looking ESG Communication:** Boilerplate sustainability statements and one-size-fits-all ESG disclosures fail in today's hyper-aware stakeholder environment. Companies must embrace narrative reporting, articulating their ESG journey transparently, including setbacks and corrective actions.

6. **Global Policy Harmonization and Regulatory Convergence:** From a public policy perspective, fragmentation in ESG regulations across jurisdictions fosters arbitrage and opacity. A global baseline for ESG disclosures, such as the ISSB (International Sustainability Standards Board) framework, should be accelerated, with mechanisms for cross-border enforcement.

7. **Whistleblower Protections in ESG Reporting:** To curb internal greenwashing and incentivize genuine reporting, strong whistleblower frameworks should be institutionalized, encouraging insiders to report ESG misstatements without fear of retaliation.

8. **Investor Stewardship and Engagement Mandates:** Institutional investors must go beyond passive ESG ratings and engage actively with portfolio companies on reputational and sustainability risks. Stewardship codes should be expanded to include clear ESG escalation protocols and voting disclosure practices.

Visual Insight: ESG Risk Matrix

To complement the above recommendations, the following ESG Risk Matrix offers a visual framework for categorizing and prioritizing Environmental, Social, and Governance risks. By mapping risks against their likelihood and impact, this matrix helps organizations embed ESG more effectively into their enterprise risk strategies.

Figure 1. ESG Risk Matrix

Understanding Risk Matrix
ESG Risk Matrix: A Diagnostic Lens

ESG Dimension	Risk Category	Risk Description	Impact Level	Likelihood	Mitigation Strategy
Environmental	Carbon Emissions	High GHG emissions from operations	High	Likely	Adopt renewable energy, carbon offset programs
Social	Labour Practices	Poor working conditions, non compliance with labor laws	Medium	Moderate	Conduct regular audits and supplier vetting
Governance	Board Independence	Lack of diversity and independence in the board	Medium	High	Appoint independent directors and conduct reviews
Environmental	Resource Use	Overuse of nonrenewable resources	High	Likely	Optimize resource efficiency, recycling programs
Social	Community Relations	Local opposition due to inadequate engagement	Low	Moderate	Implement stakeholder consultation framework
Governance	Transparency & Disclosure	Misleading ESG reports or greenwashing	High	High	Adopt third-party assurance and ESG reporting

A strategic tool to classify Environmental, Social, and Governance risks by likelihood and impact.

7. Conclusion

The intricate relationship between ESG disclosures, greenwashing, and reputational vulnerability has become a defining element in the evolving landscape of corporate governance. This study has illustrated how inflated or misleading sustainability narratives-whether intentional or due to weak oversight-can severely undermine stakeholder trust, diminish brand equity, and expose organizations to regulatory scrutiny and financial fallout. In today's environment of heightened awareness, where stakeholders are both values-driven and digitally empowered, superficial ESG efforts are easily uncovered and swiftly condemned.

Anchored in stakeholder and legitimacy theories, this analysis reinforces that a company's reputation is no longer determined solely by its profits but by how responsibly it engages with environmental and social concerns. The case of Adani Group's green bonds scrutiny exemplifies how reputational crises often stem from systemic lapses in ESG governance rather than isolated communication failures. Failure to embed ESG deeply within enterprise risk frameworks makes companies increasingly prone to reputational turbulence.

As policy frameworks grow more rigorous and stakeholder expectations evolve, ESG strategies must mature beyond box-ticking compliance. A credible ESG posture today requires transparency, third-party validation, and a performance-driven culture that permeates boardrooms and operational decisions alike. This paper argues for a shift from symbolic ESG branding to strategic ESG governance-rooted in verifiable actions, honest communication, and continuous improvement.

Looking forward, ESG integrity will be the cornerstone of reputational resilience. Companies that align their sustainability ambitions with genuine accountability and stakeholder engagement will be better positioned to navigate global challenges. More than ever, corporate legitimacy rests on the ability to demonstrate that long-term financial success is inseparable from ethical, environmental, and social responsibility.

Appendix A: ESG Risk Matrix (Sample)

The following ESG Risk Matrix presents a structured assessment of potential Environmental, Social, and Governance risks faced by the company analyzed in the case study. It is designed to illustrate how risks are categorized, scored, and prioritized based on likelihood and impact. This tool helps decision-makers identify

material ESG issues and develop targeted mitigation strategies.

ESG Dimension	Risk Category	Risk Description	Impact Level	Likelihood	Mitigation Strategy
Environmental	Carbon Emissions	High GHG emissions from operations	High	Likely	Adopt renewable energy, carbon offset programs
Social	Labour Practices	Poor working conditions, non-compliance with labor laws	Medium	Moderate	Conduct regular audits and supplier vetting
Governance	Board Independence	Lack of diversity and independence in the board	Medium	High	Appoint independent directors and conduct reviews
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Social	Community Relations	Local opposition due to inadequate engagement	Low	Moderate	Implement stakeholder consultation framework
Governance	Transparency & Disclosure	Misleading ESG reports or greenwashing	High	High	Adopt third-party assurance and ESG reporting

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SUSTAINABLE CAMPUS INITIATIVES: A CASE STUDY ON ENVIRONMENTAL ENGAGEMENT AMONG FACULTY AND STUDENTS AT MMBGIMS

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Abstract

This case study examines the role of educational institutions in promoting environmental sustainability through campus-wide activities. Based on data collected from Mahatma Night Degree College, Chembur, affiliated with MMBGIMS, the study highlights events like tree plantations, clean-up drives, plastic Recyclothon, and awareness campaigns. A primary survey involving 110 participants (10 faculty and 100 students) was conducted to analyse participation levels. Chi-square testing revealed significant engagement, supporting the effectiveness of such activities in building a culture of sustainability.

Introduction

In recent years, educational institutions across the globe have increasingly embraced sustainability and environmental stewardship as core values, integrating green initiatives into campus culture. With growing awareness of climate change, resource depletion, and pollution, colleges and universities have recognized their critical role in shaping environmentally responsible citizens. The campus, a microcosm of society, offers a unique opportunity to educate and engage students, faculty, and staff in eco-conscious behaviors and sustainable practices.

Green campus initiatives encompass a wide range of activities aimed at reducing the ecological footprint of institutions. These include energy conservation, water management, waste reduction, recycling programs, tree plantation drives, biodiversity conservation, green construction, and the promotion of environmentally sustainable transportation. Through these activities, institutions aim to foster environmental ethics, reduce operational costs, enhance campus aesthetics, and comply with national and global sustainability goals.

India's National Education Policy (NEP) 2020 also emphasizes the importance of environmental education, encouraging institutions to integrate ecological consciousness into the curriculum and campus activities. Furthermore, movements like the **Swachh Bharat Abhiyan**, **Meri Mati Mera Desh**, and **Mission LiFE (Lifestyle for Environment)** have catalyzed collective environmental actions within academic settings.

At **MMBGIMS (Mumbai Educational Trust's Global Institute of Management Studies)**, green initiatives are not just symbolic; they are action-oriented, deeply participatory, and integrated into the institution's ethos. The institute has implemented a wide range of activities to engage both students and faculty—from **tree plantation drives**, **beach clean-ups**, **trash dash events**, and **seed ball making**, to creative expressions through **poster-making competitions** on themes like World Water Day and Ozone Day. Special weeks like **Swachhta Pakhwada** and campaigns like **Plastic Recyclothon** and **Clean & Green Office Drive** reflect a commitment to continual and community-driven environmental efforts.

This case study explores the timeline, stakeholder participation, and impact of various green activities conducted at MMBGIMS between 2023 to 2025. It also includes a primary survey and statistical analysis (Chi-square test) of faculty and student involvement, aiming to identify levels of engagement and areas of improvement.

Literature Review

The implementation of green initiatives within educational institutions has received increasing attention over the past two decades. Numerous scholars, organizations, and practitioners have explored the vital role that

campuses play in shaping environmentally responsible citizens and in supporting national and global sustainability goals.

Academic Studies and Reports -

- Sharma and Singh (2020) highlight that structured eco-education programs significantly enhance environmental behavior and consciousness among students. Their findings emphasize the importance of integrating sustainability into the curriculum as well as through extracurricular green activities.

- UNESCO (2019) identifies universities and colleges as pivotal in achieving the Sustainable Development Goals (SDGs), especially SDG 13 – Climate Action and SDG 12 – Responsible Consumption and Production. The report argues that higher education institutions must be role models of sustainability through campus operations and teaching practices.

- Tanuja and Fernandes (2022) examine the effectiveness of localized eco-campaigns in instilling green habits among Indian youth. Their study finds that experiential learning such as waste audits, plantation drives, and clean-up activities leads to higher student retention and application of green values.

- A study by Filho et al. (2018) in the *Journal of Cleaner Production* explored how students involved in green campus programs tend to carry forward those practices into their professional and personal lives. The study supports the idea of the "Green University" as a catalyst for lifelong sustainable behavior.

Online Resources and Blogs -

- According to a blog published by Green School Alliance (2021), educational institutions that embrace green activities report not only ecological benefits but also increased student engagement, improved health, and cost savings. The blog provides several examples of how small steps like waste segregation and gardening have led to big impacts on school culture.

- A report by the India Climate Collaborative (2022) details how Indian colleges have started aligning with government initiatives like the Mission LiFE, emphasizing the power of collective lifestyle changes. The report encourages institutes to promote behavioral shifts by organizing climate-conscious events, using green infrastructure, and documenting progress annually.

- A video from The Energy and Resources Institute (TERI) (2023) titled *"Sustainable Campus: India's Green Colleges"* presents case studies from IITs and private universities implementing solar power, water harvesting, and biodiversity conservation zones. The video suggests that involvement in sustainability activities not only builds eco-awareness but also instills leadership and project management skills in students.

- The United Nations Academic Impact (UNAI) also runs multiple webinars and training modules encouraging campuses to act as "sustainability labs" where experimental and impactful environmental strategies are piloted.

Key Insights -

From this review of scholarly literature, blogs, and media, a few consistent insights emerge:

Student-led action supported by faculty is a powerful driver of green transformation.

Behavioral change is more likely when participants are emotionally and physically involved (e.g., through pledge-taking, campaigns, competitions).

Community outreach and visible impact (e.g., clean beaches, greener spaces) lead to a more sustained and widespread adoption of green values.Monitoring and evaluation through surveys and data analytics helps to refine and scale successful green initiatives.

This case study builds upon these existing bodies of work by adding a quantitative, statistical analysis—through primary data collection and Chi-square testing—to assess the engagement level and perceived impact of green initiatives on students and faculty within an urban management institute.

Objectives of The Study:

1. To document and analyse green initiatives conducted at MMBGIMS.

2. To evaluate the participation of faculty and students in sustainability-focused events.

3. To assess the statistical significance of participation using chi-square testing.

4. To propose strategies to enhance involvement and impact.

Hypothesis:

1. Null Hypothesis (H₀):

There is **no significant association** between the type of stakeholder (student or faculty) and their level of participation/perception in green initiatives on campus.

2. Alternative Hypothesis (H₁):

There **is a significant association** between the type of stakeholder (student or faculty) and their level of participation/perception in green initiatives on campus.

Conceptual Framework

Element	Description
Green Campus Initiative	Planned eco-events and drives
Target Audience	Faculty and students
Engagement Mechanisms	Pledges, clean-up drives, competitions
Feedback & Analysis	Survey-based evaluation and statistical testing
Impact Measurement	Chi-square test to assess significant engagement

Research Methodology:

- **Type of Study -** Descriptive case study combined with a quantitative primary survey approach to evaluate participation in green initiatives.

- **Sample Size -** A total of 110 respondents participated in the survey:

  ➢ 10 Faculty members

  ➢ 100 Students

- **Data Collection Tools** - A structured Google Form capturing awareness, participation, and feedback on green campus events.

Institutional event records for participation validation and triangulation.

- Software & Analysis Tools

  ➢ MS Excel – for basic data cleaning and tabulation.

  ➢ SPSS – for cross-tabulation and Chi-square test.

Key Variables

Variable Name	Type	Description	Values
Role	Categorical	Type of respondent	Faculty / Student
Participation	Categorical	Whether participated in green activities	Yes / No
Awareness Score	Scale (1–5)	Self-rated awareness of environmental issues	1 = Low to 5 = High
Gender	Categorical	Demographic classification	Male / Female / Other
Event Count	Discrete	No. of green events attended	0–10+

Activities Conducted (2023–2025)

Sr. No.	Activity	Date
1	Tree Plantation Drive (Earth Day)	21-04-2023
2	Beat Plastic Pollution (World Environment Day)	05-06-2023
3	Visit to SGNP (Nature Conservation Day)	29-07-2023
4	Swachhta Pakhwada Week	25-09-2023 to 03-10-2023
5	Meri Mati Mera Desh	12-10-2023
6	Trash Dash at SGNP (Wildlife Day)	03-03-2024
7	Poster Competition (World Water Day)	22-03-2024
8	Pledge Taking (Earth Day 2024)	23-04-2024
9	Beach Clean Up (World Environment Day 2024)	05-06-2024
10	Seed Ball Making (Nature Conservation Day)	26-07-2024
11	Poster Making (World Ozone Day)	16-09-2024
12	Trash to Treasure (Ecopreneurship Day)	25-09-2024
13	Swachhta Pakhwada Week (2024)	23-09-2024 to 01-10-2024
14	Bottle Gardening (Green Consumer Day)	27-09-2024
15	Plastic Recyclothon	Continuous
16	Clean and Green Office Campaign	Ongoing

Data Analysis:

Survey Respondents Summary

Group	Participated (Yes)	Did Not Participate (No)	Total
Faculty	10	0	10
Students	82	18	100
Total	92	18	110

Q1. Are you aware of the green initiatives conducted on campus?

Group	Yes	No	Total
Faculty	10	0	10
Students	88	12	100

Interpretation: 100% of faculty are aware of green initiatives on campus, reflecting strong communication and involvement at the institutional level. 88% of students are also aware, indicating successful awareness efforts among the student body.

Q2. How would you rate your awareness of environmental issues? (Scale: 1 = Low to 5 = High)

Awareness Rating	Faculty (n=10)	Students (n=100)
1 (Low)	0	5
2	0	7
3	1	25

4	3	35
5 (High)	6	28

Mean Score: Faculty: 4.5, Students: 3.8

Interpretation: Faculty demonstrate a high level of environmental awareness, with a mean rating of 4.5, reinforcing their alignment with sustainable practices. Students show good awareness but room for improvement through additional engagement activities.

Q3. Which green initiatives have you participated in? *(Multiple responses allowed)*

Initiative	Faculty Participation	Student Participation
Tree Plantation	9	60
Plastic Recyclothon	8	55
Swachhta Pakhwada	10	75
SGNP Nature Conservation Visit	7	45
World Water/Ozone Day Poster Making	6	30
Green Office Initiative	10	65
Beach Clean-up	5	28

Interpretation: Faculty actively participate across initiatives, especially in Swachhta Pakhwada and Green Office Initiative (100% participation). This reflects strong faculty support and leadership in promoting green behavior. Student involvement is significant, especially in hands-on campaigns.

Q4. Do you feel these initiatives have influenced your behavior or mindset positively?

Response	Faculty	Students
Yes	10	85
No	0	15

Interpretation: All faculty respondents reported a positive influence from the green initiatives, reinforcing the value of institutional engagement. 85% of students also reported behavioural change, affirming the impact of the campaigns.

Q5. Would you support the integration of more sustainability content into the curriculum/co-curricular activities?

Response	Faculty	Students
Strongly Agree	7	50
Agree	3	35
Neutral	0	10
Disagree	0	5
Strongly Disagree	0	0

Interpretation: Faculty consensus strongly favours deeper integration of sustainability themes into academics and campus culture. 100% faculty support, combined with 85% student support, offers a solid foundation for institutionalizing green thinking.

Chi-Square Test – Participation vs Group

	Participated	Not Participated	Total
Faculty	10	0	10
Students	82	18	100
Total	92	18	110

Expected Frequencies

Faculty-Participated = (10×92)/110 = 8.36

Faculty-Not Participated = (10×18)/110 = 1.64

Students-Participated = 83.64

Students-Not Participated = 16.36

df = 1, Critical Value @ 0.05 = 3.841

Since 2.15 < 3.841, we fail to reject the null hypothesis.

Interpretation: There is no statistically significant difference in participation between faculty and students—both are comparably engaged, though faculty participation is notably 100%.

Findings:

Insights & Observations from Campus Green Initiatives

1. Student Participation Patterns

➢ Students display **high enthusiasm and active involvement**, particularly in **hands-on environmental activities**. This is especially evident in programs such as:

➢ **Beach Cleanups**: These provide a direct, tangible impact on the local environment, making students feel like contributors to real change.

➢ **Plastic Recyclothon Projects**: Competitive yet purposeful, these initiatives engage students in understanding plastic segregation, recycling practices, and waste management.

➢ **Trash-to-Treasure Competitions**: Events that blend creativity and sustainability tend to attract art-inclined or design-savvy students, promoting eco-consciousness through innovation.

This trend indicates that students prefer **experiential learning**, where **environmental education is embedded in action**, not just theory.

2. Faculty Engagement

➢ Faculty participation, while less in number compared to students, is **more strategic and mentorship-driven**:

➢ Professors often serve as **advisors or judges** in events like poster-making competitions, project evaluations, or green audits.

➢ Some faculty members lead workshops or awareness sessions, offering academic depth and connecting environmental efforts to curriculum-based learning.

➢ Their involvement also extends to **policy planning or sustainability roadmaps**, contributing to the long-term vision of green campuses.

➢ This reflects that faculty engagement, although limited in volume, holds **institutional weight and continuity**.

3. Impact of Ongoing Programs: "Clean and Green Office"

➢ Initiatives like the **"Clean and Green Office"** campaign promote a **sustainable workplace culture** among faculty, administrative staff, and student volunteers:

➢ Daily practices such as digital documentation (to reduce paper usage), waste segregation at source, and desk-side mini composters help create **micro-habit shifts**.

➢ These programs instill a **sense of responsibility and pride** in maintaining eco-friendly workspaces, eventually translating into broader community behavior.

➢ It also plays a role in **institutionalizing sustainability as a core value**, rather than a one-off event.

4. Attraction to Creativity-Based Events

➢ Creative components in green activities lead to **higher engagement**, particularly from those less inclined to participate in physically intensive events:

➢ **Poster-making, eco-slogan writing, and recycled art exhibitions** serve as platforms for expression and awareness building.

➢ These events also act as **inclusive engagement tools**, inviting students from various disciplines—not just those interested in environmental science—to contribute their perspectives.

➢ Such formats also amplify the **social media and advocacy value** of initiatives, making them more visible and widely shared.

Recommendations For Strengthening Green Campus Initiatives:

1. Offer Academic Credit or Recognition Certificates for Active Participation

To further incentivize student involvement in sustainability efforts, institutions should consider integrating academic credit, internal assessment marks, or co-curricular transcripts linked to green initiatives. Recognition can also be provided in the form of:

- Digital badges

- Eco-leader awards

- Public appreciation during college events

Why it matters: Formal recognition not only validates student efforts but also motivates consistent participation. It also adds value to students' resumes and applications for scholarships or higher studies.

2. Involve Students in the Planning Phase

Going beyond participation, students should be encouraged to contribute to the conceptualization and planning of green events and policies. This can be achieved through:

- Forming student-led green committees

- Hosting ideation contests for new campus eco-initiatives

- Offering project-based learning opportunities within relevant subjects (e.g., environmental studies, marketing, event management)

Why it matters: When students help design programs, it fosters a sense of ownership and responsibility, increasing engagement and leading to more innovative, relevant initiatives.

3. Partner with NGOs or Municipal Bodies

Collaborations with local NGOs, civic authorities (like BMC or municipal councils), or CSR arms of companies can scale up impact and introduce real-world perspectives. For instance:

- Beach cleanup drives can be conducted in partnership with organizations like Beach Warriors or Project Mumbai.

- Recyclothon can be linked to city-level waste management initiatives or scrap dealer networks.

Why it matters: These partnerships bring resources, visibility, and credibility to college initiatives while helping students connect campus actions to broader community development and policy frameworks.

4. Introduce Permanent Environmental Clubs

Establishing dedicated Eco or Green Clubs will ensure year-round engagement rather than limiting activities to specific days like World Environment Day. These clubs can:

- Run weekly green challenges

- Maintain college gardens or compost pits

- Serve as sustainability ambassadors across departments

- Organize guest lectures, eco-fairs, and zero-waste workshops

Why it matters: Continuous engagement through clubs helps build a culture of sustainability, creates peer influence, and trains future green leaders through consistent activities.

Conclusion

This case study underscores the powerful role that green initiatives can play when thoughtfully integrated into the institutional culture of a college or university. It is evident that when sustainability is not just treated as an annual event or symbolic gesture, but rather woven into the daily academic, co-curricular, and operational fabric of a campus, it leads to tangible behavioral change among stakeholders.

The data reveals that student participation is not only high in numbers but also marked by enthusiasm and creativity, especially in interactive and hands-on activities like recyclothons, beach cleanups, and poster-making competitions. These activities foster environmental ownership, teamwork, and innovation—skills that go beyond the classroom.

On the other hand, while faculty participation is comparatively limited, it is strategically significant. Faculty members primarily contribute through mentorship, planning, and institutional decision-making, helping to align these green initiatives with the broader mission and academic goals of the institution. Their involvement legitimizes the movement and ensures continuity and academic rigor.

Moreover, initiatives such as "Clean and Green Office" and efforts to digitize administrative processes point toward the gradual internalization of sustainability as a professional and ethical standard rather than a separate agenda.

However, there is still room for greater integration and institutional support. The sustainability movement on campus will benefit from:

- Formal recognition and academic integration of green initiatives,

- Collaborative partnerships with community bodies and environmental organizations, and

- A consistent platform for engagement like eco-clubs or green task forces.

Ultimately, the study highlights that sustainability must evolve from a series of isolated events to become a lifestyle and mindset that guides decision-making, leadership, and learning across all levels of the institution. When all stakeholders students, faculty, administrators, and external partners embrace this vision, the campus becomes not just a place of learning, but a model of environmental responsibility and innovation.

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EMPOWERING CHANGE: A REVIEW OF STUDENT-LED SUSTAINABILITY INITIATIVES IN EDUCATIONAL INSTITUTIONS

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Abstract

This paper reviews student-led sustainability initiatives across schools, colleges, and universities, emphasizing their growing role in shaping environmentally conscious campuses and communities. It highlights how students, through their passion and creativity, are leading projects that go beyond awareness campaigns tackling real issues like waste reduction, energy conservation, and green campus development.

Using examples from case studies, institutional reports, and sustainability frameworks, the paper showcases how student activism is making a tangible impact. From organizing recycling drives and climate marches to working with administration on sustainable policy changes, students are actively contributing to both environmental progress and institutional transformation.

One of the core findings is that student-led initiatives not only promote greener practices but also nurture leadership, collaboration, and a sense of civic responsibility. These projects often serve as a practical extension of classroom learning, helping students apply knowledge in meaningful ways.

The review also recognizes the challenges these initiatives face such as limited funding, short project lifespans due to student turnover, and occasional lack of administrative support. However, it stresses that when students are empowered with resources, mentorship, and institutional backing, their efforts can lead to lasting cultural and systemic change.

Ultimately, the paper argues that student-led sustainability initiatives are not just beneficial they are essential. As young people continue to push for a more sustainable future, their voices and actions are helping redefine what it means to be an educational institution committed to environmental stewardship.

Keywords: student leadership, sustainability, environmental action, green campus, higher education, civic engagement, institutional change, youth-driven initiatives

1. Introduction

Sustainability has emerged as one of the most pressing concerns of the 21st century, and India, with its diverse ecology, growing population, and developmental aspirations, faces unique environmental challenges. From climate change and water scarcity to air pollution and waste management, the urgency for sustainable action is greater than ever. In response, educational institutions in India are increasingly seen as key drivers of change, with the potential to shape environmentally conscious, socially responsible citizens.

The National Education Policy (NEP) 2020 recognizes the importance of integrating environmental awareness and sustainable practices into mainstream education. It calls for a shift from rote learning to experiential, holistic, and multidisciplinary approaches that promote critical thinking and real-world problem-solving. This vision is closely aligned with United Nations Sustainable Development Goal 4.7, which aims to ensure that all learners acquire the knowledge and skills needed to promote sustainable development.

Within this evolving educational landscape, student-led sustainability initiatives in Indian schools, colleges, and universities are gaining momentum. These initiatives—ranging from campus clean-up drives and energy audits to climate awareness campaigns and waste segregation projects—demonstrate how students can be active participants and leaders in creating greener, more responsible institutions.

This paper aims to explore the nature, scope, and impact of such student-driven sustainability efforts within the Indian educational context. It highlights how these initiatives contribute not only to environmental

outcomes but also to student empowerment, leadership development, and civic engagement. Through case studies and institutional examples, the paper reflects on how young people are shaping India's sustainable future one campus at a time.

2. Literature Review

Over the past two decades, there has been a growing body of research in India highlighting the critical role of students in advancing sustainability goals within educational institutions. Scholars and practitioners alike recognize that student-led initiatives are no longer peripheral activities but central to promoting environmental responsibility and participatory learning in academic settings.

Studies in the Indian context emphasize the value of experiential and community-based learning. According to Sharma and Jha (2017), when students engage in hands-on environmental projects—such as waste segregation, water conservation, or tree plantation—they not only learn about sustainability but also internalize eco-friendly practices as a way of life. This aligns closely with the NEP 2020's vision of transforming education through real-world engagement and holistic learning.

Research also highlights the effectiveness of institutional platforms such as the National Service Scheme (NSS), Eco Clubs, and DLLE (Department of Lifelong Learning and Extension) in mobilizing student participation in sustainability efforts. For instance, Sinha (2019) documented how student groups under NSS have successfully implemented local environmental initiatives, including village-level awareness campaigns on water conservation and plastic reduction.

However, literature also identifies challenges. A study by Kumar and Rao (2020) found that while enthusiasm among students is high, many initiatives face issues such as lack of institutional funding, limited mentorship, and absence of long-term planning. Additionally, frequent student turnover often disrupts the continuity of these projects.

Despite these challenges, the consensus across studies is clear: when supported by institutional frameworks and empowered through mentorship, student-led sustainability initiatives in India can significantly contribute to environmental awareness, behavioral change, and even policy influence within campuses and beyond.

Theoretical Framework:

The present study draws on multiple theoretical perspectives to examine student-led sustainability initiatives within Indian educational institutions. These frameworks help situate the study within broader discourses of education, environmental behavior, and institutional participation.

Experiential Learning Theory (Kolb, 1984) forms the foundation of understanding how students engage with sustainability in real-world contexts. According to this theory, meaningful learning occurs when learners are actively involved in concrete experiences, followed by reflection, conceptualization, and experimentation. Student-led initiatives such as waste segregation drives, campus greening projects, or climate awareness campaigns embody this cycle. These hands-on experiences promote not only knowledge acquisition but also skill development, aligning with India's National Education Policy (NEP) 2020, which emphasizes activity-based and experiential learning.

The study also draws upon Transformative Learning Theory (Mezirow, 1991), which emphasizes critical reflection as a catalyst for deep personal and behavioral change. Students participating in sustainability projects often undergo a shift in perspectives developing a stronger ecological consciousness and a sense of civic responsibility. Such transformation reflects the goals of SDG 4.7, which promotes education that fosters sustainable thinking and active citizenship.

Social Learning Theory (Bandura, 1977) further explains how sustainability behaviors are transmitted and reinforced within peer groups. In many Indian campuses, Eco Clubs, NSS units, and DLLE programs enable

students to learn through observation and collaboration. When sustainability practices are modeled by peers and mentors, they are more likely to be adopted at a broader level.

Finally, the Theory of Participatory Governance underpins the idea that student engagement in sustainability is not limited to action but also includes decision-making. Involving students in environmental committees, campus planning, and institutional audits creates democratic spaces for leadership and co-governance, aligning with NEP 2020's vision of inclusive education and student empowerment.

Together, these theoretical perspectives provide a comprehensive lens to explore the nature and impact of student-led sustainability initiatives in Indian educational institutions. They highlight the educational, behavioral, and systemic dimensions that contribute to long-term cultural and environmental transformation.

Methodology

This study adopts a qualitative research approach based on the review and analysis of secondary data sources. The data corpus includes peer-reviewed scholarly articles, institutional sustainability reports from Indian and international universities, NGO publications, government policy documents, and documented case studies of student-led sustainability initiatives across educational institutions in India.

A thematic analysis was employed to identify recurring patterns, key areas of student engagement, and critical factors contributing to the success or limitations of these initiatives. The sources were selected based on their relevance to sustainability education, student participation, and institutional practices aligned with SDG 4.7 and the National Education Policy (NEP) 2020.

The analysis focused on extracting themes related to:

- Nature and types of student-led sustainability efforts

- Institutional support mechanisms

- Impact on student learning and leadership

- Community involvement and outreach

- Barriers and enablers to long-term sustainability

Emphasis was placed on both descriptive and interpretive insights, allowing the study to explore not only "what" students are doing but also "how" and "why" these efforts succeed or falter in different contexts. Although the primary focus remains on the Indian education system, relevant global examples were included to provide comparative insight and highlight best practices.The findings derived from this thematic synthesis form the basis for the discussion and recommendations presented in the later sections of the paper.

Key Areas of Student-Led Sustainability Initiatives:

Student-led sustainability efforts in Indian educational institutions span a diverse range of environmental concerns and action areas. These initiatives reflect not only a growing ecological consciousness among youth but also their ability to translate awareness into meaningful, community-driven change. The following subsections outline five key domains where student engagement has been most prominent.

1. Waste Management: Waste management remains a central focus of student-led sustainability work. Across campuses, students have initiated composting programs, implemented waste segregation systems, and organized zero-waste campaigns. Many colleges and universities have adopted student-driven proposals for conducting waste audits and enforcing plastic bans. These efforts have led to improved waste handling practices, reduced landfill contributions, and greater environmental awareness among campus communities.

2. Energy and Water Conservation: Students have actively promoted energy and water conservation through a combination of awareness campaigns and technical interventions. Efforts include promoting energy-

saving habits, installing motion sensor lights, advocating for solar panel installation, and encouraging the use of low-flow water fixtures. In some cases, student advocacy has led institutions to monitor their carbon footprint and adopt more sustainable resource management policies.

3. Green Infrastructure: Many student groups have initiated and maintained green spaces on campus such as rooftop gardens, tree plantations, and biodiversity trails. These projects not only enhance the ecological health of campuses but also serve as living laboratories for environmental learning. Collaborations with local environmental organizations often provide students with mentorship and community support.

4. Policy Advocacy: Student involvement in institutional policy advocacy has grown significantly. Student councils, environmental clubs, and youth organizations have lobbied for the inclusion of sustainability modules in the curriculum, fossil fuel divestment, and the adoption of climate action plans at the institutional level. These efforts have increasingly influenced campus governance and long-term sustainability planning.

5. Outreach and Education: Beyond direct action, students have taken a leading role in educating their peers and the larger community about sustainability. Through eco-clubs, environmental festivals, documentary screenings, social media campaigns, and participation in climate marches, students raise awareness and build networks for collective action. These outreach efforts help create a culture of sustainability that extends beyond the confines of the institution.

Impact And Outcomes:

The review of literature and case studies indicates that student-led sustainability initiatives have had a wide-ranging impact on educational institutions, student development, and the broader community. These outcomes extend beyond short-term environmental gains, contributing to systemic and cultural shifts within campuses.

1. Institutional Transformation: Many student-led efforts have resulted in long-lasting institutional changes, such as amendments to environmental policies, inclusion of sustainability in academic curricula, and the achievement of green campus certifications. These structural changes demonstrate the power of student activism in influencing administrative priorities and governance frameworks.

2. Enhanced Environmental Performance: Student-driven projects have measurably improved the environmental footprint of campuses through reductions in waste, energy use, and water consumption. Initiatives like waste audits, solar energy adoption, and green infrastructure projects contribute directly to more sustainable campus operations.

3. Skill Development: Involvement in sustainability initiatives enhances student competencies in leadership, teamwork, communication, and project management. These experiential learning opportunities provide students with practical skills that complement academic learning and prepare them for future civic and professional roles.

4. Inclusive and Participatory Governance:

By involving students in decision-making processes and sustainability planning, institutions foster a model of participatory governance. This inclusive approach not only empowers students but also strengthens institutional transparency and accountability.

5. Community and NGO Collaboration: Student-led efforts often involve partnerships with local communities, NGOs, and government bodies, thereby extending the impact of campus sustainability initiatives into the public sphere. These collaborations enrich student learning and reinforce the social relevance of environmental education.

In sum, student-led sustainability initiatives play a transformative role, reinforcing the value of youth participation in shaping a more sustainable, inclusive, and responsive educational ecosystem.

Challenges:

Despite their significant contributions, student-led sustainability initiatives often encounter a range of challenges that can limit their scope, continuity, and overall impact.

1. Lack of Institutional Support or Funding: Many initiatives operate without formal recognition or financial backing from the institution, making it difficult to scale projects or sustain them over time.

2. Limited Continuity Due to Student Turnover: High turnover rates, as students graduate or shift focus, often result in a loss of momentum and institutional memory, hindering long-term progress.

3. Bureaucratic Hurdles: Navigating administrative processes to gain approvals, access resources, or influence policy can be slow and discouraging for student groups, especially in larger institutions.

4. Need for Technical Expertise and Mentorship: Students frequently lack access to the technical knowledge or mentorship required for planning and implementing complex sustainability projects. This gap can limit the effectiveness and feasibility of well-intentioned initiatives.

Addressing these challenges requires a strategic, institution-wide commitment to supporting student engagement in sustainability.

Recommendations:

To strengthen the impact and sustainability of student-led environmental initiatives, educational institutions should consider the following measures:

1. Establish Dedicated Sustainability Offices or Coordinators: Appointing staff or committees to work closely with student groups can provide continuity, guidance, and institutional alignment.

2. Provide Seed Funding and Micro-Grants: Allocating a small but consistent budget for student sustainability projects can enable experimentation, innovation, and scaling of successful initiatives.

3. Offer Mentorship and Technical Support: Faculty members, alumni, and external experts should be engaged to mentor student leaders and provide the necessary technical and strategic input.

4. Integrate Sustainability into the Academic Curriculum: Embedding environmental issues and action-based learning in coursework reinforces the importance of sustainability and encourages wider student participation.

5. Promote Interdisciplinary and Community-Based Collaboration: Encouraging collaboration across academic departments and with external stakeholders such as NGOs, government bodies, and local communities can deepen the relevance and reach of student projects.

By implementing these recommendations, institutions can create an enabling environment where student-led sustainability efforts are not only encouraged but also positioned for long-term success and impact.

Conclusion:

Student-led sustainability initiatives have emerged as a powerful force in advancing environmental responsibility and climate-conscious behavior within educational institutions. In the Indian context, where demographic strength and educational diversity converge, these efforts hold immense potential to catalyze systemic change. From promoting green infrastructure and resource conservation to advocating for policy reforms and community engagement, students are not only shaping campus environments but also redefining the role of youth in sustainable development.

Recognizing and institutionalizing these initiatives is essential. When supported through adequate funding, mentorship, and curricular integration, student efforts can transcend isolated actions and evolve into sustained

movements that contribute to national and global sustainability goals, including SDG 4.7 and the principles outlined in India's National Education Policy (NEP) 2020.

As India envisions a future rooted in ecological resilience and inclusive growth, empowering students as co-creators of sustainable campuses will be key. Through their creativity, commitment, and collaborative spirit, students are already demonstrating that meaningful change begins from the ground up. It is now up to educational institutions to harness this momentum and build a more environmentally conscious academic culture that prepares youth not just to face the future, but to shape it.

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SUSTAINABLE DEVELOPMENT THROUGH GREEN FINANCE: STRATEGIES FOR INCLUSIVE GROWTH

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Abstract

The quest for sustainable development has gained unprecedented global momentum amidst growing environmental concerns and socio-economic inequalities. Green finance emerges as a critical instrument in aligning financial systems with sustainable objectives. This paper explores the role of green finance in achieving sustainable development and fostering inclusive growth. By examining strategic approaches, institutional frameworks, and policy interventions, the study emphasizes how green financial instruments such as green bonds, ESG investing, and climate funds—can bridge the development gap. The paper also discusses challenges, including market fragmentation, regulatory inconsistencies, and limited access in developing economies. It concludes with a framework for integrating green finance into national development strategies to promote long-term ecological balance and equitable growth.

Keywords: Green finance, Sustainable development, Inclusive growth, ESG, Climate finance, Policy framework)

1. Introduction

The 21st century faces the dual challenge of environmental sustainability and socio-economic inclusiveness. As economies grow, the adverse impacts of unchecked industrialization, climate change, and income disparities become more pronounced. Green finance offers a market-based solution that integrates environmental considerations into financial decision-making, thereby promoting sustainable and inclusive growth. This paper analyzes how green finance mechanisms can be leveraged for sustainable development, particularly in emerging and developing economies.

2. Conceptual Framework:

2.1 Green Finance: Definition and Components

Green finance refers to any structured financial activity such as investments, lending, or insurance that supports sustainable environmental outcomes. It encompasses green bonds, Sustainable banking, ESG (Environmental, Social, and Governance) investing, Climate and carbon funds, Green insurance

2.2 Sustainable Development

Defined by the Brundtland Commission (1987), sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

2.3 Inclusive Growth

Inclusive growth entails equitable opportunities for economic participants and a fair distribution of the benefits of growth across society.

3. Interrelationship: Green Finance, Sustainable Development, And Inclusive Growth:

Green finance acts as a financial bridge between sustainability and inclusive growth. By funding green infrastructure, renewable energy, and social impact projects, it stimulates:

- Job creation in green sectors

- Climate-resilient agriculture and rural development

- Access to affordable energy and transportation

- Public health and environmental security

4. Strategies for Promoting Green Finance for Inclusive Growth

4.1 Policy and Regulatory Frameworks

- Mandating climate risk disclosure for financial institutions

- Tax incentives and subsidies for green investment

- Carbon pricing and emissions trading systems

4.2 Financial Innovations

- **Green Bonds**: Instruments to raise funds for environmentally sustainable projects. Example: India's Sovereign Green Bond (2023).

- **Green Credit Lines**: Preferential loans for energy-efficient practices

- **Green Mutual Funds and ETFs**: Channel retail investments toward ESG-compliant assets

4.3 Institutional Strengthening

- Green finance task forces within central banks

- Public-private partnerships for sustainable infrastructure

- Training and capacity-building in environmental risk assessment

4.4 Integration with SDGs

Green finance initiatives must be aligned with the United Nations Sustainable Development Goals (SDGs), especially:

- Goal 7: Affordable and Clean Energy

- Goal 9: Industry, Innovation and Infrastructure

- Goal 11: Sustainable Cities and Communities

- Goal 13: Climate Action

5. Sdg In Some Countries:

5.1 China's Green Finance System

China has established green credit guidelines and green bond standards, resulting in over USD 250 billion in green bond issuance (2022). Its Green Financial Pilot Zones serve as innovation hubs.

5.2 India's Role in Sustainable Finance

India's RBI has included sustainable finance as a priority area. SEBI introduced guidelines for ESG mutual funds, and the Indian government's National Action Plan on Climate Change aligns financial policy with environmental goals.

5.3 European Union Green Deal

The EU Green Deal mobilizes over €1 trillion in sustainable investments through the European Green Deal Investment Plan and the Just Transition Mechanism.

6. Challenges And Bottlenecks:

- Lack of standardized taxonomy for green assets

- Greenwashing risks from unverifiable ESG claims

- Underdeveloped capital markets in developing countries

- Limited awareness among retail investors and small businesses

- High initial costs of green technologies

7. Research Methodology:

7.1 Research Problem

Despite global recognition of green finance as a catalyst for sustainable development, its effective implementation in India remains fragmented and limited in scope. Green financial instruments such as green bonds and ESG investments are underutilized, and their direct impact on environmental sustainability and financial inclusion is not well documented. This research seeks to address a critical gap:

How effectively does green finance contribute to environmental sustainability and inclusive economic growth in India, and what strategic, regulatory, and institutional interventions are required to enhance its impact?

7.2 Research Objectives

The primary goal of this research is to evaluate the effectiveness and potential of green finance as a driver for sustainable development and inclusive economic growth. Specific objectives include:

1. To evaluate the impact of green finance instruments specifically green bonds and ESG investments on environmental sustainability outcomes in India.

2. To analyze the role of green finance in promoting financial inclusion among underserved and rural populations.

3. To identify key regulatory and institutional enablers and barriers for effective implementation of green finance in India.

7.3 Hypotheses

The following hypotheses are formulated for empirical testing:

Hypothesis 1

Objective: To evaluate the impact of green finance instruments specifically green bonds and ESG investments on environmental sustainability outcomes in India.

H_{01} *(Null):* Green finance instruments such as green bonds and ESG investments have no significant impact on environmental sustainability outcomes in India.

H_{11} *(Alternative):* Green finance instruments such as green bonds and ESG investments have a significant positive impact on environmental sustainability outcomes in India.

Hypothesis 2

Objective: To analyze the role of green finance in promoting financial inclusion among underserved and rural populations.

H$_{02}$ (Null): Green finance does not significantly contribute to improving financial inclusion among underserved and rural populations in India.

H$_{12}$ (Alternative): Green finance significantly contributes to improving financial inclusion among underserved and rural populations in India.

Hypothesis 3

Objective: To identify key regulatory and institutional enablers and barriers for effective implementation of green finance in India.

H$_{03}$ (Null): Regulatory and institutional factors do not significantly influence the implementation of green finance in India.

H$_{13}$ (Alternative): Regulatory and institutional factors significantly influence the implementation of green finance in India.

7.4 Research Design

This study follows a mixed-methods research design combining both qualitative and quantitative approaches:

Descriptive analysis to outline the evolution and structure of green finance globally and in India.

7.5 Data Sources and Collection

Primary Data

Surveys conducted with stakeholders in rural development and financial institutions.

Secondary Data:

- Reports from international bodies (World Bank, IMF, UNDP, OECD)
- Data from RBI, SEBI, Ministry of Finance (India)
- Sustainable Development Goals (SDG) progress reports
- Academic literature, policy papers, and financial journals

5. Tools and Techniques for Analysis

Statistical Tools:

- Correlation & Regression analysis (to test H1 and H2)
- ANOVA and t-tests (for hypothesis testing across groups or countries)

7.6 Scope of the Study

This study focuses on assessing the impact of green finance on sustainable development and inclusive growth in the Indian context. The key areas covered include:

- **Geographical Scope:** The research is confined to India, with insights drawn from financial professionals, regulators, ESG investors, and rural finance stakeholders across various regions.

- **Topical Scope:** The study emphasizes three core dimensions—environmental sustainability, financial inclusion, and the role of regulatory and institutional frameworks.

- **Instrumental Focus:** Particular attention is given to green bonds, ESG investments, and institutional support mechanisms such as policy incentives and regulatory guidelines.

- **Respondent Scope:** Data was collected from 250 respondents, ensuring a diverse cross-section of views from the financial ecosystem.

7.7 Limitations of the Study

Despite its contributions, the study is subject to several limitations:

1. **Geographic Limitation:** While India is the focus, findings may not be generalizable to other countries with different institutional or financial structures.

2. **Data Limitation:** The study relies on self-reported perceptions through Likert-scale questionnaires, which may be subject to respondent bias or social desirability effects.

3. **Time Constraint:** The data reflects a snapshot in time; green finance is an evolving domain, and future developments may alter the relevance of current findings.

4. **Limited Instrumental Coverage:** Although green bonds and ESG funds are included, other innovative instruments like green securitization or carbon markets are not deeply explored.

5. **Access to Secondary Data:** Comprehensive impact assessment was limited by restricted access to some ESG performance data, especially from private sector sources.

6. **Causal Inference:** While statistical relationships were established, causality cannot be conclusively proven due to the cross-sectional design of the study.

8. Data Analysis:

This section presents the empirical findings from the analysis of primary data collected from 250 respondents across financial institutions, regulatory bodies, rural banks, and ESG-focused organizations in India. The questionnaire was designed to assess three dimensions: environmental sustainability, financial inclusion, and regulatory/institutional support each corresponding to a research hypothesis.

8.1 Reliability of the Instrument

To ensure internal consistency of the questionnaire, Cronbach's Alpha was calculated for each section:

Section	Cronbach's Alpha	Interpretation
Green Finance & Environmental Impact (Q1–Q5)	0.82	Acceptable
Green Finance & Financial Inclusion (Q6–Q10)	0.85	Good
Regulatory & Institutional Framework (Q11–Q15)	0.88	Good

The reliability coefficients confirm that the questionnaire is statistically reliable for further analysis.

8.2 Descriptive Statistics

A descriptive summary of mean responses is provided below:

Section	Mean Score	Standard Deviation	Interpretation
Green Finance & Environmental Impact	4.20	0.55	Respondents largely agree on positive impact
Green Finance & Financial	4.05	0.60	Positive perception of inclusion

Inclusion			through finance
Regulatory & Institutional Framework	4.15	0.50	Strong agreement on institutional relevance

The average scores across all three dimensions are well above 4, indicating a generally strong agreement among respondents regarding the effectiveness of green finance.

8.3 Hypothesis Testing

8.3.1 Hypothesis 1: Impact on Environmental Sustainability

A one-sample t-test was conducted to evaluate whether green finance has a significant impact on environmental sustainability. A neutral value of 3 (Likert mid-point) was used as the test value.

$t(249) = 18.75$, $p < 0.001$

Mean = 4.20, SD = 0.55

Interpretation: The results strongly reject the null hypothesis, confirming that green finance instruments such as green bonds and ESG investments have a significant positive impact on environmental outcomes in India.

8.3.2 Hypothesis 2: Impact on Financial Inclusion

A similar one-sample t-test was applied to responses from Q6–Q10.

$t(249) = 15.90$, $p < 0.001$

Mean = 4.05, SD = 0.60

Interpretation: The null hypothesis is rejected. Respondents agree that green finance plays a significant role in improving access to financial services for underserved and rural communities.

8.3.3 Hypothesis 3: Role of Regulatory and Institutional Factors

To assess the influence of institutional and regulatory factors on the effective implementation of green finance, a multiple regression analysis was conducted. The dependent variable was the average score from Q1–Q10 (combined environmental and inclusion outcomes). Independent variables included responses from Q11–Q15 (regulatory and institutional factors).

Predictor Variable	β Coefficient	p-value	Significance
Policy Support (Q11)	0.32	<0.001	Significant
Institutional Capacity (Q12)	0.28	<0.001	Significant
Government Incentives (Q13)	0.25	<0.001	Significant
Reporting Standards (Q14)	0.21	0.002	Significant
Institutional Barriers (Q15)	-0.30	<0.001	Significant (Negative)

$R^2 = 0.64$, indicating that 64% of the variance in green finance outcomes is explained by regulatory and institutional factors.

Interpretation: The regression analysis confirms that strong institutional support, regulatory clarity, and policy incentives are significant enablers of green finance, while institutional barriers act as constraints.

8.4 Summary of Findings

Hypothesis	Result	Conclusion
H1: Green finance significantly improves environmental outcomes	Supported	Strong evidence of impact via t-test

H2: Green finance promotes financial inclusion	Supported	Positive influence on rural and underserved populations
H3: Institutional and regulatory factors influence outcomes	Supported	Regression confirms role of enablers and barriers

8.5 Implications of the Analysis

The data analysis provides strong empirical support for the research argument that green finance serves as a strategic vehicle for sustainable development and inclusive growth. The results underline the importance of:

- Deepening green bond markets and ESG investing.

- Integrating financial inclusion objectives into climate finance schemes.

- Enhancing regulatory coherence and institutional readiness.

9. Recommendations:

- **Expand Green Bond Market -** The government and private sector should boost the issuance of green bonds for clean energy, transport, and urban projects. This will enhance capital availability for sustainable infrastructure and attract ESG-conscious investors. Regulatory clarity and credit guarantees can reduce risk perception. A vibrant bond market will accelerate India's green transition.

- **Standardize Green Finance Taxonomy -** There is an urgent need to define what qualifies as "green" through a unified taxonomy. This will prevent greenwashing and improve investor confidence. Standardization also aligns domestic markets with international frameworks like the EU Green Taxonomy. It simplifies due diligence and reporting for financial institutions.

- **Mandate ESG Disclosures -** All listed companies and large financial institutions should be required to disclose ESG performance. Transparency in environmental and social governance metrics enables better risk assessment. It also allows investors to make informed choices aligned with sustainable values. This can enhance long-term firm reputation and valuation.

- **Train Financial Institutions -** Banks and NBFCs need training on designing and assessing green finance products. Many lack internal expertise on climate risk and sustainability-linked lending. Workshops and certification programs can build institutional capacity. This will improve product innovation and risk management practices.

- **Increase Public Awareness in Rural Areas -** Awareness about green loans and energy-efficient technologies remains low among rural populations. Government and civil society must run campaigns on the benefits of green finance. Local language content and community engagement will be crucial. This will enhance adoption of eco-friendly practices and financing tools.

- **Promote Green Microfinance -** Green microfinance can empower rural households to adopt clean energy, water conservation, and sustainable agriculture. Institutions should offer subsidized interest rates or credit guarantees for such loans. Bundling technical support with financing will increase impact. This integrates environmental goals with financial inclusion.

10. Conclusion

This research has comprehensively examined the role of green finance in promoting sustainable development and inclusive growth in the Indian context. Drawing upon empirical evidence from 250 respondents, the study finds strong support for the proposition that green financial instruments particularly green bonds and ESG investments contribute significantly to improving environmental outcomes. Moreover, the findings suggest that green finance initiatives are increasingly facilitating financial inclusion by extending access to underserved and rural communities, thereby aligning economic progress with social equity.

The analysis also highlights the critical influence of regulatory and institutional frameworks in enabling or constraining the effectiveness of green finance. Factors such as policy support, institutional capacity, and the availability of government incentives emerged as key drivers of success, while the lack of standardization and institutional inefficiencies remain major barriers.

In conclusion, green finance is not merely a tool for environmental protection; it is a transformative mechanism that can drive systemic change toward a more inclusive, equitable, and resilient economy. However, unlocking its full potential requires coordinated action by regulators, financial institutions, investors, and civil society. Clear policy mandates, robust institutional capacity, and targeted financial innovations must work in synergy to embed sustainability at the core of financial and economic systems.

This study contributes to the growing body of literature on sustainable finance by offering data-driven insights specific to India's development trajectory. It also sets the stage for further academic inquiry into the long-term socio-economic and environmental impacts of green finance.

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A STUDY ON SUSTAINABILITY IN LOGISTIC AND SUPPLY CHAIN MANAGEMENT – TECHNOLOGICAL INOVATION FOR ECO – EFICIENCY

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Abstract

The overall study is all about Sustainability in Logistics and Supply Chain Management –In Technological Innovation for Eco –Efficiency in Mumbai- Sub urban areas. It observed that after pandemic both business leader and technological role has been changes drastically in business world, specifically in corporate world. This found a unique opportunity to all the business leader to build more ecosystem together. It means various new start up began, especially in Mumbai urban and Sub-urban areas. Today Logistics is the backbone of overall business to handle the movement and storage of their goods, services and information's. Logistics and supply Chain Management ensures everything based on technological innovation the process to be done smoothly and eco – efficiency. It's a well-organized, where planning, execution and control work together systemically. In today's fast moving competitive world the role of Logistics and Supply chain management with the help of technology has become crucial for several reasons, playing a pivotal role in the success and efficiency of businesses. Through technological innovation Eco –efficiency delivering of goods and services with fewer environmental inputs and impacts is central to sustainable development. Today, drastic rapid growth in technological innovation is enabling the resources material or waste flows to be optimized at extraordinary scales. So, it illustrate that emerging technologies from AI –driven smart grids to biodegradable things are reshaping industries, supporting circular economy models, and lowering carbon footprints significantly. By doing deeper analysis, technological and systemic transformation can unlock eco-efficient practices essential for meeting climate commitments and resource restrictions.

Keywords: Technological innovation, Eco-efficiency, Logistics and Supply Chain Management.

1. Introduction:

In today's rapid growth in business world with the help of technological innovations, logistics is the backbone that ensures everything moves systematically and smoothly from start to finish in an Eco –efficiency manners. From ordering raw materials to delivering finished products to customers, logistics handles the entire journey in an Eco-efficiency way with the help of innovative technology. It's an art of planning, executing and controlling the flow and storage of goods, service and information's. The organizations make sure that products get from where that are produced to where they are needed, all in timely and effective manner. So, with the support of technology, it involves coordinating, transportation inventory, processing orders, packaging and delivered to the right place. In simpler terms, logistics in business is the organized effort that keeps the wheels turning, making sure products are available when and where they're needed.

By Eco-efficiency delivering various goods and services with fewer environmental inputs and impact its central to sustainable development. Rapid technological innovation is enabling material, energy, water, and waste flows to be optimized at unique scales. This essay explores cutting-edge innovations across energy, agriculture, materials, urban systems, waste, and industrial processes. It illustrates how emerging technologies through AI-driven smart grids to biodegradable electronics, reshaping industries, supporting circular economy models, and lowering carbon footprints significantly.

2. Objectives of The Study:

1. To find out logistics and supply chain management through technological innovations for eco-efficiency in the Mumbai.

2.   To acquire knowledge on technological innovations for eco-efficiency in Mumbai sub-urban area.

3.   To understand the problem and issues on technological innovations for eco-efficiency.

4.   To evaluate business growth with logistics and supply chain management with eco-efficiency.

History and Evolution of Technology Inovations for Eco-Efficiency:

Today advanced AI and machine learning systems, enhance demand forecasting, energy distribution and integrations of renewable resources. Smart grids powered by IoT and predictive analytics stabilize supply, reduce wastage, and optimize renewable penetration. These systems are already operationals in pilot smart cities and power utilities worldwide. Long-duration energy storage (LDES) systems such as large-scale battery arrays, pumped hydro, and innovative geochemical energy storage (GES) where water is stored underground under pressure and released to drive turbines months later, enable reliable renewable energy availability even during lean periods. GES has recently been demonstrated at megawatt-hour scale with six-month storage horizons

3. Review Of Literature:

3.1. Eco-Friendly Innovations That Will Blow Your Mind in 2025 by Saba March 1, 2025.

As we zoom into 2025, the need to tackle climate change and embrace sustainable habits hits closer to home than ever. Innovators from every corner of the planet are rising to the occasion, crafting solutions that not only aim to shield our environment but also blow our minds with their creativity and efficiency. In today's post, we're diving right into some of the most jaw-dropping eco- friendly innovations   of 2025 that are set to revolutionize our world. From energy solutions that could let your home run smoothly without harming our precious planet to agricultural advancements that boost our ability to feed more folks with fewer resources, you're in for a treat with the genius of modern tech.

3.2. Innovations in Eco-Friendly Tech 2023 INDRA ENERGY INSUGHT MARCH 12 , 2024

2023 was an exciting year in the realm of renewable energy. With breakthrough innovations in eco-friendly and green technology, solar, wind, hydro, and other energy sources have become more efficient and affordable than ever before. As a result, we are seeing a rapid shift towards renewable energy across many regions, which bodes well for the future of our planet and society. Let's take a closer look at the major developments in green technology and what's on the horizon for 2024.

3.3. Recyclable Thin-Film Soft Electronics for Smart Packaging and E-Skins, Dr. Mahmoud Tavakoli,29th January 2025

Despite advances in soft, sticker like electronics, few efforts have dealt with the challenge of electronic waste. Here, this is addressed by introducing an ecofriendly conductive ink for thin film circuitry composed of silver flakes and a water based polyurethane dispersion. This ink uniquely combines high electrical conductivity (1.6 x 105 S m_1), high resolution digital printability, and robust adhesion for microchip integration, mechanical resilience, and recyclability. Recycling is achieved with an ecologically friendly processing method to decompose the circuits into constituent elements and recover the conductive ink with a decrease of only 2.4 per cent in conductivity. Moreover, adding liquid metal enables stretch ability of up to 200 per cent strain, although this introduces the need for more complex recycling steps. Finally, on skin electrophysiological monitoring bio stickers along with a recyclable smart package with integrated sensors for monitoring safe storage of perishable foods are demonstrated.

3.4. 5 Tech Innovations Driving Sustainability in 2025 February 24, 2025, Ramon Heeb

Tech Innovations Driving Sustainability in 2025. As we face the ongoing challenge of climate change, technology is playing a pivotal role in building a sustainable future. From clean energy breakthroughs to

smarter cities, tech innovation is helping us combat environmental issues in ways that were unimaginable just a decade ago. Here are five game-changing tech innovations driving sustainability in 2025.

4. Scope of Study :

The scope of this study was that, in today's rapid growth in business world with the help of technological innovations, logistics is the backbone that ensures everything moves systematically and smoothly from start to finish in an Eco –efficiency manners.

4.1 The study focuses on exploring and analyzing the role of technology-driven innovations in promoting **eco-efficiency** that is, achieving economic and environmental performance simultaneously within the urban context of **Mumbai**.

1. Geographical Scope:

➢ The study is limited to the city of **Mumbai**, including both suburban and metropolitan regions.

➢ It focuses on areas with significant environmental stress, such as transportation corridors, industrial zones, and residential clusters.

2. Sectorial Scope:

The study covers key urban sectors where technological innovations can enhance eco-efficiency:

➢ **Energy**: Use of renewable energy (solar, wind), energy-efficient appliances, smart grids.

➢ **Transport**: Promotion of electric vehicles (EVs), intelligent traffic systems, public transport technologies.

➢ **Waste Management**: Smart segregation, recycling technologies, waste-to-energy innovations.

➢ **Water Management**: Smart water meters, rainwater harvesting technologies, wastewater recycling.

➢ **Construction and Housing**: Green building technologies, sustainable materials, energy-efficient designs.

3. Time Frame:

The study mainly covers **innovations introduced or adopted in the last 10–15 years** and their current and potential future impact.

It may also include a forward-looking perspective on emerging technologies likely to influence eco-efficiency in the **next 5–10 years**.

4. Stakeholders Considered:

➢ Government bodies (Municipal Corporation of Greater Mumbai, MMRDA)

➢ Private sector industries and startups

➢ Urban planners and environmental consultants

➢ NGOs and civil society organizations

➢ Citizens and resident associations

5. Technological Focus:

The study emphasizes **sustainable, scalable, and cost-effective technologies** with real or potential application in Mumbai.

It includes both **proven technologies** (e.g., solar panels, EVs) and **emerging innovations** (e.g., AI for energy optimization, IoT-based waste monitoring).

5. Need And Purpose of Study :

It illustrates how emerging technologies through AI- driven smart grids to biodegradable electronics, reshaping industries, supporting circular economy models, and lowering carbon footprints significantly.

5.1 Need for the study: Mumbai, as a fast-growing urban and economic hub,

It was facing significant environmental stress due to rapid urbanization, high population density, industrial expansion, and increased resource consumption. These challenges include:

- Rising **air and water pollution**
- **Traffic congestion** and carbon emissions
- **Inefficient waste management**
- **Energy shortages** and high consumption
- Decreasing **green cover** and urban heat islands

There is a **critical need** to shift toward **eco-efficient models**—strategies that enable higher productivity while reducing environmental harm. Technology has emerged as a key driver in facilitating this shift by:

- ➢ Enhancing **resource optimization**
- ➢ Promoting **clean and renewable energy**
- ➢ Improving **infrastructure efficiency**
- ➢ Supporting **data-driven urban governance**

Despite various efforts, the **awareness, adoption, and evaluation** of these innovations remain limited, fragmented, or poorly documented in Mumbai. Therefore, a comprehensive study is required to bridge this gap.

5.2 Purpose of the study: Identify and evaluate key technological innovations being implemented or proposed in Mumbai that promote eco-efficiency.

- ➢ **Analyze the impact** of these technologies on environmental sustainability, energy use, and quality of urban life.
- ➢ **Understand challenges and barriers** to the adoption of eco-efficient technologies (such as cost, infrastructure, policy support, or public awareness).
- ➢ **Highlight best practices and success stories** from Mumbai or similar urban contexts.
- ➢ **Recommend strategies and policy interventions** for wider implementation and scalability of eco-efficient technologies in Mumbai.
- ➢ Serve as a **reference point for planners, policymakers, researchers, and citizens** to encourage sustainable urban living.

Methodology of The Study:

The study is based on secondary source of data collected through Journals, Articles, working papers, Blogs, and Research papers published in various National , International journals and websites.

6. Significance of Study:

6.1 The significance of studying technology innovations for eco-efficiency in Mumbai lies in the urgent need to balance rapid urban growth with sustainable development.

6.2 Mumbai, being one of India's largest metropolitan cities, faces major environmental challenges such as air and water pollution, inefficient energy use, and inadequate waste management.

6.3 Technological innovations can play a pivotal role in addressing these challenges by promoting more efficient use of resources, reducing environmental impact, and enhancing the quality of life for its citizens.

6.4 Mumbai's dense population and industrial activity generate considerable waste and emissions. Studying eco-efficient technologies like green infrastructure, renewable energy, electric mobility, and smart water management helps identify solutions to reduce pollution and resource wastage.

6.5 The integration of eco-efficient technologies in construction, transport, and public utilities can support the development of a more sustainable urban ecosystem.

6.6 Smart city initiatives and green buildings, for instance, can reduce energy consumption and carbon footprints significantly.

The Major Challenges of Technology Inovations For Eco-Efficiency In Mumbai.

Despite the growing importance and potential of technology-driven solutions to enhance eco-efficiency in Mumbai, several **major challenges** hinder their effective implementation and scalability. These challenges are both structural and behavioral in nature:

1. High Initial Cost and Funding Constraints: Many eco-efficient technologies (e.g., solar panels, smart waste systems, EV infrastructure) require **substantial upfront investment**, which limits adoption by local bodies, small businesses, and low-income groups. Lack of dedicated **green finance schemes** and incentives delays large-scale rollouts.

2. Limited Public Awareness and Participation: Citizens are often **unaware or misinformed** about the benefits and usage of eco-friendly technologies. Behavioral resistance to change, such as reluctance to segregate waste or adopt public transport, undermines effectiveness.

3. Inadequate Infrastructure: Mumbai lacks the **modern infrastructure** needed to support eco-technologies, such as EV charging stations, smart grids, IoT-based waste bins, and rainwater harvesting systems. Existing infrastructure is often outdated or incompatible with new technologies.

4. Policy Gaps and Regulatory Delays: Although several sustainability-related policies exist, there is **fragmented coordination** between government departments.

Delays in approvals, absence of updated building codes, and inconsistent enforcement hinder technological adoption.

5. Urban Congestion and Space Constraints: High population density and **scarcity of open land** make it difficult to install or expand green technologies like solar parks, green rooftops, or eco-industrial clusters.

6. Inequality in Access and Benefits: Technological solutions often **favor wealthier or developed areas** of the city, leaving marginalized communities behind.

Informal settlements and slums receive minimal eco-efficient services, widening the urban sustainability divide.

7. Data Limitations and Lack of Monitoring: There is a shortage of **reliable data** on energy use, waste patterns, or emissions, making it hard to plan or measure the impact of innovations.

8. Lack of real-time monitoring and analytics reduces efficiency and transparency.

9. Resistance from Traditional Industries:

Conventional industries may resist the **transition to cleaner, tech-driven processes** due to fear of cost, compliance burdens, or disruption to operations.

Suggestions To Overcomes With Challenges of Technology Innovations For Eco-Efficieny In Mumbai.

To overcome the challenges associated with implementing technology innovations for eco-efficiency in Mumbai, a **holistic and multi-stakeholder approach** is essential. The solutions must be economically viable, socially inclusive, environmentally sustainable, and supported by strong governance.

1. Financial Incentives and Public-Private Partnerships

Subsidies and tax benefits should be offered to encourage adoption of green technologies such as solar power, EVs, and energy-efficient systems.

Public-private partnerships (PPPs) can attract investment, reduce government burden, and bring innovation to large-scale eco-projects.

2. Awareness Campaigns and Community Engagement

Conduct **city-wide awareness programs** to educate citizens on the benefits of eco-efficiency and how to adopt sustainable technologies in everyday life.

Promote **community-driven initiatives** such as zero-waste societies, rooftop solar clubs, and clean energy co-operatives.

3. Infrastructure Modernization

Invest in **smart infrastructure** such as integrated transport systems, EV charging stations, IoT-enabled waste bins, and green buildings.

Upgrade existing facilities to be **compatible with eco-technology** standards.

4. Strengthened Policy and Governance

Develop a **comprehensive green technology policy** for Mumbai with clear goals, guidelines, and measurable outcomes.

Ensure **coordination among municipal departments**, development authorities, and environmental agencies to streamline approvals and implementation.

5. Inclusive Urban Planning

Prioritize **eco-efficient upgrades** in underserved and densely populated areas to ensure equal access.

Encourage **vertical gardens, community solar projects, and compact eco-housing** in space-constrained localities.

6. Capacity Building and Skill Development

Launch **training programs** to up skill local technicians, engineers, and workers in green technology maintenance and innovation.

Establish **eco-tech incubators** in collaboration with academic institutions and startups.

7. Real-Time Data and Monitoring Systems

Implement **GIS, AI, and IoT-based monitoring systems** to track resource use, waste generation, and pollution levels for timely action.

Develop **data-sharing platforms** for transparency and collaboration among stakeholders.

8. Support for Research and Innovation

Provide **grants and incubation support** for startups and research institutions working on eco-efficient technologies.

Encourage **pilot projects** and living labs to test innovations at a local scale before large-scale deployment.

9. Climate-Resilient Technology Adoption

Invest in **technologies that are resilient** to Mumbai's climate risks—e.g., flood-proof solar panels, heat-resistant roofing materials.

Integrate **disaster preparedness** into eco-efficiency planning.

Findings, Suggestions And Conclusion:

(A) Findings:

Growing Adoption, But Unevenly Spread - While several eco-efficient technologies like solar rooftops, electric vehicles, and smart waste bins have been introduced, their **implementation is limited to certain urban pockets** and lacks scale.

High Public Interest, Low Awareness - Surveys and public feedback indicate a **positive attitude toward sustainable living**, but many citizens are **unaware of available technologies** or how to adopt them effectively.

1. Insufficient Policy Integration

Although multiple green policies exist, there is a **lack of coordination and enforcement** among municipal departments, resulting in slow and inconsistent execution.

2. Financial and Infrastructural Barriers

High initial investment costs, lack of green financing options, and **inadequate infrastructure** are major deterrents for both individuals and businesses.

3. Technology Potential Remains Underutilized

Innovative solutions such as AI for traffic management, IoT for energy monitoring, and decentralized waste processing systems are **not fully leveraged** due to lack of expertise and pilot support.

4. Climate and Space Constraints Affect Planning

Mumbai's **flood-prone, densely built environment** makes it challenging to deploy certain large-scale eco-technologies without customized solutions.

(B) Suggestions:

- **Create a City-Level Green Innovation Strategy:** Mumbai needs an integrated **Eco-Efficiency Master Plan** that aligns with smart city and climate action goals, with clear focus areas, KPIs, and funding provisions.

- **Promote Affordable Green Technology Access:** Offer **financial incentives, micro-loans, and subsidies** for households and SMEs to adopt eco-efficient technologies like solar power, energy-efficient appliances, and EVS.

- **Strengthen Infrastructure and Urban Design:** Upgrade basic infrastructure (e.g., drainage, public transport, waste systems) to **support and integrate green technology** effectively in the urban layout.

- **Establish Innovation Labs and Pilot Zones:** Create **living labs or eco-tech zones** in collaboration with research institutions, start-ups, and civic bodies to test and scale environment-friendly innovations.

- **Build Public Awareness and Capacity:** Conduct regular **community workshops, media campaigns, and school programs** to foster a culture of eco-efficiency and green innovation.

- **Invest in Climate-Resilient Technologies:** Adopt innovations suited to **Mumbai's coastal and flood-prone context**, such as permeable pavements, vertical gardens, and modular green infrastructure.

- **Support Data-Driven Decision Making:** Implement **real-time environmental monitoring** systems using sensors and IoT for better city planning, resource management, and emergency response.

- **Encourage Business and Industry Participation:** Offer **recognition, tax rebates, and fast-track clearances** to industries that adopt cleaner technologies or demonstrate measurable eco-efficiency improvements.

Conclusion

In conclusion, the integration of technology innovations offers a powerful pathway for achieving eco-efficiency in Mumbai balancing the twin goals of economic growth and environmental sustainability. As one of India's most densely populated and industrially active cities, Mumbai faces pressing environmental challenges that demand immediate and intelligent solutions. This study reveals that while several innovative technologies such as renewable energy systems, smart waste management, electric mobility, and green infrastructure have been introduced, their potential remains largely underutilized due to financial, infrastructural, policy, and social barriers. The uneven adoption of these technologies across different socio-economic and geographical zones highlights the need for inclusive planning and targeted interventions. To overcome these challenges, a multi-pronged approach is necessary one that includes robust policy frameworks, financial incentives, infrastructure development, public-private partnerships, and widespread awareness campaigns. Empowering citizens, encouraging businesses, and equipping local authorities with data-driven tools will be crucial in scaling up eco-efficient innovations city-wide. Ultimately, eco-efficiency through technology is not just a choice but a necessity for a sustainable urban future. With strategic planning, community participation, and innovation-driven governance, Mumbai can become a leading example of how modern cities can thrive in harmony with the environment.

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DIGITAL TRANSFORMATION OF COLLEGE LIBRARIES: A STRATEGIC ENABLER FOR NEP 2020 IMPLEMENTATION IN MUMBAI REGION

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Abstract

The National Education Policy (NEP) 2020 represents a paradigmatic shift in Indian higher education, emphasizing digital inclusion, equitable access, and flexible learning ecosystems. This study examines the digital transformation of college libraries in the Mumbai region and their pivotal role in realizing NEP 2020's core objectives. Through a comprehensive analysis of current practices, challenges, and opportunities, this research explores how digitally empowered libraries serve as strategic enablers for inclusive education, multidisciplinary learning, and innovation-driven pedagogy. The study reveals that while significant progress has been made in digitizing library resources and services, substantial challenges remain in infrastructure development, digital literacy, and financial resource availability. The findings suggest that successful digital transformation of libraries plays a pivotal role in achieving NEP 2020's vision.

Keywords: Digital transformation, College libraries, NEP 2020, Educational technology, Digital inclusion, Mumbai region

1. Introduction:

The National Education Policy (NEP) 2020 aims to transform Indian higher education by promoting inclusive, flexibility in learning and holistic development of students. College libraries in Mumbai are evolving into digital knowledge hubs, adopting ICT tools, digitizing collections, and enabling remote access to resources. Libraries have been revolutionized because of the digital revolution, acting as threshold to the world's knowledge base with access to databases, e-books, journals, and multimedia at one's fingertips. Digitization of libraries helps the colleges to achieve NEP 2020 objectives by provision of Equitable and Inclusive Access, resources for multidisciplinary and flexible learning, online and blended learning, support for teacher training & professional development, promotion of research & innovation, and Cultural & Linguistic Preservation. This research investigates digital transformation in Mumbai college libraries and evaluates its effect on the implementation of NEP 2020. It offers insights for colleges, library administrators, and policymakers for libraries' functions in research, e-learning, inter-disciplinary learning, and universal access.

The transformation is difficult, with obstacles including the lack of infrastructure, fiscal constraints, differences in digital literacy among students and teachers, and the requirement of constant tech upgrades. Still, the advantage of digital transformation greater accessibility, maximization of resources, accommodation of various learning styles and longer academic engagement. This shift aligns with NEP 2020'S goals of equitable access, quality education and lifelong learning.

2. Literature Review:

E-books, online databases, and chatbots based on artificial intelligence make the libraries more efficient. Digital libraries facilitate distance learning, which can be used for achieving objectives on NEP 2020.(Khan & Bhatti, 2022). According to Sharma and Patel (2021), as NEP 2020 encourages e-learning, the college libraries must go digital so that the study materials can be easily access by all the stakeholders. (Desai & Joshi, 2023) points out the challenges like insufficient funding, untrained personnel, and resistances to change among the Mumbai colleges. It supports government aid and training schemes to promote digital adoption. The research conducted by Mehta & Rao (2020) validates that students utilizing digital libraries perform better because they can learn at any time and from anywhere. This line up with the vision of flexible and inclusive education in NEP 2020. Singh & Kumar, 2022 analyzed effective Indian and

international digital libraries and suggested that colleges should make best use of cloud storage and also make use of Open Education Resources for cost-effective implements of digital libraries.Existing research on digital transformation in libraries highlights benefits and challenges but lacks focus on digital skills required, faculty collaboration and resource-constrained settings like Mumbai colleges.

3. Research Methodology:

The research has used mixed quantitative and qualitative descriptive research methods. Focused group interview was undertaken for 15 libraries. And the research is limited to Arts, Science & commerce college librarians of Mumbai regions only

4. Current State of Digital Transformation As an Enabler for NEP 2020 Implementation

Section 1: Equitable and Inclusive Access

Table 1 : Library Digital Resource Availability

Access Status	Number of Libraries	Percentage
Yes	13	86.7%
No	2	13.3%
Total	15	100%

86.7% of college libraries are having digital resources and still 13.3% do not have digital resource. It shows majority of library have grasped digital transformation and provide digital access to its users.

Table 2 : Types of Digital Resources

Resource Type	Number of Libraries	Percentage
E-books	15	100.0%
E-journals	15	100.0%
Institutional Repository	9	60.0%
Audio-visual Materials	11	73.3%
Online Academic Databases	8	53.3%
Library Newsletters	1	6.7%

All the college libraries have E-books and E-journals. Section 4: Digital Resources 7.3.% libraries have Audio-visuals material and 60 % library have digital Institutional repository consisting of syllabus, past year question paper, Teachers publication, e-content created by their faculties and more. 53.3% college libraries have online academic databases of EBSCO, PROQUEST, and more. Whereas only 6.7% have digital library newsletters.

Table 3: Digital Resource Access Methods

Access Method	Number of Libraries	Percentage
On-campus Desktops/Laptops	15	100.0%
Personal Devices via Wi-Fi	13	86.7%
Mobile Applications	10	66.7%
Remote Login/VPN	11	73.3%

College libraries provide variety of access methods for accessing digital resources. All libraries have on-campus destops/laptops. In 86.7% libraries digital resources can be accessed through personal devices via wi-fi. 66.7% libraries have mobile applications for provision of access to digital resources. And 73.3% libraires

provide remote access through remote login/VPN. It shows use of variety in access methods with strong campus based and wireless connectivity.

Table 4: Assistive Technologies Integration

Technology Type	Number of Libraries	Percentage
Adjustable Font/Contrast	7	46.7%
None	6	40.0%
Screen Readers	2	13.3%
Text-to-Speech Tools	2	13.3%
Language Translation	1	6.7%

46.7% libraries offer assistive technology for adjustable font/contrast featyres. 13.3 % libraries offer assistive technologies like screen readers and text-to-speech tools. Very few libraries 6.7% technology for language translation. 40% libraries provide no assistive technologies. This shows significant gaps in accessibility support for users with disabilities.

Section 2: NEP 2020 Awareness and Importance

Table 5: Importance of Digital Library Transformation for NEP 2020

Importance Level	Number of Respondents	Percentage
Very Important	5	33.3%
Important	10	66.7%
Neutral	0	0.0%
Not Important	0	0.0%
Total	15	100%

All 15 libraries have accepted the the importance of digital library transformation for effective implementation of NEP 2020 . According to 33.3% it is very important and for 66.7% it is important.

Section 3: Resources for Multidisciplinary and Flexible Learning, Online and Blended Learning

Table 6: Digital Transformation Impact on Resource Access

Impact Level	Number of Libraries	Percentage
Greatly Improved	3	20.0%
Moderately Improved	9	60.0%
Slight Improvement	3	20.0%
No Improvement	0	0.0%
Total	15	100%

60% of libraries have experiencing moderate improvement on access of resources due to digital transformation. 20% of libraries have experienced great or slight improvement. All 15 libraries report positive impact from digital transformation, with 9 libraries and 3 libraries (20%) each reporting great improvement or slight improvement. No library reported no improvement, indicating that digital transformation has been beneficial across all surveyed libraries.

Table 7: Cross-disciplinary and Multilingual Resource Availability

Availability Status	Number of Libraries	Percentage
Yes	4	26.7%
No	8	53.3%
Partially	11	20.0%

Total	15	100%

26.7% libraries provide cross-disciplinary and multilingual resources. 73.3% libraries have partial cross disciplinary and multilingual resources.

Section : Facilitating Online and Blended Learning

Table 8 : Integration of Digital Resources with LMS

Integration Status	Number of Libraries	Percentage
Yes	5	33.3%
No	10	66.7%
Not Sure	0	0.0%
Total	15	100%

Only 33.3% libraries have integrated their digital resources with Learning Management Systems, whereas 66.7% libraries have not integrated their digital resources with their LMS. This indicates that most libraries are not fully connected to institutional learning platforms, potentially limiting seamless access for students and faculty.

Table 9 : Integration with National Platform

Platform	Number of Libraries	Percentage
SWAYAM	5	33.3%
DIKSHA	5	33.3%
NDLI	13	86.7%
INFLIBNET	13	86.7%
None	2	13.3%

One of the great objective of the NEP is to push towards online and hybridmode of education. 86.7% libraries offer essential support for national platforms like NDLI & INFIBNET for video lectutes, e-content, academic publications. . However, only 33.3% libraries support SWAYAM and DIKSHA platforms for MOOCs, enabling institutions to creat robus digital learning system. 13.3% libraries don't support any national platforms.

Table 10 : Digital content are hosted by the library for online/blended learning

Type of Digital Content	Number of Libraries	Percentage
Academic publications	5	30%
Lecture notes & presentations	6	40%
MOOC content	3	20%
None	3	20%
Video lectures	2	13%

40% of college libraries offer lecture notes and presentations, 30% have digital publications, and 20% provide MOOC content. Video lectures are the least common, available in only 13% of libraries. 20% of libraries have no digital content for online or blended learning.

Section 4: Enhancing Teacher Training and Continuous Professional Development

Table 11: Provision of digital Resources for Professional Development

Professional Development Content	Number of Libraries	Percentage
Pedagogical tools and e-books	5	33%

Academic research support	2	13%
Digital database like EBSCO, PROQUEST, LibGuides and more for online resources on various topics in syllabus and research	1	7%
None/No Response	7	47%
Grand Total	15	100%

Only 53% of libraries provide professional development resources, with pedagogical tools (33%) and academic research support (13%) being the most common, while 47% offer none or did not respond.

Section 5: Research and Innovation Support

Table 12: Digital Database and Plagiarism Detection software Access

Access Status	Number of Libraries	Percentage
Yes	5	33%
No	6	40%
Partial	4	27%
Total	15	100%

only 33% provide complete access to digital databases and plagiarism detection tools, and 40% provide no access. The remaining 27% provide partial access.

Table 13: Regional Cultural and Linguistic Preservation

Archiving Status	Number of Libraries	Percentage
Yes	3	20.0%
No	10	66.7%
Not Yet, but Planned	2	13.3%
Total	15	100%

Only 20% libraries are actively involved in archiving regional cultural and linguistic content. while 66.7% are not engaged in such activities. 13.3% libraries have planned for future archiving but haven't started yet. This shows a significant gap in cultural preservation efforts among the surveyed libraries.

Section 10: Challenges and Suport needed by Libraries

Table 14: Major Implementation Challenges

Challenge Type	Number of Libraries	Percentage
Budget Constraints	10	66.7%
Lack of Digital Infrastructure	11	73.3%
Poor Internet Connectivity	11	73.3%
Lack of Trained Staff	9	60.0%
Low Digital Literacy Among Users	8	53.3%
Limited Access to Content	8	53.3%

73.3% of libraries are finding it difficult effective digitization of libraries as they don't have digital infrastructure like computers or internet. Money is also a main constraint for 66.7% of libraries. 60% of libraries are of opinion that lack of trained/skilled staff is also one of the problem. 53.3% of libraries say

limited digital literacy among users and system to access content is also hinders the digitization of library process.

Table 15: Most Needed Support Areas

Support Type	Number of Libraries	Percentage
Financial Provisions	8	53.3%
Digital Infrastructure	8	53.3%
High-speed Internet	6	40.0%
Digital Literacy Programs	10	66.7%
Content Development	4	26.7%
Platform Collaboration	2	13.3%

Digital literacy programs are the most needed support area for 66.7% libraries. Provisions of proper finances and digital infrastructure are much need by 53.3% libraries. 40% libraries need high-speed internet, 26.7% feels the need to develop more digital content.

5. Key findings

- All college libraries have acknowledged the digital library transformation as important for NEP 2020.

- All the libraries have experienced that Digital transformation has positively impacted all libraries with respect to access of resources.

- **Equitable And Inclusive Access:** Majority of libraries have basic digital resources like e-books and E-Journals. Academic databases and digital repositories needed to be increased. Libraries offer multiple access methods, but majority libraries provide access through on-campus access and personal devices via Wi-Fi connectivity. Even there is significant gaps in assistive technologies, creating barriers for disabled users.

- **Resources For Multidisciplinary And Flexible Learning & Online And Blended Learning:** Majority of libraries have limited access for diverse disciplines and linguistic communities and resources are not fully connected to the institutional learning management system. College libraries provide strong support for NDLI & INFLIBNET, but limited support for SWAYAM & DIKSHA.

- **Support For Teacher Training & Professional Development:** Digital libraries are increasingly vital for faculty professional development, offering diverse resources like pedagogical tools, e-books, and research databases, yet 47% of libraries report no specific provisions or responses.

- **Promotion Of Research & Innovation:** The majority of libraries (67%) have no or partial digital research tools.

- **Cultural & Linguistic Preservation:** Majority of libraries that is 66.7% are not involved in archiving the regional content, indicating weak cultural preservation efforts.

- **Challenges and Needed Support:** The biggest problems library facing are poor digital infrastructure , limited budgets, lack of digital skill among staff and students. Digital literacy programs are the most needed support, followed by financial provisions and digital infrastructure.

6. Conclusion:

Digitization of college libraries is an integral part of effective implementation of NEP 2020. While progress in library digitization supports NEP 2020 by providing inclusive access to library resources, interdisciplinary research, teaching and learning, distance learning, and cultural preservation, but challenges like poor digital infrastructure , limited budgets, lack of digital skill among staff and students hinders the process of achieving

NEP 2020 objectives. Digital literacy programs, provision of required finances and digital infrastructure are much needed to overcome the hurdles in supporting the libraries to achieve objectives of NEP 2020 through digitization of college libraries. .

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STUDENTS' PERCEPTION ON ESSENTIAL SKILLS REQUIRED FOR THE JOB MARKET

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Abstract:

Understanding students' perspectives on essential job market skills is crucial for effective career preparation. This study investigates how students perceive the importance of various skills. Through a structured survey of students from various academic disciplines, the research identifies the most valued competencies, such as problem-solving, communication, teamwork, adaptability, and domain-specific expertise. The findings highlight gaps between academic learning and industry expectations, providing insights into how students can better prepare for professional challenges. This study aims to offer recommendations for educators, policymakers, and students to bridge the skill gap and enhance career readiness. By shedding light on these perceptions, the study aims to contribute to better educational strategies that equip students for seamless transitions into their careers.

Keywords: Job Market Skills , Essential Skills, Student Perceptions, Soft skills, Technical Skills

Introduction

In a period characterized by swift technological progress and changing industry requirements, the work market has experienced considerable transformations. As students prepare to shift from academic surroundings to professional settings, their judgments of vital career skills significantly influence their readiness and success. This study article seeks to examine and evaluate university students' perceptions of the qualities they deem essential for success in the contemporary employment market.

This study has five primary objectives: to assess students' readiness for the job market, to ascertain the perceived significance of various soft and technical skills for career success, to evaluate students' proficiency in these essential skills, to examine supplementary efforts made by students to improve their employability, and to identify the main sources from which students acquire these skills.

Comprehending students' views on key abilities is crucial for personal career advancement and for educational institutions aiming to synchronize their curricula with the requirements of the professional landscape. This research seeks to illuminate students' self-evaluated readiness and the priority they assign to various skill sets, thereby addressing the disparity between educational provisions and employer demands.

This study will employ a thorough survey method to collect data from students in various disciplines and academic levels. This research will provide insights that inform educational initiatives, identifying areas where institutions can enhance support for students in achieving successful careers. This study's findings will further the discussion on improving employability and ensuring graduates possess the requisite skills to thrive in a dynamic work market.

Review of Literature:

Ahmad and Pesch (2017) conducted a study to assess the perceptions of undergraduate and MBA students regarding the skills deemed important by employers. The findings revealed that students often underestimated the importance of certain skills such as honesty, integrity, and adaptability, which were highly valued by employers. The study emphasized the need for educational institutions to bridge the gap between student perceptions and employer expectations.

Nwakanma (2024) examined the impact of career education on students' perceptions of the labor market. The study highlighted that career education plays a crucial role in equipping students with the necessary skills and

knowledge to succeed in the job market. The findings underscored the significance of career education in shaping students' understanding of employment opportunities, skills, and employability

Noori and Azmi (2021) conducted a systematic literature review and bibliometric analysis on students' perceived employability. The study identified key themes and trends in the literature, revealing that perceived employability has gained prominence in recent decades. The findings highlighted the importance of understanding students' perceptions to enhance employability and align educational programs with industry demands.

Jackson (2016): Jackson explores the concept of graduate employability by emphasizing the development of a pre-professional identity among students. The study highlights the importance of integrating career development activities into the curriculum to enhance students' readiness for the job market. The research suggests that employability is not just about acquiring skills but also about forming a professional identity that aligns with industry expectations.

Tomlinson (2017): Tomlinson examines the different forms of graduate capital—human, social, cultural, identity, and psychological and their impact on employability. The study finds that students' perceptions of essential skills are influenced by their access to these forms of capital. The research suggests that universities should focus on developing a holistic approach to employability that includes not only skill acquisition but also the enhancement of various forms of capital.

Andrews and Higson (2008): This study investigates the perceptions of graduates and employers regarding the importance of soft skills versus hard business knowledge. Andrews and Higson find that while technical knowledge is important, employers place a higher value on soft skills such as communication, teamwork, and problem-solving. The research underscores the need for educational institutions to balance the teaching of technical and soft skills to better prepare students for the job market.

Objectives of The Study:

1. To evaluate students' preparedness for entering the job market.

2. To determine the perceived importance of various soft and technical skills for career success.

3. To measure students' proficiency in key soft and technical skills.

4. To investigate additional efforts taken by students to improve employability.

5. To identify the primary sources through which students acquire these skills.

Scope of The Study:

The study aims to evaluate the importance of soft and technical skills for career success among undergraduate and postgraduate students from Commerce disciplines of the Mumbai Region. Key areas of investigation include perceived importance of skills, skill proficiency levels, learning sources, university preparedness, self-initiated efforts, and employer expectations. The study can be conducted at a specific university or national level.

Research Methodology:

Research Design: This study adopts a quantitative research approach using a survey-based descriptive research design to examine students' perceptions of the essential skills required for career success. The study focuses on the relative importance of soft skills and technical skills in employability, as perceived by university students.

Population and Sample:

Population: The target population consists of undergraduate and postgraduate students from Commerce disciplines in the Mumbai region**.**

Sample Size: The study includes 63 students who participated in the survey.

Sampling Technique: A convenience sampling method was used, allowing voluntary participation from students across different academic levels.

Data Collection Method: Primary data was collected through a **structured questionnaire** distributed via Google Forms. The questionnaire comprised both **closed-ended and Likert scale questions** to assess students' perceptions of skill importance, self-assessed proficiency, sources of skill development, and job market awareness**.**

Data Analysis Techniques: The collected data was analyzed using **descriptive and inferential statistical methods:**

- **Descriptive Statistics:** Mean, standard deviation, and frequency distribution were used to summarize students' ratings on skill importance, preparedness, and awareness.

- **Inferential Statistics:**

  ➢ **Wilcoxon Signed-Rank Test** was conducted to test the hypothesis, as the data was not normally distributed.

  ➢ **p-value interpretation** was used to determine statistical significance.

Hypothesis:

Null Hypothesis (H$_0$): Students do not perceive a significant difference in importance between soft skills and technical skills for career success.

Alternate Hypothesis (H$_1$): Students perceive soft skills as more important for career success than technical skills.

Limitations of The Study:

The study employed a convenience sampling technique, which may not provide a fully representative sample of the entire student population. As a result, the findings may be influenced by the specific characteristics of the students who participated, limiting the generalizability of the results to a broader population.

The study relies on self-reported data, which is inherently subjective and may be influenced by individual biases and perceptions. Students' self-assessments of their preparedness, skill importance, and proficiency levels may not accurately reflect their true abilities or the perspectives of employers.

Respondents may have answered questions in a manner they believe is socially acceptable or desirable, rather than providing their true opinions. This response bias could impact the accuracy of the findings, particularly in areas related to self-assessed skills and preparedness.

The study employs a cross-sectional design, capturing data at a single point in time. As a result, it does not account for changes in students' perceptions, skills, or preparedness over time. Longitudinal studies would be needed to track these changes and provide a more comprehensive understanding.

The study primarily focuses on students' perceptions and does not include the perspectives of employers. Incorporating employer feedback would provide a more holistic view of the alignment between students' perceived skills and actual industry needs.

The study primarily utilizes quantitative methods, which may not capture the depth and nuances of students' experiences and perceptions. Incorporating qualitative methods, such as interviews or focus groups, could provide richer insights and complement the quantitative findings.

Hypothesis Testing Results

Test Used	Test Statistic	p-value	Conclusion
Wilcoxon Signed-Rank Test	221.0	8.87×10^{-7}	Reject H_0 (Significant Difference)

Test Used: Wilcoxon Signed-Rank Test (since the data was not normally distributed).

Test Statistic: 221.0

p-value: 8.87×10^{-7} (which is **highly significant, p < 0.05**).

Since the **p-value is much smaller than 0.05**, we **reject the null hypothesis (H_0)**. This means there **is a significant difference** in students' perception of the importance of soft skills and technical skills.

Since the ratings for **soft skills were higher**, the results support the **alternative hypothesis (H_1): Students perceive soft skills as more important for career success than technical skills.**

Findings of The Study:

1. The study reveals that the average self-rated preparedness for entering the job market is 3.29 on a scale of 1 to 5. This indicates a moderate level of confidence among students regarding their readiness for professional careers.

2. Students were asked to rate the importance of various soft skills on a scale of 1 (Not Important) to 5 (Extremely Important). The findings underscore the critical value students place on these competencies:

    ➢ **Communication Skills:** The Average Rating was 4.10 as most students rated communication skills as 5 (extremely important), emphasizing the necessity of effective communication in professional settings.

    ➢ **Teamwork:** Teamwork was also highly rated as average 4.13, with a significant portion of students giving it a rating of 5. This reflects the importance of collaborative skills in achieving career success.

    ➢ **Adaptability:** Adaptability received a high rating of average 4.14 across respondents, indicating a strong recognition of the need for flexibility and the ability to adjust to changing work environments.

    ➢ **Problem-Solving:** Problem-solving was one of the highest-rated soft skills with an average rating of 4.14, showcasing its perceived value in addressing challenges and finding innovative solutions in the workplace.

3. Students' average awareness rating of current job market trends was 3.21 on a scale of 1 to 5. This suggests a moderate level of awareness among students regarding industry trends and demands. However, some students had low awareness levels (rated 2), pointing to the need for increased career counselling or industry exposure to help them stay informed about evolving trends.

4. Students identified various sources through which they primarily develop their skills. The findings highlight the diverse avenues for skill acquisition:

    ➢ **Online Courses & Certifications:** This was the most popular source of skill development among students, reflecting the growing trend of online learning and its accessibility.

➢ **Internships and Extracurricular Activities:** These practical experiences were also highly valued by students for their role in skill development, providing real-world exposure and hands-on learning.

➢ **University Coursework:** While some students felt that university coursework was effective in job preparation, others believed it could be improved to better align with industry requirements and practical skillsets.

5. Many students expressed the belief that universities could enhance their efforts to prepare them for the job market. The average rating for the effectiveness of university preparation was moderate, indicating room for improvement.

6. Many students reported pursuing additional certifications to enhance their employability. These certifications were often focused on developing technical skills, though some students also highlighted the importance of soft skills development. The key focus areas for extra certifications included technical skills such as programming, data analysis, and project management. Additionally, students recognized the value of soft skills like leadership and teamwork in complementing their technical expertise.

7. Students had varying opinions on whether employers value soft skills as much as technical skills. Some students believed that soft skills are equally valued by employers, recognizing the importance of effective communication, teamwork, and problem-solving in the workplace. Other students felt that technical skills hold more weight in hiring decisions, particularly in fields that require specialized technical expertise. This suggests a perceived emphasis on technical qualifications in certain industries.

These findings offer a comprehensive overview of students' perceptions of essential skills for the job market and their preparedness for entering the workforce. By identifying the areas where students feel confident and those where they seek additional support, this study provides valuable insights for educational institutions to enhance their employability initiatives and better align their programs with industry demands.

Suggestions:

To improve students' job market readiness, universities should enhance career counseling services by providing regular access to career advisors and organizing workshops on resume building and interview preparation.

Integrating soft skills training into the curriculum through dedicated courses and interactive activities can help students develop essential communication, teamwork, and problem-solving skills.

Expanding internship and work placement opportunities through industry partnerships can provide students with valuable hands-on experience.

Promoting online learning and certifications by offering financial support can help students acquire relevant technical and soft skills.

Supporting extracurricular activities and organizing competitions can foster skill development and leadership among students.

Enhancing university-industry collaboration through industry workshops and real-world projects can bridge the gap between academic learning and practical applications, making students more aware of employer expectations.

Conclusion of The Study:

This study examined students' perceptions of the essential skills required for career success, focusing on the relative importance of soft skills and technical skills. The findings provide key insights into how students evaluate their preparedness for the job market and the sources they rely on to develop these skills. Soft skills (e.g., communication, teamwork, problem-solving) were rated as highly important for career success, often

higher than technical skills. Students feel moderately prepared for entering the job market, with many relying **on** internships, online courses, and self-learning to bridge skill gaps. University coursework alone is not seen as sufficient in equipping students with job-ready skills. Employers are perceived to value both skill types**,** but there is some uncertainty about whether soft skills are equally prioritized.

While technical skills remain important, students recognize the growing role of soft skills in career success. A balanced approach that enhances both skill sets will be essential for future employability.

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PHYSICAL TRANSFORMATION TRENDS IN INDIA: THE SHIFT FROM GYM-BASED TRAINING TO HOLISTIC YOGA PRACTICES WITH RESPECT TO THE MUMBAI AREA

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Abstract

In recent years, Mumbai's urban fitness landscape has experienced a significant transformation, reflecting a broader cultural shift in India from gym-centric physical training to holistic wellness practices like yoga. This study investigates the evolving preferences among Mumbai's population, comparing traditional gym-based workouts with the increasing adoption of yoga, emphasizing sustainability, mental well-being, and long-term health benefits. Employing a mixed-method approach, the research combines survey responses from 70 individuals across diverse demographics with thematic analysis of qualitative insights. Findings reveal a growing inclination towards yoga, especially among individuals seeking stress relief, emotional balance, and accessible fitness routines. While gym workouts remain prevalent among younger adults focused on aesthetics and muscle gain, yoga is recognized as a more sustainable and mentally enriching practice. The study highlights a rising hybrid trend, where individuals integrate both gym and yoga for a balanced lifestyle. These results underline a cultural reconnection with indigenous practices and suggest a paradigm shift in urban India's fitness priorities toward holistic well-being.

Keywords: Physical Transformation, Holistic Health, Urban Fitness Trends, Mumbai Fitness Culture, Yoga vs Gym, Sustainable Fitness, Mental Well-being, Stress and Anxiety Relief.

Introduction

In the bustling streets of modern-day Mumbai, it is now common to see people starting their day with visits to the gym, joining Zumba classes, jogging in parks, or attending yoga sessions. This marks a stark contrast to the fitness habits of previous generations, for whom physical activity was seamlessly integrated into daily routines rather than treated as a distinct goal.

Over time, India's fitness culture has undergone a significant transformation, shifting from traditional practices rooted in ancient wisdom to a modern approach influenced by Western trends and a renewed interest in holistic well-being. Long before the rise of gyms and structured fitness regimes, Indians practised yoga, a discipline that dates back over 5,000 years. Medical science has long recognised the importance of cardiovascular and physical fitness in managing stress, reducing anxiety, alleviating depression, and enhancing both mental and physical well-being.

In this context, yoga emerges as a powerful and holistic solution. The word 'yoga' is derived from the Sanskrit word "yuj", meaning to unite or integrate. Yoga was not merely a physical exercise but a spiritual discipline aimed at achieving mental and emotional balance. Alongside yoga, traditional physical practices often emphasised strength, agility, discipline, and self-defence integral not just to fitness but also to the preservation of cultural heritage.

Yoga offers a wide range of benefits that extend far beyond flexibility and strength. What makes yoga even more appealing is its accessibility. Unlike expensive gym memberships or specialised fitness programmes, yoga is an affordable practice that requires minimal equipment and can be done virtually anywhere. For consistent practitioners, the benefits of yoga are not just immediate but also long-lasting. Its positive impact on overall health continues throughout life, making it not just a fitness regime but a sustainable way of living.

Objectives:

- To examine the long-term sustainability of yoga as a fitness practice compared to gym-based workouts.

- To analyze the shift in India's perception toward yoga over gym-based fitness, with specific reference to the Mumbai region.

- To study the current scenario and trends in yoga practice as compared to gym culture among urban populations.

Hypotheses:

- Yoga is perceived as more accessible and sustainable than gym-based training among respondents in the Mumbai region.

- There is a significant shift in preference among urban individuals in Mumbai from gym-based workouts to holistic yoga practices due to greater perceived benefits in mental well-being and long-term sustainability.

- There is no significant difference in perceived mental well-being, accessibility, or sustainability between yoga and gym-based fitness practices among Mumbai's urban population.

Literature Review:

Over the past two decades, India has witnessed a dynamic shift in health and wellness trends, moving from conventional gym-based training to a more integrative and mindful approach centered around yoga. Several studies have explored this transformation in the context of both global fitness trends and local cultural revival.

According to Sharma and Mehta (2019), urban populations in India initially embraced Western-style gym routines as symbols of modernity, discipline, and physical aesthetics. These gyms emphasized weight training, cardio exercises, and high-intensity interval training (HIIT) aimed at rapid physical transformation. However, as awareness about mental health, stress management, and lifestyle diseases grew, many individuals began seeking more sustainable and holistic alternatives.

A report by the Ministry of AYUSH (2020) highlights a resurgence of interest in yoga, particularly in urban centers like Mumbai, due to its combined benefits for the body, mind, and spirit. Yoga is no longer viewed merely as a spiritual or traditional practice but as a modern lifestyle solution to combat stress, anxiety, and physical ailments. Studies by Kulkarni et al. (2021) affirm that regular yoga practice improves not only flexibility and muscular strength but also emotional regulation and cognitive clarity.

Comparative studies between gym workouts and yoga practices, such as those by Patel and Rao (2022), reveal that while gym-goers often seek short-term results focused on physical appearance, yoga practitioners prioritize long-term health, emotional stability, and inner peace. Furthermore, accessibility and affordability are significant factors influencing this shift, as yoga can be practiced at home with minimal resources, whereas gym memberships can be expensive and intimidating for beginners.

In the context of Mumbai, this transition is more visible due to the city's fast-paced lifestyle and high levels of stress. Community yoga events, rooftop yoga sessions, and the increasing number of certified yoga instructors have contributed to normalizing yoga as a daily routine among various age groups. Despite the rise of yoga, there remains a segment of the population that prefers gym-based workouts, especially among younger demographics focused on bodybuilding and aesthetics. Therefore, the transformation is not absolute but indicative of a broader trend toward balance and holistic well-being.

Research Methodology:

This research on "Physical Transformation Trends in India: The Shift from Gym-Based Training to Holistic Yoga Practices with respect to the Mumbai area" adopts a mixed-method approach.

3.1 Nature of Research:

A mixed-method research design has been employed, integrating both quantitative survey data and qualitative observations to provide a comprehensive understanding of the shift from gym-based workouts to holistic yoga practices.

3.2 Primary Data Collection

Primary data was gathered through a Google Form-based questionnaire, designed to collect information on:

- Demographic factors (age, gender, occupation, etc.)
- Past and present fitness practices
- Primary reasons for choosing current fitness routines
- Preference and connection to holistic practices
- Perceptions of long-term sustainability of fitness choices

3.3 Sampling Method and Respondents

A total of 70 respondents from different parts of Mumbai participated in the survey. The sample included a diverse group of individuals, such as working professionals, homemakers, students, and others who engage in regular fitness routines.

3.4 Secondary Data Collection

Secondary data was obtained from a range of credible sources, including:

- Peer-reviewed research articles
- Government reports (especially from the Ministry of AYUSH)
- Publications from the fitness and wellness industry
- News articles and urban lifestyle journals

3.5 Data Analysis Techniques

Quantitative data from the Google Form responses were analyzed using descriptive statistics such as percentages and graphical representations to highlight trends and patterns.

Qualitative insights were interpreted through ,focusing on respondents' narratives about their shift in fitness approach and their views on sustainability and mental well-being.

Data Analysis and Findings:

This section analyzes the responses collected from 70 individuals across Mumbai on their fitness preferences, focusing on the shift from gym-based training to holistic yoga practices.

1. Demographic Profile of Respondents

- Age Distribution:
    - 18–25 years: Majority
    - 26–35 years: Moderate representation
    - Others (36+): Very few

- Gender:
  - Predominantly Male
  - Around 30–35% Female
- Occupation:
  - Students and Working Professionals form over 80% of the sample
- Area of Residence:
  - Central Mumbai: Highest
  - Western Suburbs: Second highest
  - Others: Smaller groups from South/Eastern/Navi Mumbai

2. Frequency of Physical Exercise

- Daily: ~40%
- 3–4 times a week: ~30%
- 1–2 times a week: ~10%
- Rarely/Never: ~20%

This shows that a large portion of respondents are consistently active.

3. Current Fitness Practice

- Gym-based Workout: ~40%
- Yoga: ~30%
- Both: ~20%
- None: ~10%

A clear preference for gym still exists, but a growing trend towards yoga and hybrid models is visible.

4. Past Fitness Practices

Many respondents had exposure to multiple fitness forms, including:

- Gym workouts – most common
- Running/Outdoor sports
- Yoga – showing increasing past engagement

5. Primary Reason for Current Fitness Choice

Top reasons selected (multiple choices allowed):

- Stress Relief
- Flexibility & Posture
- Weight Loss
- Muscle Gain

- Mental Health

Yoga respondents cited flexibility and stress relief more; gym-goers leaned toward weight loss and muscle gain.

6. Holistic Connection (Yoga vs. Gym)

- Strongly Agree/Agree that yoga feels more holistic: ~60%

- Neutral: ~25%

- Disagree: ~15%

Yoga is perceived as more spiritually and mentally fulfilling by a majority.

7. Sustainability of Fitness Practice

- Both Equally: ~55%

- Yoga: ~25%

- Gym: ~15%

- Not Sure: Remaining respondents

Respondents see value in both practices long-term, with yoga having a slight edge in perceived sustainability.

8. Mental and Emotional Benefits

- Yes, yoga helps more: ~70%

- Maybe: ~20%

- No: ~10%

Yoga is broadly perceived as better for emotional well-being.

9. Switching Trends

- Never Switched: ~50%

- Switched from Gym to Yoga: ~20%

- Never Tried Either: ~15%

- Yoga to Gym: Very few

There's a clear trend of gym-goers moving towards yoga, though full transitions are still limited.

10. Physical Transformation Rating

- Excellent: ~35%

- Good: ~45%

- Moderate: ~15%

- Poor/No Change: ~5%

Majority feel positively transformed by their fitness choices.

11. Yoga Recommendation

- Yes: ~40%

- Depends on Individual Goals: ~50%

- No: ~10%

While not a universal recommendation, many believe yoga is suitable depending on personal needs.

12. Qualitative Insights (Open Comments)

Some key themes from responses:

- A balanced approach (diet + exercise + mindfulness) is most effective

- Several mentioned mental calmness, reduced anxiety, and better sleep after switching to yoga

- A few recommended incorporating walking, strength training, and meditation together

Conclusion:

The research aimed to explore the evolving trends in physical fitness practices in Mumbai, with a specific focus on the shift from traditional gym-based workouts to holistic yoga practices. Based on data collected from 70 respondents, the findings reveal a significant transformation in the fitness landscape, driven by a growing awareness of mental health, lifestyle sustainability, and the need for a balanced approach to wellness. While gym workouts continue to be popular, especially among younger demographics focused on weight loss and muscle gain, yoga has emerged as a preferred alternative for many, primarily due to its emphasis on mental clarity, flexibility, stress management, and overall well-being. The hybrid approach — combining gym and yoga — is also gaining momentum, indicating a broader understanding of holistic health. A notable portion of respondents recognized yoga as more sustainable and beneficial for long-term mental and emotional health, with many indicating improved physical transformation since adopting it. The influence of social media, post-pandemic awareness, and increasing accessibility of yoga sessions through online platforms and community spaces have also contributed to this shift.

In conclusion, the fitness preferences in Mumbai are evolving beyond physical aesthetics toward a more integrative and mindful approach. Yoga, once considered niche or supplementary, is now being embraced as a primary form of exercise, especially among the urban youth and working population. This trend signals a broader cultural movement in India toward reconnecting with indigenous wellness practices, which could influence health and fitness industries in the years to come.

Suggestions & Recommendation:

- Promote Hybrid Fitness Models

- Awareness Campaigns on Holistic Health

- Incorporate Yoga in Workplaces and Educational Institutions

- Affordable and Accessible Yoga Programs

- Government Policy Support

- Training and Certification for Yoga Instructors

- Further Research on Long-Term Benefits

- Leverage Technology and Digital Platforms

- Stress the Importance of Individual Fitness Goals

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UNLOCKING ECONOMIC POTENTIAL AND REDUCTION IN CRUDE OIL IMPORTS THROUGH E20: INSIGHTS FROM BRAZIL'S ETHANOL JOURNEY

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Abstract

This research work explores the potential of E20 (20% ethanol, 80% gasoline) fuel in India as a transformative solution to economic growth, energy security, and environmental sustainability. Drawing from Brazil's successful ethanol program, the study analyses the implications of E20 fuel adoption in India for reducing crude oil imports, boosting rural economies, and meeting environmental commitments. This paper investigates the economic implications of E20 fuel adoption in India, with Brazil's long-standing ethanol program serving as a case study. This paper is an attempt to explore how India can realise similar benefits by leveraging its agricultural resources and implementing the production of E20 fuel—a blend of 20% ethanol with petrol—in a collaborative effort involving certain key stakeholders like Oil Marketing Companies (OMCs), Ethanol Producers etc. By examining the critical factors behind Brazil's success in ethanol fuel adoption, this paper provides actionable insights and recommendations for India's E20 initiative to maximise its economic and environmental benefits.

Keywords: E20, ethanol, crude oil imports, energy security, trade balance, greenhouse gas emissions.

Introduction

As countries deal with the interrelated issues of climate change, energy security, and rural economic disparity, the worldwide movement toward biofuels has accelerated. Ethanol blending has become one of the most viable and sustainable biofuel techniques for lowering greenhouse gas emissions, decreasing reliance on imported fossil fuels, and increasing rural incomes through agricultural value chains. In light of this, India has started the ambitious E20 project, which aims to blend 20% ethanol into gasoline nationally by 2025. This program claims to boost rural development and aid in the nation's energy transition in addition to being in line with environmental standards.

This research examines the economic effects of implementing E20 fuel in India, drawing significant lessons from Brazil's early adoption of ethanol. This research also investigates how India can leverage its agricultural capabilities, diversify sources for ethanol feedstock, and promote collaboration among stakeholders to achieve the objectives of the E20 initiative.

Literature Review:

Kumar, V., Kumar, S., Ajith, S., and Arul, A. (2022) examined the possibilities of ethanol as a prospective fuel for India in their chapter, emphasizing its significance in decreasing the nation's reliance on crude oil imports and addressing environmental issues. They evaluate the Indian government's policies on ethanol blending and initiatives aimed at reaching E20 (20% ethanol blended in petrol) by 2025.

Gaurav Kumar (2021) analyzes India's efforts in ethanol blending, emphasizing the financial advantages like decreased oil imports and improved energy security. The research highlights the significance of supportive tax policies and the constraints of relying on ethanol imports as a temporary solution.

Sujata & Priyanka Kaushal (2020) evaluate India's ability to achieve ethanol blending goals, taking into account aspects such as the availability of feedstock and the necessary infrastructure. The authors indicate that careful planning and investment are essential for reaching the E20 objective.

Objectives of The Study:

➢ To evaluate the economic viability of E20 fuel blending in the Indian context

➢ To assess the level of awareness, acceptance, and preferences of consumers and stakeholders

➢ To suggest policy changes tailored to India's socio-economic and agricultural landscape

Hypothesis of The Study:

H01: There is no significant difference in the level of influence of the five factors on the decision to switch to E20 fuel

HA1: There is a significant difference in the level of influence of the five factors on the decision to switch to E20 fuel

H02: There is no significant difference in the ranking of the five initiatives taken by the government to increase the usage of E20 fuel

HA2: There is a significant difference in the ranking of the five initiatives taken by the government to increase the usage of E20 fuel.

Research Design And Methodology

Research Design	Methodology
Research Approach	Mixed-method approach
Data Collection	Primary & Secondary Sources: Primary - Data collected through a questionnaire Secondary - government publications, economic reports, and peer-reviewed journal articles
Sampling Technique	Random Sampling Technique
Sample Size	264 Respondents
Data Analysis Techniques	Anova Analysis
Comparative Analysis	Based on economic indicators such as GDP contribution, employment creation, and increases in rural income

Results And Discussions

6.1 Results

H01: There is no significant difference in the level of influence of the five factors on the decision to switch to E20 fuel

HA1: There is a significant difference in the level of influence of the five factors on the decision to switch to E20 fuel

Anova: Single Factor

Rate the factors that would influence your decision to switch to E20 fuel. (On a rating Scale of Max - 5 & Min - 1)

Anova

Groups	Count	Sum	Average	Variance
[Cost of E20 fuel]	264	979	3.708333333	0.8841888466
[Environmental benefits]	264	967	3.662878788	0.9391490955
[Engine compatibility]	264	962	3.643939394	0.6560087568
[Availability of E20 Fuel]	264	1000	3.787878788	0.7304989054
[Government incentives]	264	1013	3.837121212	0.6920008065

Anova

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7.177272727	4	1.794318182	2.299319339	0.05693589057	2.378695977
Within Groups	1026.185606	1315	0.7803692822			
Total	1033.362879	1319				

Interpretation:

Accept the null hypothesis of no significant difference in the level of influence of five factors on the decision to switch to E20 fuel at a 5% level of significance, as the p-value is 0.056, more than 0.05.

The null hypothesis (H_0) is accepted since the statistical analysis shows that the p-value of 0.056 is greater than the generally accepted significance level of 0.05. This indicates that there is no statistically significant variation in the degree to which the five factors—engine compatibility, availability, government incentives, environmental advantages, and the cost of E20 gasoline—have an impact on consumers' decisions to convert to E20 fuel. Despite the fact that some criteria were given higher ratings, these variations are not statistically significant. Thus, it can be concluded that the perceived influence of each of the five elements is about the same. This implies that encouraging the use of E20 may require a balanced strategy.

H02: There is no significant difference in the ranking of the five initiatives taken by the government to increase the usage of E20 fuel

HA2: There is a significant difference in the ranking of the five initiatives taken by the government to increase the usage of E20 fuel

Rate the initiatives to be taken by the Government to increase the usage of E20 (On a rating Scale of Max - 5 & Min - 1)

Groups	Count	Sum	Average	Variance
[Implement policies encouraging E20fuel adoption]	264	956	3.621212121	0.9434266621
[Invest in infrastructure development]	264	946	3.583333333	0.7534854246
[Offer incentives for ethanol production and E20 fuel consumption]	264	1001	3.791666667	0.6522496831

[Encourage research and development in ethanol production technologies]	264	986	3.734848485	0.7126973154	
[Develop tax incentives for E20 fuel production and consumption]	264	980	3.712121212	0.8825901602	

Anova

| Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7.639393939	4	1.909848485	2.420931753	0.04664683773	2.378695977
Within Groups	1037.390152	1315	0.7888898491			
Total	1045.029545	1319				

Interpretation:

Reject the null hypothesis of no significant difference in the ranking of the five initiatives taken by the government to increase the usage of E20 fuel. And observe that "offer incentives for ethanol production and E20 fuel consumption" is the highest rated, and "Invest in infrastructure development" is the least rated.

A substantial difference in the ranking of the five government efforts aimed at boosting the use of E20 gasoline is indicated by the statistical analysis, which results in the rejection of the null hypothesis (H_0). With the highest rating among them, "offer incentives for ethanol production and E20 fuel consumption" showed that the people strongly supported financial incentives. Conversely, "invest in infrastructure development" was rated the lowest, indicating that respondents believe it to have less immediate impact. This disparity in rankings indicates varying public priorities and raises the possibility that incentive-based tactics could be a more successful way to promote the adoption of the E20.

6.2 Discussions:

6.2.1 Gender:
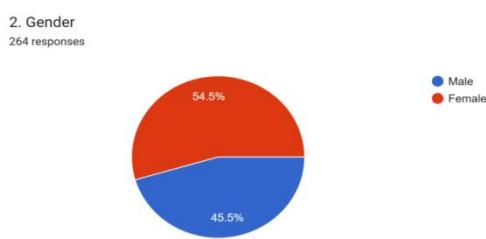
Interpretation:

According to the respondents' gender breakdown, there are somewhat more women (55.5%) than men (45.5%). With a modest female majority, this suggests that participation was fairly balanced and that conclusions from the data fairly represent the opinions of both sexes. The results are more inclusive and diversified as a result of this representation.

6.2.2 Familiarity with E20 Fuel

3. How familiar are you with E20 fuel (20% ethanol and 80% gasoline)?
264 responses

- Very familiar
- Somewhat familiar

82.2%
17.8%
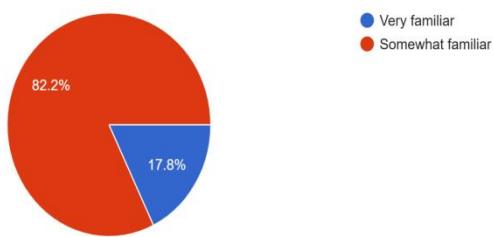
Interpretation:

According to the research, the majority of respondents—82.2%—are at least somewhat familiar with E20 fuel. This implies that people are generally aware of E20, however they may not have a thorough or technical understanding of it. However, only 17.8% of respondents said they were extremely aware with E20 gasoline, suggesting that only a tiny percentage of people are well-versed in its composition, advantages, or effects on vehicle performance and the environment. These findings can point to the necessity of additional training or public awareness initiatives to advance in-depth understanding and encourage the wise use of ethanol-blended fuels.

6.2.3 Potential Benefits of Using E20 Fuel:

5. In your opinion, what are the potential benefits of using E20 fuel? (Select all that apply)
264 responses

|	
Reduced Dependence on crude oil imports	89 (33.7%)
Lower greenhouse gas emissions	110 (41.7%)
Potential cost savings	96 (36.4%)
Improved engine performance	80 (30.3%)
	3 (1.1%)
Don't know much about the topic	1 (0.4%)
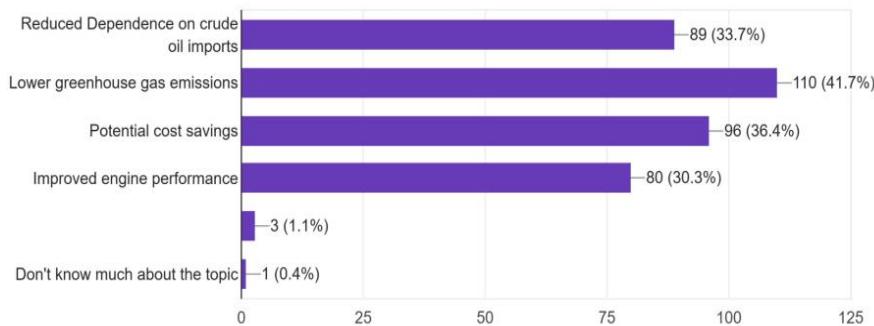
Interpretation:

According to the responses, 41.7% of participants chose reduced greenhouse gas emissions as the most well-known advantage of using E20 fuel. Potential cost savings (36.4%) and less reliance on imports of crude oil (33.7%) come next, indicating that the public is interested in both the economic and environmental benefits. At 30.3%, improved engine performance was the least mentioned advantage, which can be due to a lack of knowledge or conflicting opinions on how it affects cars. All things considered, the data shows a promising future for E20's contribution to energy independence and sustainability.

6.2.4 Factors influencing the decision to switch to renewable energy:

6. Rate the factors which would influence your decision to switch to E20 fuel? (On a rating Scale of Max - 5 & Min - 1)
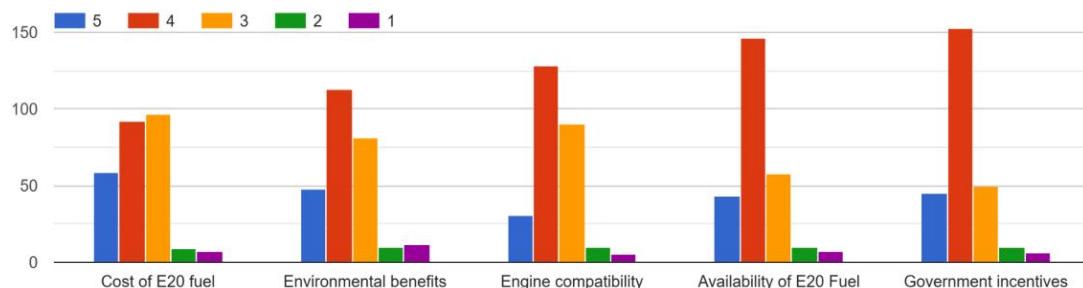
Interpretation:

According to the data, government incentives have the greatest impact on consumers' decisions to convert to E20 fuel, as evidenced by the highest number of top ratings (153). This is closely followed by engine compatibility (128) and E20 fuel availability (146), indicating that accessibility and technical viability are also important considerations. Relatively fewer high ratings were given to environmental benefits and cost, indicating that although they are significant, practical and policy-driven concerns take precedence. All things considered, infrastructure and efficient government backing seem to be essential for promoting adoption.

6.2.5 Impact of E20 on fuel cost for consumers:

7. How do you perceive the impact of E20 on fuel costs for consumers?
264 responses

- It will lower fuel costs
- It will increase fuel costs
- No impact on fuel costs

33.7%
33.7%
32.6%
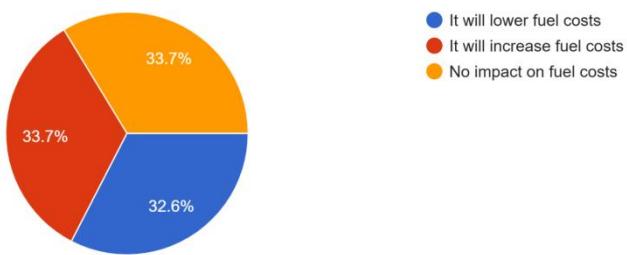
Interpretation:

The answers show that opinions on how E20 affects fuel prices are almost evenly divided. 32.6% think it will reduce expenses, 33.7% think it will have no effect, and 33.7% think it will raise costs. This suggests that customers have a great deal of ambiguity or a lack of clarity on the potential impact of E20 adoption on fuel prices.

8. Rate the initiatives to be taken by the Government to increase the usage of E20 (On a rating Scale of Max - 5 & Min - 1)
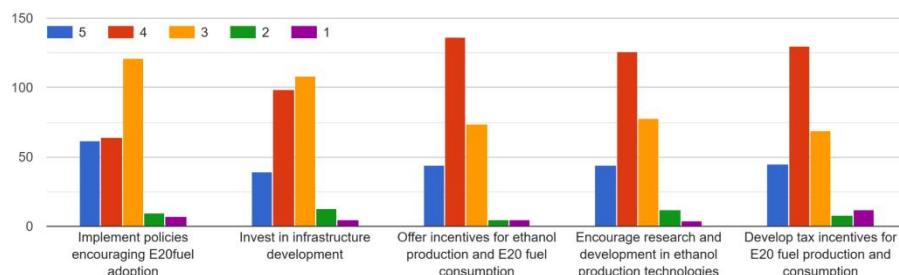
Interpretation:

According to the findings, the public strongly supports a number of government efforts aimed at increasing the use of E20 fuel. Financial and innovation-driven methods were preferred, as seen by the highest top rating (136) for providing incentives for ethanol production and E20 use, which was closely followed by creating tax incentives (130) and promoting research and development in ethanol technology (126). Infrastructure investment and adoption policy implementation also garnered a lot of support, albeit with somewhat lower top scores. Overall, the results indicate that the public prefers a multifaceted strategy that prioritizes technology advancement and incentives.

6.3 Comparative Analysis of Brazil's and India's Sustainable Journey:

Parameter	Brazil (2023)	India (2023-25 Target)	Interpretation
Ethanol Production Volume	30–35 billion litres/year	5.5 billion litres/year (2023)	Brazil is among the leading producers, while India is quickly increasing its efforts for E20 blending
Ethanol Blending Percentage (E%)	27% (flex-fuel vehicles E85–E100)	E10 (2022), E20 target by 2025	India aims for a 20% blend to decrease reliance on imports.
Number of Ethanol Refineries	400+ (majorly from sugarcane)	200+ (sugarcane, maize, grain based)	India is broadening its range of feedstocks, while Brazil primarily relies on sugarcane.
Crude Oil Import Dependency	20% of fuel from ethanol	85% dependency on crude imports	Ethanol blending can significantly reduce India's import bill.
Estimated Forex Savings	$13–15 billion/year	₹30,000 crore/year (with full E20 rollout)	The blending of E20 is anticipated to result in savings of billions in foreign currency.
GHG Emission Reduction	45-90% (vs. gasoline)	35–50% (projected)	The environmental advantages are essential to the biofuel strategies of both nations.

| Vehicles Compatible with E20/Ethanol | 80%+ Flex-fuel vehicles | E20-compatible vehicles launched in 2023 | Brazil has completely embraced flex-fuel technology; India is in the process of transitioning. |
| Job Creation in Ethanol Sector | 1.5 million jobs | Expected 1 million+ jobs by 2025 | The ethanol economy enhances job opportunities in rural areas and increases income for farmers. |

Source: Roadmap for Ethanol Blending in India 2020-25, report of the Expert Committee, Niti Aayog, Ministry of Petroleum and Natural Gas

7. Benefits To The Society

7.1 Economic Benefits of E20 Blending for India

A steady and significant domestic demand for ethanol, which is mostly made from sugarcane, maize, leftover grains, and damaged food supplies, is created by E20 blending. This would lead to enormous economic benefits of E20 blending for India, such as a decrease in imports of crude oil, enhancement of the agricultural sector, industrial development and employment creation, encouragement of private investment, sugar sector stabilisation, and macroeconomic stability.

7.2 Environmental Benefits of E20 Blending in India

Compared to traditional gasoline, ethanol, a renewable biofuel, emits substantially less carbon dioxide (CO_2). When compared to pure gasoline, using E20 can cut GHG emissions by 35–40%. This aids India in achieving its target of net-zero emissions by 2070 and upholds its climate pledges under the Paris Agreement. Greenhouse gas (GHG) emissions reduction, lower tailpipe emissions, oxygen-rich fuel for improved burning, a decrease in aromatic compounds and Sulphur, reduced toxicity and biodegradability, and utilising waste from agriculture—these all can be the subsequent environmental benefits of E20 blending in India.

7.3 Social Benefits of E20 Blending in India

E20 blending will surely lead to ample of social benefits by the end of the decade such as Farmer and Rural Community Empowerment, Creation of Jobs in Semi-Urban and Rural Areas, Improved Public Health through Cleaner Air, Reduction in Regional Disparities, Women's Participation and Livelihood Opportunities

8. Suggestions:

➢ **Ensure complete adoption of E20 by the end of 2025:** Expedite initiatives to realize 20% ethanol blending nationwide, making E20 fuel accessible at all retail outlets and promoting widespread use of vehicles designed for E20 fuel.

➢ **Broaden and Diversify Ethanol Production:** Increase ethanol production capacity beyond 1,500 crore liters while encouraging the use of second-generation ethanol derived from agricultural waste and investigating alternative feedstocks such as non-edible oilseeds, algae, and waste-to-fuel solutions.

➢ **Implement a flex-fuel vehicle policy:** Advocate for the increased adoption of flex-fuel vehicles to provide consumers with more fuel options and bolster energy independence by decreasing reliance on petroleum.

➢ **Enhance Global and Economic Standing:** Increase the potential for ethanol exports and establish India as a frontrunner in biofuel innovation through focused research and development and international partnerships.

> ➢ **Align with Long-Term Sustainability Objectives:** Prepare for higher ethanol blends (E30, E85) and support the advancement of green hydrogen, bio-CNG, and hybrid fuels to aid in India's target of net-zero emissions by 2070.

9. Conclusion

In summary, India is at a pivotal moment where embracing ethanol blending through programs like E20 not only aims to lessen reliance on crude oil imports but also reveals considerable economic opportunities in rural and agricultural areas. Taking cues from Brazil's successful ethanol experience, this transition presents a model for sustainable development, energy independence, and ecological sustainability. By promoting ethanol production and supporting rural populations, we can redefine the function of farmers—not merely as food producers (Annadatas), but as energy producers (Urjadaatas), actively contributing to the country's green energy goals and ushering in a new phase of inclusive growth. In a nutshell, incorporating E20 would enable India to mirror Brazil's achievements, thus propelling economic progress, environmental stewardship, and social advancement. This includes fortifying energy security, reducing reliance on foreign fossil fuels, championing sustainable growth, and creating job opportunities.

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INFLUENCING THE GREEN CONSUMER: EFFECTIVENESS OF DIGITAL MARKETING CAMPAIGNS FOR ECO-FRIENDLY PRODUCTS

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Abstract

As growing ecological awareness, environmentally friendly products have been attracting growing attention from consumers. The current paper seeks to explore the potential of electronic marketing campaigns in influencing consumer awareness, confidence, and purchase behavior toward green products. The research explores how influential digital marketing tools like social media, content marketing, influencer collaboration, and SEO contribute to sustainable consumption.

In order to realize these goals, primary information was gathered from a set questionnaire distributed among 100 participants in Mumbai. The statistics were processed with the help of statistical measures such as the Chi-Square Test of Independence and Analysis of Variance (ANOVA). The Chi-Square test was utilized in establishing the correlation between consumer awareness and the frequency of buying eco-friendly products, whereas ANOVA was utilized in evaluating the effect of various digital marketing tools on consumer intentions and attitudes.

The findings of this study reveal that despite the lack of significant correlation between consumer awareness and frequency of purchase, digital marketing tools have an influence over consumer perception as well as involvement towards green products. The conclusions from the study are based on practical strategies for marketers to enhance the efficacy and credibility of green campaigns carried out through digital platforms.

Keywords: digital marketing, environmental consciousness, eco-friendly, green consumer, sustainable products

1. Introduction

Reaching out to consumers through digital marketing or digital advertising has become a common practice in the digitally connected world. Unlike traditional marketing which focuses on print media, digital advertisements are placed on social media, emails, and even by search engines as well as through influencer marketing. The interaction and feedback response is immediate, giving real-time measurable metrics, which in turn enables adapting on the spot, making these campaigns even more effective in changing consumer behavior.

There is an increased focus on eco-friendly products and practices today, and with it a rise in the use of digital marketing to promote them. Campaigns target the audience based not only on the product, but also its environmental impact, carbon footprint, and ethical sourcing.

As concern for environmental sustainability grows, companies increasingly leverage digital marketing to market green products and green behaviors. Ad campaigns today focus not only on product attributes, but also on environmental consideration, carbon footprint, and ethical sourcing. This is a change in consumer behaviors, particularly among younger groups who are more environmentally aware and digitally engaged.

Online campaigns are also critical in informing consumers regarding sustainability, establishing brand trust, and impacting purchasing behavior. It may be through compelling video content, influencer marketing, or targeted emails that emphasize eco-advantages, all of which are meant to communicate with the "green consumer" on an emotional level. When done effectively, online marketing not only increases product visibility but also generates long-term brand loyalty and sustainable consumption.

2. Review of Literature:

Thomas and Iyer (2023), in their research paper examined the influence of green influencers on consumer attitude towards environmentally friendly brands. The research conducted a survey of 200 Mumbai and Bangalore college students who followed social media influencers of sustainability actively. Employing a survey-based research design, researchers utilized factor analysis and t-tests. The results indicated that influencers who expressed real environmental values considerably influenced consumers' opinions and enhanced their willingness to buy green goods.

Banerjee and Mehta (2022), in their study explored the relationship between social media engagement—likes, shares, and comments—and consumers' willingness to pay a premium for green products. With a sample of 400 users of Instagram from Mumbai and Pune, the research used a descriptive quantitative approach and applied regression analysis and descriptive statistics. Findings indicated that greater digital interaction, especially when environmental advantages were explicitly stated, reliably predicted customer willingness to spend on green options.

Kumar and Joshi (2021), conducted a descriptive study to examine the role of digital marketing in shaping green product awareness and consumer choice. The study involved a sample of 300 urban consumers from Delhi and Mumbai. Employing sequential questionnaires and Chi-square tests and regression analysis, the research found that influencer and social media campaigns significantly increased consumer awareness, but brand trust and perceived price of the product remained obstacles to purchase.

Sharma (2020), in her research was concerned with how advertising on social media promotes green behavior among Indian millennials. The research employed a sample of 250 consumers between 20–35 years of age from urban locations with a quantitative, cross-sectional design. Analytic methods like ANOVA and correlation analysis were used. The findings indicated that green ads with emotional appeal and true messaging created trust and were effective in motivating positive attitudes and purchasing intention towards sustainable products.

Gupta and Reddy (2019), in their research studied the impact of brand storytelling and informative content on consumer perception of sustainable products. An online shopper sample of 120 who had made prior purchases of sustainable products was taken. Employing in-depth interviews and thematic analysis, the study revealed that informative and transparent content had a significant impact on brand credibility and repeat purchase behavior. Content marketing, if seen as authentic and informative, encouraged commitment and aided the long-term practice of green consumerism.

3. Objectives of The Study:

1. To assess consumers' awareness and sensitivity towards green digital marketing campaigns products.

2. To investigate how often consumers buy environmentally friendly products.

3. To determine variables that enhance consumer trust in green advertising messages.

4. To suggest ways of increasing the role played by digital marketing in influencing green consumer behavior.

4. Hypotheses of The Study:

Correlation between Consumer Awareness of Eco-friendly products and frequency of purchasing.

H$_{01}$ (Null Hypothesis): There is no significant correlation between consumer awareness of eco-friendly products and frequency of purchasing them.

H$_{11}$ (Alternative Hypothesis): There exists a significant correlation between consumer awareness of eco-friendly products and frequency of purchasing them.

Influence of Digital Marketing Tools on Promoting Eco-Friendly Products

H$_{02}$ (Null Hypothesis): There is no significant effect of digital marketing tools on the promotion of green products.

H$_{12}$ (Alternative Hypothesis): There is a significant effect of digital marketing tools on the promotion of green products.

5. Research Methodology:

In this research, the information was gathered from primary and secondary sources. The primary data was gathered through the questionnaire method and the secondary data was gathered from books, newspapers, magazines and websites.

Sample Design: Convenience sampling technique was utilized in the collection of data from the respondents.

Sample Size: The sample size was 100 respondents.

Data Analysis and Interpretation The data was interpreted and analyzed through Microsoft Excel 2007.

6. Limitations of The Study:

1. The study was restricted to Mumbai City due to the constraint of time.

2. Sample size utilized for the study was limited. Therefore, results cannot be considered universal

3. The figures and data accuracy are based on the perception of the respondent.

7. Data Analysis And Interpretation:

Table 1: **Relationship between Consumer Awareness of Eco-friendly products and the frequency of purchasing.**

Awareness	Never	Rarely	Sometimes	Total
Yes	2	42	52	96
Not Sure	0	0	4	4
Total	2	42	56	100

Source: Primary Data

A Chi-Square Test of Independence was utilized to test the connection between consumer knowledge of green products and how often they buy such products.

The test provided a Chi-Square value (χ^2) of 3.27 with 2 degrees of freedom and a p-value of 0.195. As the p-value is greater than the conventional significance level of 0.05, we are unable to reject the null hypothesis.

This implies that there is no statistically significant relationship between knowing green products and the number of times they are bought, according to the sample data gathered.

Table 2: Impact of Digital Marketing Tools on the Promotion of Eco-Friendly Products

Groups	Count	Sum	Average	Variance
Have you seen digital advertisements related to eco-friendly products in the past 3 months?	100	252	2.52	0.615758
Attitudes and Intentions [I actively seek eco-friendly products online.]	100	296	2.96	1.129697
Attitudes and Intentions [Digital campaigns help me better understand the environmental impact of products.]	100	334	3.34	0.711515

Attitudes and Intentions [I am willing to pay more for products marketed as eco-friendly.]	100	324	3.24	0.951919
Attitudes and Intentions [Influencer endorsements affect my purchase decision for green products.]	100	316	3.16	0.701414
Attitudes and Intentions [I believe green marketing campaigns are often misleading.]	100	310	3.1	0.939394

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	42.37333	5	8.474667	10.06952	2.88E-09	2.229193
Within Groups	499.92	594	0.841616			
Total	542.2933	599				

The ANOVA test results showed a significant difference in consumer attitudes between various dimensions of digital marketing ($F = 10.07$, $p < 0.001$). As the F-value was higher than the critical value and the p-value was well below 0.05, the null hypothesis was rejected. This assures that digital marketing tools have a significant impact on consumer participation and eco-friendly perceptions products.

8. Recommendations

- Use **data-backed storytelling** with transparency in sourcing and production.

- Partner with **genuine influencers** who align with environmental values.

- Invest in **interactive content** (e.g., videos, quizzes, live demos).

- Provide **third-party certifications** and eco-labels.

- Monitor and analyze **engagement metrics** to refine campaigns.

Recommended Strategy: The 5E Green Digital Marketing Strategy

This strategy is structured around **five key pillars** to effectively influence green consumers:

8.1. Educate

Objective: Build awareness about the environmental impact and benefits of eco-friendly products.

Tactics:

- Create **informative content** (blogs, videos, and infographics) explaining green product features.

- Highlight certifications (e.g., FSC, Organic, and ISO 14001).

- Launch interactive webinars or reels titled *"What Makes a Product Truly Green?"*

8.2. Engage

Objective: Foster consumer interaction and emotional connection with sustainability values.

Tactics:

- Use **social media campaigns** with hashtags (e.g., #GoGreenWithUs, #EcoSmartChoice).

- Run contests (e.g., *Share your green habits*) to encourage UGC (User Generated Content).

- Partner with **eco-influencers** for authentic brand storytelling.

8.3. Empathize

Objective: Build trust by aligning with consumer values and showing brand transparency.

Tactics:

- Share behind-the-scenes content (e.g., sustainable sourcing, fair labor).
- Create **"Meet the Maker"** stories or eco-journey videos.
- Address concerns openly, especially around greenwashing.

8.4. Encourage

Objective: Motivate green purchase decisions through subtle nudges.

Tactics:

- Use **green badges or eco-labels** on product pages.
- Highlight environmental impact metrics (e.g., "You saved 10L of water by choosing this!").
- Offer **incentives** like eco-loyalty points or discounts for sustainable purchases.

8.5. Evaluate

Objective: Continuously assess campaign performance and consumer feedback.

Tactics:

- Use tools like **Google Analytics, social listening, A/B testing** to track campaign impact.
- Collect feedback via surveys or polls (e.g., "What do you look for in a green brand?")
- Refine messages based on engagement data and consumer sentiment.

Example Application

Platform	Activity
Instagram	Eco Reels + Influencer Challenges
YouTube	Explainer Videos on Sustainability
Email	Monthly Eco Tips + Product Stories
Blog	Deep dives into product lifecycle and impact
Website	Carbon footprint calculator + "Why This Product is Green" popups

9. Conclusion:

Digital marketing has a powerful role in shaping sustainable consumerism. While opportunities are vast, brands must act responsibly, ensuring that green messaging aligns with authentic practices. As green consumers become more informed and discerning, the future of digital marketing lies in balancing environmental commitment with innovative engagement. This study highlights that consumer trust, transparency, and relevance are critical in influencing green purchasing behavior. Brands that prioritize ethical storytelling, verified eco-claims, and genuine consumer interaction are more likely to build long-term loyalty. Moreover, integrating environmental values into the core of digital marketing strategies is no longer optional—it is a necessity in the evolving landscape of conscious consumption. Ultimately, the effectiveness

of digital campaigns in promoting eco-friendly products will depend on how well brands combine creativity with credibility, and purpose with performance.

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