



Sustainability Study of Green Buildings in India – through PESTLE and SWOC Analysis

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Abstract: This research paper conducts a sustainability study of green buildings in India using a combined analysis of the PESTLE (Political, Economic, Social, Technological, Legal, and Environmental) and SWOC (Strengths, Weaknesses, Opportunities, and Challenges) frameworks. The objective is to assess the current state of green building practices in India, identify the key factors influencing their adoption and implementation, and evaluate their overall sustainability performance. The study utilizes both primary and secondary data sources, including interviews, surveys, and literature review, to provide insights into the political, economic, social, technological, legal, and environmental aspects related to green buildings in India. The findings highlight the strengths, weaknesses, opportunities, and challenges associated with green building practices and offer recommendations for enhancing their sustainability in the Indian context.

Keywords: Green Buildings, GRIHA, Sustainable Construction, IGBC, LEED, PESTLE Analysis.

1. Introduction:

India is a country of variety of historical buildings. The great monuments (e.g. Hawa Mahal, Gol Gumbaz, Taj Mahal, Agra Fort etc.) of our country proudly depict the usage of various renewable sources at their optimum level. The structures of these buildings were designed in a way that the natural habitations around them were not disturbed. Along with the development of civilization, tradition and culture in India, their dwellings also got modernized. The advancements in technology and trends increased industrialization and urbanization. The robust increase in the population of India and the growth in GDP have brought in very rapid increases in the demand for buildings. This in turn builds pressure on the availability of resources. Buildings interact with the environment in various ways by consuming resources in the form of energy, water, materials etc., also emit wastes directly or indirectly. The Indian real estate sector can be bifurcated into its sub-sectors like residential, commercial retail and hospitality sectors. It has been receiving a huge FDI flow and expect that it will attract more foreign investment especially in urban areas. The Indian Construction industry plays a very important role in its economy contributing to an average 6.5% of the GDP. Commercial and residential sectors are the major market for the construction industry. [1]

India has a rich tradition and history in holistic buildings construction. Some local initiatives are promoting sustainable buildings but there is no coordinated approach to address the wide sustainable building agenda. The actions and reactions of the construction industry towards sustainable construction have a major impact on defining the foundation for developing and carrying out a strategic plan of sustainable buildings, and these sustainable practices are influenced by the size of the firm and its major business [2]. Making the built environment sustainable is a driver in the construction industry to achieve social and environmental goals. The important aspects of sustainable design and construction include conservation of non-renewable resources, improving indoor environmental quality and environmental conservation and waste management. [3]

2. Objectives of the study

- To make an overview of the development of sustainable building in India.
- To study the role and involvement of green building rating agencies of India.
- To analyze the strengths and weakness of green buildings and to understand their prospects.
- To arrive at some strategic solutions to make green buildings more popular in India

3. Methodology

This study is conducted through a comprehensive review of the literature published in various national and international journals over ten years. It also relies on the websites of green building rating agencies operating in India and some other developed countries. Informal discussions were also done with some active persons involved in the real estate industry.

In this study, Green buildings are considered as a part of the construction industry, and to analyze and understand the micro and macro utilities and impact of them, two important strategic analytic tools are applied, they are;

SWOC- Strengths, Weakness, Opportunities and Challenges.

PESTLE – Political, Economic, Social, Technological, Legal and Environmental.

These two techniques shall help the construction industries to improvise their strategies and popularize green buildings in India. It shall also help the researchers to find out new ways to implement green buildings to the individual properties.

4. Sustainable (Green) buildings.

Green building or green construction refers to the environmentally responsible and resource- efficient process of constructions right from sitting to design, operation, maintenance, renovation and demolition. It can only be achieved through close cooperation of the design team, the architects, the engineers and the clients. Green building is a broader concept as it concerns with not only economy, utility, durability, and comfort but also the socio-environmental impact of the building. The existing buildings account for more than 40% of the world's total primary energy consumption and 24% of global carbon dioxide emissions, as per International Energy Agency's publication. [4] The building and the construction sector being the largest consumer of natural resources in the form of land use and material extraction creates wide anthropogenic impacts on the environment. As such, construction industries view Green building as a method of protecting natural capital and remediating the environmental impacts of the building by merging the priorities of economic prosperity, environmental quality and social equity. Globally several techniques have evolved, different methods are followed, different mechanisms have been invented to introduce and develop the green buildings. [5]

Green buildings are considered as a boon to mankind while they make the living spaces quite efficient, healthy, and sustainable; they also cause less harm to the planet and increase the occupant wellness and satisfaction. Green buildings mainly benefit through reduced energy consumption using more efficient appliances, water and waste management by recycling and composting. These buildings release fewer greenhouse gases throughout their life cycle. They also try to use more natural light and air, which in turn improves the indoor air quality. [6]

Similar concept to green building is natural building. It is usually carried out on a small scale and focuses mainly on using naturally available local materials that do not cause more harm to nature.

[7] our traditional Indian homes are examples of these natural houses, use of thatched roofs in summer, ice homes (igloo), using of earthen pots, limestone and salt for natural refrigeration, reusing the degradable waste of plants

and trees, recycling of used water by disposing them to plants and trees. This concept is being utilized by some of the resorts and hospitality industries to save cost and attract nature lovers. [8] One more type of sustainable buildings is Zero – energy buildings that can be defined as buildings that produce as much energy as they consume over a full year. Usage of solar rooftops, installing of windmills etc. can be considered as some options for Zero energy buildings.

5. Green Building Revolution in India.

As many as twenty-three developed countries have already implemented their green building guidelines. Most of the developing nations are undertaking the framework of green buildings for their built environment but are facing the issue of non-uniformity of sustainability practices. Hence the adoption of guidelines comes as a rescue to these countries. Still, a lot needs to be worked out on implementation strategies as rapid adoption of standard green building guidelines is the need of the hour. India has been witnessing a major trend in the context of green buildings since 2001. But the Indian construction industries rate of adoption to green building guidelines is very poor. [9]

The Indian Green Building Council (IGBC), was formed in the year 2001, as a part of CII (Confederation of Indian Industry). The vision of the council is “to enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025”. [10] The council provides services including developing of new green building rating programs, certification services and green building training programs. It works with several state and central government, world green building council, bilateral, multilateral agencies in promoting green building concepts in the country.

The environmental pressure coupled with a rapidly changing climate is being addressed by the policymakers at various levels. Considering all these, to enhance the use of renewable and recycled resources by the building sector, TERI has played a crucial role. GRIHA has been set up to converge various initiatives, essential for effective implementation and mainstreaming of sustainable habitats in India and minimize overall ecological impact to a certain nationally acceptable limits/ benchmarks. [11] Green building movement in India was triggered with CII-Sorabjee Godrej Green Business Centre building in Hyderabad being awarded the prestigious Platinum rated green Building rating in India. Today most of the large building are going green from IT parks to the commercial and residential complex, from airports to government offices etc. [12] EDGE Program in India: the IFC, a member of WB group, and the Confederation of Real Estate Developers' Association of India (CREDAI), an apex body of Private real estate developers, have partnered to promote green buildings in the country through IFC's EDGE certification. [12] Indira Prayavaran Bhavan constructed at Delhi is a Zero- energy building and many such green buildings have been built in India. [13]

India has come up with policy initiatives to mainstream energy efficiency and green buildings such as control and regulatory instruments, including appliances, standards, mandatory labelling and certification, energy efficiency obligations. Some of these initiatives are;

- Energy conservation building code, 2007
- Ministry of Environment and Forest (MOEF), Environment Impact Assessment (EIA) and clearance for the built-up area above 20000 square feet. [1]
- Indian Green building council is set up to promote and administer green building rating tools to encourage industry to exceed the requirements of local building codes. [5]
- Sustainable Habitat Mission under National Action Plan, on climate change
- Sample buildings are been built both from residential and commercial sectors and have been built employing the principles of sustainability and representatives from all climatic zones will be selected for understanding these structures. [1]

6. Green Building Rating Systems in India.

Green buildings rating helps in increasing the sustainable construction practices and thus reduces the environmental impacts of the buildings throughout their life cycle from design to demolition. Some of the rating systems in India are IGBC rating systems, LEED certification and GRIHA rating and EDGE certification. [14]

6.1 IGBC rating system:

These rating systems are based on the Panchabhutas i.e., five elements of nature and blended with modern architecture and technological innovations. IGBC rating systems are voluntary, market-driven programs, for which the builder has to register with IGBC. The rating systems apply to all climatic zones in India. Different kinds of buildings are given different ratings such as IGBC Green Homes, IGBC Green Schools, IGBC Green SEZs, IGBC Green Existing buildings and so on. [10]

6.2 BEE (Bureau of Energy Efficiency):

BEE is a national statutory energy conservation body under the power ministry established in the year 2002. It provides the relevant codes and star rating program to encourage energy-efficient buildings through ECBC (Energy Conservation Building Code).

6.3 LEED certification:

LEED stands for Leadership in Energy and Environmental Design and is an independent third party verification rating system. [16] LEED India is a rating system especially for commercial buildings. All the LEED certificates are provided by GBCI (Green Building Certification Institute) which was earlier given by IGBC. This collection includes LEED India Projects including those registered & certified by the IGBC. [17]

6.4 GRIHA Rating:

GRIHA is an acronym for Green Rating for Integrated Habitat Assessment, it's derived from the Sanskrit word which means 'Abode'. The rating system is based on the national and international established and accepted principles that help to evaluate the buildings environmental performance throughout its life cycle. The GRIHA rating system uses qualitative and quantitative assessment methods to rate the buildings on the degree of its greenness and also has been adopted by the Ministry of New and Renewable Energy. [11]

6.5 EDGE Certification:

In India EDGE certificates are provided by GBCI. It empowers the sustainable real estate construction. It motivates the builders in going for green buildings by demonstrating the uses of various green materials and training; it also assists builders to promote their green buildings. EDGE certification helps builders to be at the forefront in the green building trend. [18]

7. SWOC Analysis.

SWOC analysis is a system adopted to understand the internal and external factors affecting the overall business, product, or strategies so as facilitate proper planning and decision making. SWOC stands for Strength, weakness opportunities and challenges. [19] The following figure shows the SWOC of the green buildings in India.



Figure 1: SWOC Analysis of Green Buildings in India.

Note: These factors/inputs are extracted from the review of various research papers and the websites of green buildings rating agencies.

7.1 Interpretation:

As mentioned in the US Green Building Council Report, a green building (LEED-certified) building uses 32% less electricity, which leads to on an average reduction in CO₂ emissions up to 350 metric tons annually. [20][21] No doubt the developed countries are all reaping the benefits of green buildings, but in a developing nation like India, it is difficult to convince people like the benefits of green buildings are arrived only after occupancy, whereas the cost is to be incurred at the initial stages only.

Indian urban population is mostly made up of migrators from rural areas that come seeking jobs. They prefer affordable houses, and green buildings are far away from their reach. Though green constructions are need of the hour, they are not properly accepted. The Indian construction industry, though commands the second place in employment generation, the majority of these workers are unskilled. They are unaware of the green products and their utility. Only the drawings or the plans are taken from qualified engineers merely for getting permission to build, the final buildings are nowhere near to the actual plan. Though building and owning a house is considered to be a huge achievement in one's lifetime, people always want to compromise for cheaper materials. Green materials availability and the cost, both stand as a barrier.

There are various benefits of green buildings like reducing material waste, utilizing the limited space at disposal, waste management, using recycled materials, limited energy consumption, and positive impact on occupant health. Green buildings are rich with features like natural lighting and ventilation, accessibility to outdoor sounds and use of indoor plants provide a better indoor working environment making them more productive. [22]

Some of the barriers for sustainable construction industries are; Lack of financial incentives, lack of integrated design, affordability, company's tax reduction incentives, and key government policy to promote sustainability. [2] The challenge for sustainable building movement in India is linking the design with the actual building. India is expected to be the destination for green materials and products, as there is enormous of potential for materials like fly ash cement, fly ash blocks, recycled aluminums, steel and tiles, roof paints etc. [16] The usage of limestones in the buildings helps to reduce the impact of carbon emission and limestone is available in India at a considerably lower rate. [23]

Green building movement in India faces a major challenge of fulfilling (realizing) the design intent of such buildings. [24] One more challenge is to quantify the benefits gained from the indoor quality, though it has a greater impact on green buildings. A detailed quantitative cost-benefit analysis of the buildings would be a time-consuming process. Several intangible factors cannot be expressed or quantified and hence cannot validate the green building benefits. [25]

8. PESTLE Analysis of Green Buildings in India.

PESTLE is an abbreviation, (Political, Economic, Social, Technological Environmental and Legal) sometimes referred to as PEST is an analysis technique used by the organization/ industry to understand the environment they are working in. This technique gives a comprehensive and more detailed understanding of the SWOC of the organization /product/ or industry. PESTLE analysis gives a bird's eye view of the political, economic, social, technological, legal and environmental factors. [26] The detailed understanding of these crucial factors further assists in framing policies and strategies, knowing the favorable and unfavorable conditions in the environment, developing more better ways to market the product. In this paper, PESTLE analysis shall help us in understanding the current Indian real estate environment and help the builders/ construction agencies to develop strategies to increase green buildings in India. Furthermore, it shall also motivate potential investors to invest in green constructions.

Table 1: Table Representing the PESTLE Analysis of the Green Buildings in INDIA

<p>Political factors</p> <ul style="list-style-type: none"> • Too much political interference and influence. 	<ul style="list-style-type: none"> • Politicians are limited by their office tenure.
<ul style="list-style-type: none"> • Government has made all the new buildings to compulsory three-star rated GRIHA buildings • IGBC has been established to motivate and guide the green construction. • Not much encouragement to green material manufacturers. • Many guidelines but No legislation for green buildings. <p>Economical factors</p> <ul style="list-style-type: none"> • Increase in urban population leading to higher demand for houses, whereas the land is scarce. <p>Social factors</p> <ul style="list-style-type: none"> • For Indians houses are meant to be a status and religious symbol, hence prefer more lavish things. • People are reluctant to adopt GB unless it is mandated. • Health has become a growing concern in the urban areas hence people prefer homes with more natural light and heat. 	<ul style="list-style-type: none"> • Green building rating systems are introduced by Govt. • The construction industry is the second highest contributor to GDP • No financial incentives, tax rebate, credit enhancement etc. • Volatile interest and inflation rates. • 100% FDI allowed in the construction industry. • More demand for affordable houses and greenhouses are on the premium side. • Labour migration is a common phenomenon, so investments in houses are often delayed. • Industrial areas are featured with More slums in urban areas green buildings is difficult. • Green buildings require lots of green resources or recycled materials that are scarce and highly priced. • Some recycled materials don't give a good look. • Changing climatic conditions, pose a great challenge to green buildings.
<ul style="list-style-type: none"> • Traditional Indian Vastushastra is more based on the direction of wind, light and rain. • Indians cultural, social and lifestyle has changed drastically. • Indians traditionally like to use wood in abundance in the house construction. • Many people migrate to urban areas only for jobs and wish to settle back in their villages; hence do not prefer investing more into houses. <p>Environmental factors:</p> <ul style="list-style-type: none"> • Indian climate is mixed having very hot and humid areas to severe cold and dry areas; hence standardisation on 	<ul style="list-style-type: none"> • Nature lovers seek solace in the natural environment. • Green buildings help to increase the life expectancy of the buildings • Most of our traditional and rural structure follows green architecture.

Technological factors

- Some technological advancement has harmed the environment.
- No proper guidance is available on Green technology.
- Much more innovations are made in green buildings.
- Green technology equipment is not affordable.
- Green building and green building equipment's require skilled and technical labour, which is scarce in our country.
- Most green building dwellers are not aware of using these types of equipment to their full potential.
- Modern standardized building materials are not responsive to local conditions.
- Rapid and robust technological advancement, make every technology out-dated very soon.

Legal factors:

- Many regulatory frameworks to control environmental degradation, but not all are legislated.
- RERA is set up to regulate the real estate business but not the technology
- No legislation passed for mandating green requirements in the buildings.
- Every municipal corporation has its own rules, no uniformity for green buildings.
- No penalty is levied for violating the environmental laws on the house dwellers or constructors.
- No strict regulations for adopting green technology, green materials etc.
- Lots of illegal mining and transfer of materials is a common phenomenon.

Note: These factors/inputs are extracted from the review of various research papers and the websites of green buildings rating agencies.

8.1 Discussion/Interpretation:

Current Indian political system imparts both favourable and unfavourable effects for promoting sustainable buildings. However, GOI has taken many initiatives to promote sustainable development in India. Green buildings are a part of the Sustainable India Mission. The construction industry is growing rapidly due to many growth drivers, but sustainable construction needs proper policies and legislations. GOI has already mandated all new Govt. buildings to be GRIHA 3 star rated ones. But some significant measures to boost are necessary for the real estate developers and construction companies to go for green constructions.

Being the second-largest employer and the second-highest FDI receiver, economically the construction industry is on the forefront. [27] Some economic measures like providing financial incentives, tax rebates, and bank credits would spur the green buildings in the nation.

Indians are always nature lovers. Most of our rural population have been practising sustainability from ages and follow till now. Today's generation has become more aware of the environment and planet degradation. Indian society has started to march towards green India but lacks community motivation and integrity. Indian climatic conditions are varying from very hot and dry to very cold and humid. The characteristics of each climate are different. Three prominent climate zones are composite, hot, and dry and moderate. [1] Because of the difference in climatic conditions, we need to have a different set of standards of green buildings.

Lots of sustainable technologies have been developed, but the cost of green technologies and equipment are predominantly high. People lack direction, incentives, and motivation to adapt to these technologies. As the demand for buildings rises, we see a commercial lobby and exploitation in both rural and urban areas, which needs to be dealt stringently. [28] A stringent legal framework and a heavy penalty for non-adoption to environmental standards only can regulate the construction industry and make way for sustainable constructions. Some researchers have also found that living in the green building promote pro-environmental behaviour among residents. [29]

9. Findings and Suggestions;

Indian construction projects can be classified as:

- Govt. buildings and infrastructure
- Profit and non-profit organisation buildings
- Individual buildings

Some of the motivational factors for the organisations to go for green buildings are to gain competitive advantage, publicity, social and environmental conscience, to follow the legal framework and to include in company policy. For individual investors, the motivational factor is just the environmental conscience and passion.

Construction industries emit 15 to 18 % of the total CO₂ emission in India. If one has to invest in the green buildings following attributes could be considered: occupants health, safety and comfort, climatic conditions, cost of investment, operations and maintenance cost, and indoor air quality. [30] Various concepts of sustainable buildings are now emerging attractions. Different stakeholders seek certified buildings to ensure social environmental and economic benefits and quality. [31]

There is a need for assessment methods to systematically assess the impacts of both existing and new buildings on the economic and environmental protection criteria. Many of our assessment methods fail to measure the green building performance outside its physical boundaries. [32] General assumptions regarding the certification is that certified green building leads to improved occupant satisfaction and indoor environment quality though many studies have found this relationship to be inconsistent. Occupant satisfaction is not only the based quality of heat light and sound but also on personal health and wellbeing. Post occupancy education and evaluation by the involvement of building professionals could help in increasing the indoor environment quality. These building rating agencies can further support green building by providing training, benchmarking performance, and increasing the communication between the stakeholders. [33]

Steps to be taken for more effectiveness of green building at the individual and institutional level:

- Ancient Indian Vastushastra can be referred to which relies more on the direction of wind and light. [28]
- The smart green roof, natural buildings etc. can be utilised.
- Media can play a crucial role in increasing awareness.
- Educational institutions can imbibe green construction and hence promote greener India
- Change in marketing strategies of the construction companies. [21]
- The builders can earn more green points with limited funds by prioritising low impact construction site, recycled materials, use of local materials etc. [30]

Some measures that can be taken by the Government:

- Legislation has to be passed. If you don't mandate, people won't start to do it. A reward and penalty scheme can be introduced.
- Banks can offer discounts in interest rates.
- Tax rebates and reliefs can be provided for individual GB constructions.
- Larger projects residential and commercial projects can be mandated for GBs.
- For builders, some financial incentives can be extended
- To stimulate green construction, monetary incentives can be provided. Baltimore, a city in the US, offers tax credits for all new residential constructions. [20]

10. Conclusion.

Sustainability is an integrated concept that stands on the three-dimensional pillar of environment, social and economic aspects. Investors and stakeholders have different attributes towards the green building. Controlling and managing these attributes whilst incorporating green building practices is very crucial. One of the major challenges to green buildings is the cost attribute. Savings in energy cost and indoor air quality is invisible and may be appreciated only after occupancy, not at the time of investment. We are facing the issue of limited land area in

Urban India that calls for the replacement of old buildings, but then its more challenging task. [30]

Making green design and constructions can be mandated, but the actual benefits of the green buildings depend substantially on the occupants' attitudes and behaviour. Every stakeholder inclusive of the final users involved in the industry must be responsible towards the environment. A strong and conscious effort of everyone only can speed up this process. Green buildings can be a boon to several investors, as they are already providing a very high return in the developed countries, compared to other investments. The usage of eco-friendly building materials shall help us build a sustainable tomorrow with a healthy future generation. There are several guidelines in India regarding the environment protection but very few are made enforceable by enacting the law. In a global pandemic situation like COVID -19, where our living spaces have become the places of confinement for work and play, green buildings can have a lot of positive impacts on occupants and the planet.

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