Journal of Mines, Metals and Fuels, *71(12): 2685-2698; 2023. DOI: 10.18311/jmmf/2023/41760*

Print ISSN : 0022-2755

Journal of Mines, Metals and Fuels

Contents available at: *www.informaticsjournals.com/index.php/jmmf*

Environmental Sustainability: Harmonizing Construction Mining Industry Practices with the Implementation of Green Consumption and Sustainable Building Materials in Bangalore, India

P. Rajendra* and T. Mohanasundaram

Department of Management Studies, M. S. Ramaiah Institute of Technology (affiliated to Visvesvaraya Technological University), Bengaluru – 560054, Karnataka, India; rajendra.scorpius@gmail.com, tmohansun@gmail.com

Abstract

This research delves into the imperative of sustainable building materials, spurred by the ecological fallout from traditionally mined construction methods that inflicted harm on our shared ecosystem. As the 21st century dawned, a heightened consciousness necessitated a paradigm shift toward innovative and sustainable construction approaches, particularly in the dynamic urban landscape of Bangalore, a tier I city. The crux lies in harnessing smart, renewable, and bio-based materials, endowed with the dual prowess of carbon reduction and absorption across their lifecycle. However, the journey towards eco-friendly construction encounters barriers, ranging from limited material understanding to standardization dilemmas, the entanglement of multiple decision-makers, fiscal demands, perceived risks, and the pervasive influence of societal dynamics. Within this maze, we examine the role of green consumption goals as an instrumental variable to overcome these obstacles. Employing a carefully constructed questionnaire, data originates from 289 respondents within the construction sector in Bangalore and judgement sampling technique is used. The data are analysed using chi-square, ANOVA, correlation analysis, multiple regression. The finds showed that 38% agreed that their building material purchase decisions were influenced by social groups, while only 15% believed their decisions were unaffected by social group influence. As per Duncan Multiple Range Tests (DMRT), age plays a role in shaping individuals' perspectives and preferences related to sustainable construction practices. In summation, this exploration vigorously advocates for the expeditious adoption of sustainable construction practices, spotlighting the salience of green consumerism as an indispensable agent of change. The narrative converges on the imperative for a recalibration towards intelligent, sustainable practices a trajectory indispensable for forging an environmentally fortified future.

Keywords: *Building Material, Consumer Adoption, Environmental, Green Consumption, Smart Material Sustainable, Sustainability*

1.0 Introduction

The construction sector is striving to lessen its negative environmental impact due to pollution created by it and the ever-increasing demand for construction in urban areas. Sand mining poses a significant threat to the biodiversity of rivers and watercourses. The impact of dust emissions from quarries varies and can have differential effects on biodiversity and pollution levels. The answer to this construction pollution lies in the adoption of environmentally sustainable construction materials. The biggest drawbacks of sustainable construction materials

**Author for correspondence*

are high construction cost, climate isolation, mental opposition from occupants, environmental challenges, and potential hazards[1]. Long-run periods, poor service life, costly building construction, environmental concerns, and existing pollutants all hindered adoption[2]. Another research stated that there are five categories of obstacles investigated: government, people, knowledge & information, marketplace, and cost & risk barriers. Construction industry is one of the key driving forces of pollution in Bangalore[3].

1.1 Research Gap

This study fills gap in consumer behaviour in the sustainable building materials market in Bangalore, India, where the traditional building materials like Portland cement, sand, steel, and others are still the norm. Not many researches covered a holistic view of Bangalore's needs for sustainable construction materials to achieve green consumption, which in-turn leads to a cleaner environment and reduced ecological harm. This research article also filled the research gap by addressing adoption hurdles.

1.2 Need of the Study

Uncontrolled mining has consistently played a major role in the deterioration of natural resources, leading to increased Greenhouse Gas emissions and significantly harming the ecology and environment. Construction dust makes up 23% of the pollution in Bangalore. This is a problem because, if no action is taken, the construction industry could affect Bangalore's healthy ecological environment[4]. In constructing the building's front elevation, smart materials played a significant role in reducing energy consumption and alleviating buildings' negative impacts on the environment[5]. Sustainable construction materials should be synthesized at each step of a building's life cycle to mitigate climate, air quality, and environmental health risks. But, users must be ready to employ Sustainable and Smart Materials (SSMA) in building. Constraints such as poor willingness to pay, poor functional capacity, a paucity of sustainable items, and trouble integrating in the conventional construction have adverse influence on customers' sustainable purchasing intentions[6]. Buildings can last longer and cost less if sensors detect damage and stress in advance. This study sheds light on mitigating environmental hazards by promoting the adoption of green consumption practices and sustainable building materials in Bangalore, India.

1.3 Suitable Marketing Stratagem for Effective Sustainable and Green Smart Material

The Figure 1 offers a new method for marketing green and sustainable smart materials with an emphasis on green

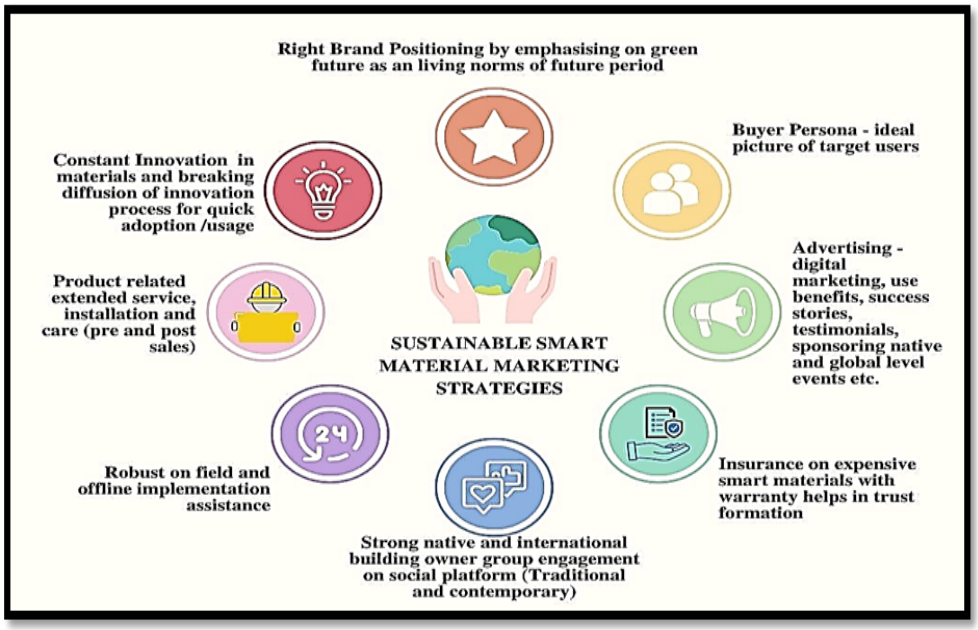

Figure 1. Marketing stratagem for promotion of green and sustainable smart materials.

consumption. Using environmental activists and a strong brand ambassador to promote these sustainable and smart materials is necessary. Promoting the awareness towards reducing the CO_2 emissions may create higher demand for sustainable construction materials.

1.4 Negative Effects of Ordinary Conventional Building Materials on Human Health and Ecosystem

Concrete mixing, concrete breaking, and hand pulverization are the top three respirable exposures, whereas hammering and shake breaking have the highest quartz presentation[7]. Even if efforts are made to reduce exposure to construction particulates, construction workers' health may still suffer. The worst-case scenario is that the construction worker passes away too soon or contracts a major disease and is hospitalized for a protracted period of time[8]. Haze has grown to be a significant source of air pollution.

2.0 Literature Review

A patented glow-in-the-dark cement (Figure 2) which is a sustainable building material and also a smart material that avoids crystalline flakes[9]. Unlike Portland cement, it is based on gel, and can be used in all types of construction, from highway roads to high rise construction structures.

2.1 Characteristics of Few Eco-Friendly Sustainable and Smart Material

Eco-friendly products possess different characteristics like renewable resources, low carbon footprint, durability,

Table 1. Characteristics of few sustainable and smart materials

Eco-friendly smart and sustainable building materials	Characteristics
Hempcrete	Reduced Co_2. Lightweight compared to conventional brick.
Bamboo	Low cost, social cohesion opportunities, local skill preservation (social benefit), and reduced CO_2.
Reclaimed wood	Decreased landfill. Reduced the use of wood by not cutting more trees for building purposes.

Figure 2. Glow in dark cement in action[9].

non-toxic, energy efficiency etc. Table 1 presents a selection of characteristics of sustainable and smart materials, highlighting their advantages in construction applications and their broader positive impact on the environment.

2.2 Role of Smart Material in Green Consumption

Environmentally friendly sustainable materials made from industrial waste (recycled) aid in lowering carbon footprints[10]. Consumers want products that are good for

Table 2. Cost-benefit analysis of conventional/traditionally mined building materials vs. Sustainable building materials

Cost-Benefit Analysis					
Conventional mined Building Material			**Sustainable Building Material**		
Factors	**Evaluation (Low/None/ High)**	**Reason**	**Factors**	**Evaluation (Low/None/ High)**	**Reason**
Labour cost	High	No need for skilled labour.	Labour cost	High	Need highly trained and skilled labourers to handle these contemporary materials.
Materials cost	Low	Popular materials, in high demand, benefit from large-scale production, reducing the per-unit cost.	Materials cost	High	Expensive as these materials are novel. Low demand leads to diseconomies of scale.
Maintenance Cost	Low	Maintenance cost is high due to low longevity.	Maintenance Cost	High	Durability and longer lifespan result in reduced maintenance costs.
Resale value of building constructed using these materials	Low	Sustainable materials have longer lifespans compared to traditional ones.	Resale value of building constructed using these materials	High	The longer life cycle of materials leads to higher resale value.
Government Incentive	None	Affordable and used in large scale and does not require any government incentives.	Government Incentive	Nominal	Some sustainable materials are attracting government incentives.
Environment benefits	None	Not eco-friendly.	Environment benefits	High	Eco-friendly. Example: Hempcrete bricks are capable of absorbing Co_2 from atmosphere.

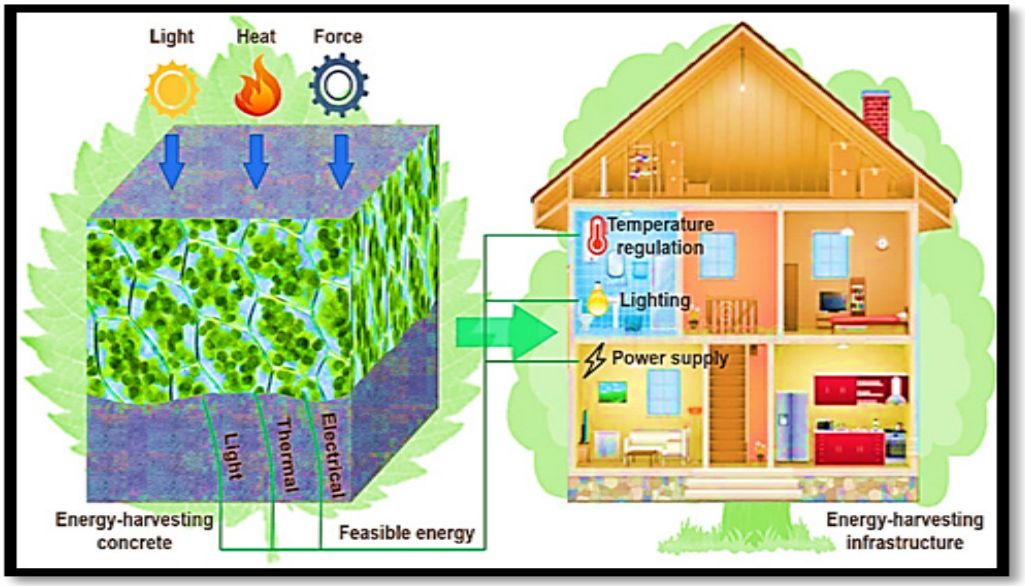

Figure 3. Cement that harvests energy and mimics an autotrophic system[11].

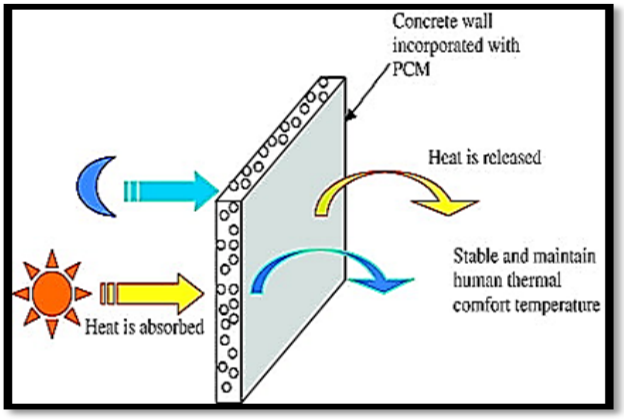

Figure 4. Concrete walls with thermal storage provide heating and cooling capabilities to maintain a pleasant interior temperature[11,12].

the environment, and laws are forcing manufacturers to think about a product's whole life when designing it. In Figures 3 and 4, energy-harvesting cement reduces the need for electricity-intensive temperature stabilizers[11,12]. Contemporary, sustainable construction materials bridge a greener future.

According to Ivanova and Smetanina's study[13], just 94 building sites in Russia have received BREEAM and LEED certification, indicating low inclination towards sustainable and green construction material adoption. Yoon[14] specified construction companies, product manufacturers, and property owners are conservative about switching to new technologies and smart materials without sufficient proven records due to the risks of disproportionately long payback periods due to higher investment, maintenance, and failure costs. The quality of labour forces in sustainable construction creates stable circumstances for protracted growth in the economy and is governed by the government[15]. The advent of "Smart Materials", which are components of a smart structural system that can detect its surroundings and function like living systems, will be crucial to the future of construction techniques[16]. Rohracher and Ornetzeder[17] points out that people understanding of sustainable buildings and their parts will affect how well they are accepted, spread, and last. Wu *et al.*[18] found that characteristics such as two types of attitude, two types of knowledge, skills, life values, age, sex, and so forth influence sustainable consumer behaviour. Education on "green attitudes and competencies" has a significant influence on people's willingness and ability to act in line with sustainable procurement standards[19].

Table 2 is focused on cost-benefit theoretical analysis which tells difference between conventional/traditionally mined building materials vs. Sustainable building materials. Figure 5 shows how mindful green consumption through the adoption of sustainable building materials

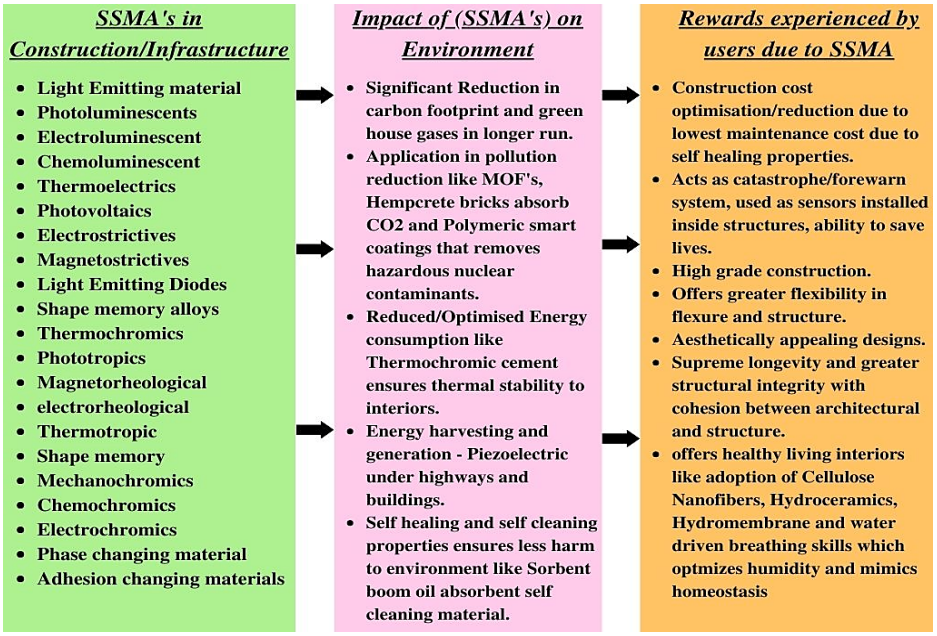

Figure 5. SSMA's effects on the environment and its rewards to consumers for choosing a green consumption in material adoption

might help the next generation with a growing population and fewer resources.

2.3 Effects of Sustainable Materials on Next Generation

Green buildings may have greater IAQ (Indoor Air Quality) than traditional structures[20]. Sustainable construction materials have the potential to improve the health and cognitive development of future generations by minimizing their exposure to potentially dangerous substances and increasing the quality of the air they breathe at home. Additionally, using sustainable materials is expected to reduce greenhouse gas emissions.

3.0 Research Methodology

A descriptive study was undertaken on the sustainable construction materials and its impact on environment. A well-structured questionnaire was used to collect the data from the construction sector consumers in Bangalore, India. The sample size in the study is 289 respondents. The responses are collected using the judgement sampling approach. The data are analysed using chi square, ANOVA, correlation analysis and multiple regression analysis.

Objectives:

- To identify level of green consumption towards sustainable materials adoption in construction sector.
- To identify critical elements/factors helping sustainable construction materials smooth adoption.
- To identify robust marketing and promotional strategies for awareness generation and smooth adoption of these materials.
- To identify relationship between perception of sustainable construction materials and factors impacting sustainable construction.

The research will propose adoption strategies while pointing customers in the direction of green consumerism and shed insight on the environmental implications of these eco-friendly smart materials. Based on the objectives, five hypotheses have been framed and they are mentioned in the data analysis and interpretation section.

3.1 Data Analysis and Interpretation

The goal of the study is to analyse and determine how green building materials consumption affects environmentally well-being in Bangalore.

Table 3. ANOVA with DMRT - Factors of Green Consumption towards sustainable construction materials adoption

H_1: There is no significant difference among age group with respect to factors of green consumption of sustainable material adoption.							
	Age Group in Years					F value	P value
Factors of sustainable construction materials adoption	**Less than 30**	**31 - 40**	**41 - 50**	**51 - 60**	**Above 60**		
Environmental Awareness	22.46^{b} (5.98)	21.67^{b} (6.04)	26.57^{c} (3.55)	20.00^{b} (12.36)	14.50^{a} (0.54)	7.49	<0.001**
Hedonic Behaviour	20.73^{b} (4.66)	20.37^{b} (3.44)	20.03^{b} (5.57)	19.33^{b} (4.11)	13.50^{a} (0.53)	5.12	<0.001**
Utilitarian Consumption	18.40^{a} (3.70)	21.70^{b} (1.96)	20.73^{b} (1.48)	22.00^{b} (0.001)	17.50^{a} (0.54)	14.18	<0.001**
Perception toward green consumption	22.59^{ab} (4.95)	22.84^{ab} (2.67)	25.30^{b} (2.15)	21.25^{a} (1.55)	23.00^{ab} (3.21)	3.01	0.019*
Awareness on Prominent sustainable construction Material	34.04^{ab} (6.85)	31.16^{ab} (9.85)	35.63^{b} (4.54)	30.00^{a} (6.18)	30.50^{a} (2.67)	3.21	0.013*
Perception toward sustainable material impact on environment	23.05^{ab} (5.11)	24.05^{ab} (2.20)	25.60^{b} (3.38)	30.00^{c} (0.01)	21.50^{a} (2.67)	8.90	<0.001**
suggested strategy/idea for sustainable Construction materials adoption	38.71^{b} (5.93)	33.72^{a} (6.93)	40.40^{b} (11.67)	48.25^{c} (1.55)	36.50^{ab} (0.54)	12.56	<0.001**
Overall green consumption towards sustainable construction material and adoption	207.24^{b} (27.99)	205.65^{b} (19.39)	221.83^{b} (17.00)	217.08^{b} (3.60)	180.00^{a} (8.55)	5.33	<0.001**

Note: the value within bracket is standard deviation; ** denoted significance at 1% level; * denoted significance at 5% level; Different alphabet among age group in years denotes significance at 5% level using DMRT.

In Table 3, all ** with DMRT: Since P value is less than 0.01, null hypotheses is rejected at 1% level with regard to factors of sustainable construction materials adoption. Hence there is significant difference among age group in years with regard to factors of sustainable construction materials adoption. Based on DMRT, the age group of 41 – 50 is significantly differ with less than 30, 31 – 40 and above 60 with respect to Environmental Awareness. In Hedonic Behaviour, the age group above 60 differs with age group less than 30, 31 – 40, 41 – 50 and 51 – 60. In Utilitarian Consumption age group less than 30 and above 60 is significantly differing with age group of 31

Table 4. Chi-square test for goodness of fit of equality level of green consumption towards sustainable material and its adoption

H_2: Level of green consumption towards sustainable impact on environment and material adoption are equally distributed.				
Level of green consumption towards sustainable material and its adoption	**Frequency**	**Percentage**	**Chi-Square value**	**P value**
Low	80	27.7	14.664	<0.001**
Moderate	127	43.9		
High	82	28.4		
Total	289	100		

Table 5. Chi-square test for association between employment type and level of green consumption towards sustainable material and its adoption

H_3: There is no association between employment type and level of green consumption towards sustainable material and its adoption						
Employment Type	**level of green consumption towards sustainable materials adoption**			**Total**	**Chi-square Value**	**P value**
	Low	**Moderate**	**High**			
Self Employed	11 (**61.1**) [13.8]	3 (16.7) [2.4]	4 (**22.2**) [4.9]	18 (100) [6.2]	32.466	<0.001**
Private Employee	58 (**29.1**) [72.5]	75 (37.7) [59.1]	66 (**33.2**) [80.5]	199 (100) [68.9]		
Government Employee	4 (**11.4**) [5]	23 (65.7) [18.1]	8 (**22.9**) [9.8]	35 (100) [12.1]		
Professional	7 (**18.9**) [8.8]	26 (70.3) [20.5]	4 (**10.8**) [4.9]	37 (100) [12.8]		
Total	80 (27.7) [100]	127 (43.9) [100]	82 (28.4) [100]	289 (100) [100]		

– 40, 41 – 50, 51 – 60. In perception toward sustainable material impact on environment age group less than 30 and 31 – 40 is significantly differing with age group of 41 – 50, 51 – 60 and above 60. In suggested strategy/idea for sustainable construction materials adoption age group

All * with DMRT: Since P value is less than 0.05, null hypotheses is rejected at 5% significance level with regards to factors of sustainable construction materials adoption. Hence there is significant difference among age group in years with regard to perception toward green consumption for less than 30, 31 – 40 and above 60 is significantly differing with 41 – 50 and 51 – 60. In Awareness on Prominent sustainable construction Material age group less than 30 and above 60 is significantly differing with age group of 31 – 40, 41 – 50, 51 – 60. Perception toward green consumption and Awareness on Prominent sustainable construction are also important as awareness acts a catalyst in establishing either constructive or obstructive perception about subject under study, the same is true here the key to stimulate favourable perception in minds of potential consumers about these sustainable materials.

In Table 4, Since P value is less than 0.01, the null hypothesis is rejected at 1% significance level. Hence concluded that level of green consumption towards sustainable material impact on environment and material adoption are not equally distributed. Based on percentage, majority of green consumption group belongs to Moderate level (43.9%).

In Table 5, Since P value is less than 0.01, the null hypothesis is rejected at 1% significance level. Hence concluded that there is association between employment type and level of green consumption towards sustainable material and its adoption. Based on row percentage 61.1% of self-employed have low level of green consumption towards sustainable material and its adoption, 22.2% of self-employed have high level of green consumption towards sustainable material and its adoption. 29.1% of private employees have low level of green consumption towards sustainable material and its adoption, 33.2% of private employees have high level of green consumption towards sustainable material and its adoption. 11.4% of government employees have low level of green consumption towards sustainable material and its adoption, 22.9% of government employees have high level of green consumption towards sustainable material and its adoption. 18.9% of professionals have low level of green consumption towards sustainable material and its adoption, 10.8% of professionals have high level of green consumption towards sustainable material and its adoption. Therefore, majority of private employees have

Table 6. Correlation analysis

H_4: There is no relationship between obstacles of green consumption adoption towards sustainable construction materials					
Obstacles of green consumption adoption towards sustainable construction materials	**EA**	**HB**	**UB**	**PTGC**	**HFSM**
Environmental Awareness	1.000	0.168**	0.431**	**0.610****	0.138**
Hedonic Behaviour	-	1.000	0.118**	0.091**	**-0.131****
Utilitarian Behaviour	-	-	1.000	**0.563****	0.154**
Perception toward green consumption	-	-	-	1.000	0.342**
Hindering/challenging factors of sustainable construction materials	-	-	-	-	1.000

high level of favourable green consumption inclination towards sustainable material and its adoption, which is immediately followed by government employees and professionals have low level inclination towards green consumption regarding sustainable material and its adoption. So focusing more on annual salary, spending index and budget of private sector a tailor-made advertisement should be like more digital advertisement, more engaging mega tie ups with private organisation and its employees for green cause related events like marathon and cleaning project etc. for attracting them and raising their level of green consumption and promoting more green certified projects held that has helped community and environment as a whole should be advertised.

In Table 6, Correlation coefficient between Environmental awareness (EA) and perception toward green consumption (PTGC) is 0.610 which indicate (0.610^2 = 0.372) 37.2 percentage positive relationship between EA and PTGC at significant level of 1%. Correlation coefficient between Utilitarian Behaviour (UB) and perception toward green consumption (PTGC) is 0.563 which indicate (0.563^2 = 0.317) 31.7 percentage positive relationship between UB and PTGC at significant level of 1%. Correlation coefficient between Hedonic Behaviour (HB) and hindering/challenging factors of sustainable construction materials (HFSM) is -0.131 which indicate (0.131^2 = -0.017) -1.7 percentage negative relationship between HB and HFSM at significant level of 1%. Suggesting that lesser environmental awareness leads to adverse outcomes in generating constructive impressions of green consumption, which leads to a lower or negative tendency to acquire sustainable material.

In Table 7, a sophisticated statistical method that enables us to assess the connection between the dependent and independent variables is multiple regression analysis. We may also predict the dependent variable from two or more independent variables due to this.

Table 7. Multiple regression analysis

$H_{5:}$ Environmental Awareness, Hedonic Behaviour, Utilitarian Consumption, Obstacles of sustainable construction materials has no impact on Perception toward green consumption.					
ANOVA					
Model	**Sum of Squares.**	**df**	**Mean Square**	**F value**	**P value**
Regression	2948.16	4	737.041	81.248	<0.001**
Residual	2576.30	284	9.071		
Total	5524.46	288			
R^2	0.534			**Adj. R^2**	0.527
Regression Coefficients					
Variables	**Unstandardized co-efficient B**	**Std. Er of B**	**Standardized co-efficient (Beta)**	**T value**	**P value**
Constant	4.076	1.349	-	3.022	0.003**
X_1	0.296	0.031	0.429	9.424	<0.001**
X_2	0.009	0.039	0.009	0.219	0.827
X_3	0.430	0.057	0.342	7.546	<0.001**
X_4	0.134	0.024	0.231	5.535	<0.001**

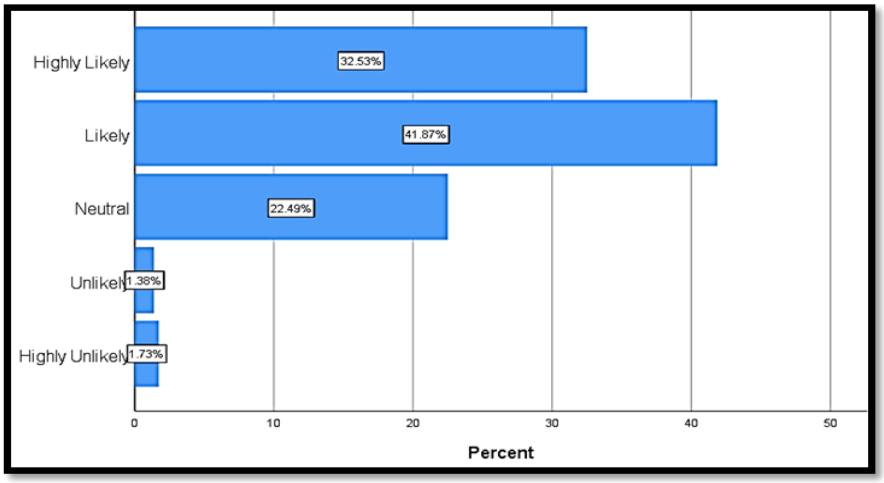

Figure 6. Post purchasing offering like free service and installation services make you feel satisfied.

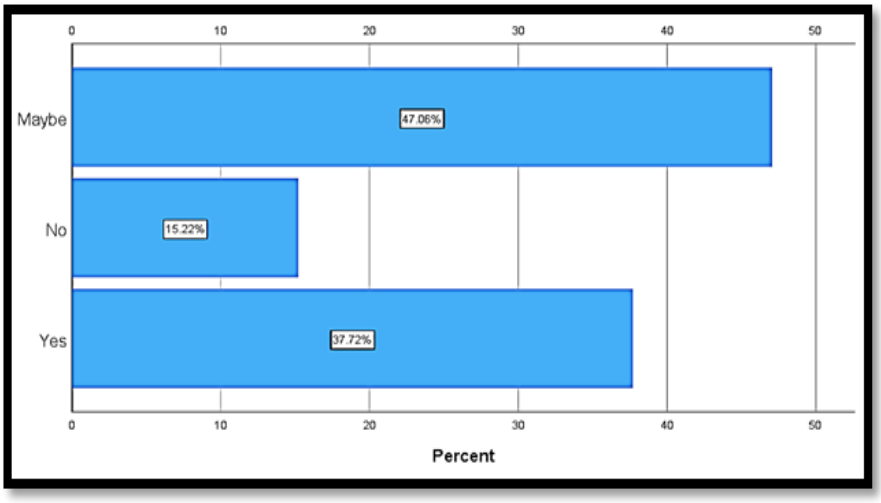

Figure 7. Purchase influenced by social group.

Perception towards green consumption (Y) = $\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e_t$ (1)

where, $(\mathbf{X_1})$ = Environmental Awareness, $(\mathbf{X_2})$ = Hedonic Behaviour, $(\mathbf{X_3})$ = Utilitarian Consumption, $(\mathbf{X_4})$ = Hindering factors of sustainable construction materials.

The outcome demonstrates the statistical significance of the entire regression analysis. The model appears to be fit quite well, as evidenced by the R2 value of 0.534. The model accurately reflects the 53.4 percent of variation in perceptions of green consumption that can be accounted for by the selected factors. Exactly one of the four independent factors used in the study are not statistically significant that is hedonic behaviour. Thus, the environmental awareness aspect variables are proved to be significantly influencing the perceptions of green consumption. The positive and statistically significant coefficient of X_1 indicates that changes in environmental consciousness have an effect on overall views of green consumption, which may influence propensity toward sustainable material consumption. The positive and significant coefficient of X_3 shows that utilitarian consumption allows consumers to evaluate

the value of a sustainable building material from many angles, including cost, life cycle, functionality, and many other aspects that impact consumption. As a result, taking these economic variables into account is extremely important in maintaining sustainable smart materials sales. The significant co-efficient of X_4 indicates that hindering factors of sustainable construction materials has an adverse impact on consumer behavioural related consumption reasons like lack of proper promotion, poor awareness on these sustainable material, lack of availability, requirement of highly skilled labourers, low demand from users and not many producers of these materials factors result in acting as detrimental factor in sustainable consumption choice in construction sector.

As shown in Figure 6, 41.8% of respondents indicated a likelihood of being satisfied with free sustainable material installation services, while 32.53% were highly likely to be satisfied with post-purchase offerings such as free service and installation services. Only 3% of respondents expressed doubts or strong reservations about being satisfied with these post-purchase services.

Figure 7 demonstrates uncertainty regarding the influence of social groups on green consumption decisions, as indicated by most respondents. Approximately 38% agreed that their building material purchase decisions were influenced by social groups, while only 15% believed their decisions were unaffected by social group influence. This suggests a notable impact of social groups on the majority of consumers' purchase decisions.

3.2 Discussions and Suggestions

The barricading factors played a major role in deciding the future course of consumption related to sustainable construction material in construction sector, with rural Bangalore having slightly lesser awareness than urban Bangalore. Rural consumers' inclination towards environment played a vital role in deciding next level strategy, with 53.29% believing that construction sector will be controlled by sustainable material. Additionally, 46.3% were aware about pollutions happening around them. All strategies suggested for sustainable construction material adoption were highly agreed by respondents, with 81% indicating offering warranty on these sustainable materials will make potential consumers consider repurchasing. However, not many producers are manufacturing these materials due to low demand, low awareness, and low margin for producers due to few units cost very high and not economical to produce. Construction materials mining firms should swiftly embrace innovative extraction methods to reduce environmental disruption. Simultaneously, implementing rigorous environmental regulations and compliance measures is crucial to guarantee responsible mining practices and construction activities.

4.0 Limitations

The study provides valuable insights into the subject matter, yet there's an opportunity for further enhancement by incorporating additional models related to consumer behaviour adoption. To address this gap, forthcoming research intends to delve deeper by exploring these models, leveraging a more extensive sample size to ensure a robust and comprehensive analysis.

In its current form, the research has successfully conducted a qualitative cost-benefit analysis. However, it's essential to acknowledge the limitations within this approach, which warrant a more expansive examination. Consequently, a dedicated effort will be made in future research endeavors to undertake a more detailed and comprehensive analysis, combining both quantitative and qualitative methodologies. This subsequent research aims to thoroughly address these limitations, providing a more comprehensive understanding of the subject matter by incorporating a wider array of analytical tools and a more extensive dataset.

5.0 Conclusion and Policy Implications

According to respondents, sustainable building materials will dominate the construction industry in the future. Due to the fact that sustainable material creation is not adequate to solve environmental challenges, consumers are becoming aware of the irreversible scarring caused by traditional building materials. The construction industry must change its perspective on the adoption of sustainable building materials, as adoption is dependent on customers. Appropriate tactics like sustainable material installation

services, offering government-backed certifications, providing insurance on sustainable construction materials, and using social group influence, etc. discovered in this study will allow fast and seamless adoption of sustainable materials by creating a complementary mentality that raises environmental awareness, promotes sustainable living, and encourages green consumption. Consumers should also be conditioned through key behavioural formation techniques to avoid critical social influence from peers, the public, and family members in the form of negative perceived benefit descriptions or falsified user testimonials that may affect their green consumption adoption intent. Segmenting and targeting customers based on green consumption inclination, degree of environmental awareness, and adopter category may effectively plan survey results to increase green building material consumption in Tier 1 cities like Bangalore. This study offers adequate reasons to enhance regulatory frameworks to prioritize sustainable practices in mining and construction, emphasizing the utilization of eco-friendly materials, responsible extraction techniques, and effective waste management strategies. Further, the study recommends allocating funds toward research and development initiatives focused on uncovering and advancing more sustainable technologies for both mining and construction practices.

6.0 References

1. Shan M, Gang HB, Wong KSN. A preliminary investigation of underground residential buildings: Advantages, disadvantages, and critical risks. Tunn Undergr Sp Technol. 2017 Nov; 70:19-29. https://doi.org/10.1016/J.TUST.2017.07.004
2. Mahmoudian M, Sharifikheirabadi P. Uses of new/smart materials in the green building with sustainability concerns. Int Transact J Eng Manage Appl Sci Technol. 2019 Nov; 11(3). https://doi.org/10.14456/ITJEMAST.2020.56
3. Nikyema GA, Blouin VY. Barriers to the adoption of green building materials and technologies in developing countries: The case of Burkina Faso. IOP Conf Ser Earth Environ Sci. 2020 Jan 1; 410(1). https://iopscience.iop.org/article/10.1088/1755-1315/410/1/012079
4. Guttikunda SK, Nishadh KA, Gota S, Singh P, Chanda A, Jawahar P, *et al*. Air quality, emissions, and source contributions analysis for the Greater Bengaluru region of India. Atmos Pollut Res. 2019 May; 10(3):941-53. https://doi.org/10.1016/j.apr.2019.01.002
5. Balali A, Valipour A. Identification and selection of building façade's smart materials according to sustainable development goals. Sustain Mater Technol. 2020 Dec; 26. https://doi.org/10.1016/j.susmat.2020.e00213
6. Nath V, Agrawal R. Barriers to consumer adoption of sustainable products – An empirical analysis. Soc Responsib J. 2022; 19(5):858-84. https://doi.org/10.1108/SRJ-12-2020-0495
7. Li CZ, Zhao Y, Xu X. Investigation of dust exposure and control practices in the construction industry: Implications for cleaner production. J Clean Prod. 2019 Aug; 227:810-24. https://doi.org/10.1016/j.jclepro.2019.04.174
8. Cheriyan D, Ho CJ. A review of research on particulate matter pollution in the construction industry. J Clean Prod. 2020 May; 254. https://doi.org/10.1016/j.jclepro.2020.120077
9. Rubio JC. Mexican scientist creates glow-in-the-dark cement — Global construction review [internet]. 2016. Available from: https://www.globalconstructionreview.com/mexican-scientist-creates-glo7w-da7rk/
10. Patil M, Boraste S, Minde P. A comprehensive review on emerging trends in smart green building technologies and sustainable materials. Materials Today: Proceedings. 2022 Jan; 65:1813-22. https://doi.org/10.1016/j.matpr.2022.04.866
11. Wang X, Dong S, Ashour A, Han B. Energy-harvesting concrete for smart and sustainable infrastructures. J Mater Sci. 2021 Jul; 56:16243-77. https://doi.org/10.1007/s10853-021-06322-1
12. Ling TC, Poon CS. Use of phase change materials for thermal energy storage in concrete: An overview. Constr Build Mater. 2013 Sep; 46:55-62. https://doi.org/10.1016/j.conbuildmat.2013.04.031
13. Ivanova Z, Smetanina T. Research into behaviour patterns typical for consumers of construction material as the mission of ecological management. MATEC Web Conferences. 2016 Aug; 73. https://doi.org/10.1051/matecconf/20167307024
14. Yoon J. Sustainability assessment of smart materials in buildings. Mater Sci Forum. 2018 Aug; 940:133-40.
15. Dudin M, Sekerin VD, Dudin MN, Gorokhova AE, Shibanikhin EA, Balkizov MH. Green building: Technologies, prospects, investment attractiveness. Int J Civ Eng Technol. 2018 Jan; 9(1):657-66. t http://http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=9&IType=1

16. Mohamed ASY. Smart Materials Innovative Technologies in architecture; Towards Innovative design paradigm. Energy Procedia. 2017 Jun; 115:139-54. https://doi.org/10.1016/j.egypro.2017.05.014
17. Rohracher H, Ornetzeder M. Green buildings in context: Improving social learning processes between users and producerst. Built Environ. 2015; 28(1):73–84. http://www.jstor.org/stable/23288552
18. Sheng WC, Xia ZX, Song M. Sustainable consumer behavior in China: An empirical analysis from the Midwest regions. J Clean Prod. 2016 Oct; 134:147-65. https://doi.org/10.1016/j.jclepro.2015.06.057
19. Bucea-Manea-ţoniş R, Martins OMD, Ilic D, Belous M, Bucea-Manea-ţoniş R, Braicu C, *et al*. Green and sustainable public procurement—An instrument for nudging consumer behavior. A case study on Romanian green public agriculture across different sectors of activity. Sustainability. 2021; 13(1):12. https://doi.org/10.3390/su13010012
20. Steinemann A, Wargocki P, Rismanchi B. Ten questions concerning green buildings and indoor air quality. Build Environ. 2017 Feb; 112:351-8. https://doi.org/10.1016/j.buildenv.2016.11.010