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Sustainable Development through Green Building: A Holistic Exploration

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ABSTRACT

Adoption of Green building is necessary for environment protection in the long run. Besides others, one of the most crucial objectives of this concept is to control the emissions of greenhouse gases, which plays a mighty role in global warming. This paper intends to demonstrate research on the status of 'Green building' and map out the future path and prospects for the global building construction industry as countless companies have either already adopted or are in the process of adopting this concept. After studying and analyzing this paper one will gain sufficient insights on the benefits, challenges, various dimensions, application as well as future scope of Green/Sustainable Building and its necessity in today's environment-conscious world.

KEYWORD: Green Building, Sustainable Development, Sustainability

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INTRODUCTION

In today's day and age, where environment and preservation of natural resources are some of the broadly debated topics throughout the globe, it is essential for industries, especially construction, to implement environmentally friendly operations and assist in the achievement of some of these social norms. Even the Sustainable Development Goals have fostered towards having a cleaner environment (SDG-13). The construction of a building or any structure today, is considered to fall into the bracket of environmental degradation because of various gas emissions, creation of noise, dust, smoke, and various kinds of pollution (Lu et al.,2019). The construction sector is also often accused of directly exploiting natural resources and energy including manpower as it uses 15% of global freshwater reserves and nearly 30% of the global resources (Zhang et al. 2019), despite the environmental issues construction work leads to massive development of the infrastructure required by every economy (Gomero et al., 2020).

"Green building" is therefore essential in the preservation of the environment. Governments of several countries have been accepting this concept and leaning towards its greater implementation for the purpose of increased sustainability. In basic terms, 'Green building' refers to the procedure of building a structure, in ways that are sustainable and environmentally friendly, and which do not lead to any kind of resource wastage throughout a building's lifecycle (Chan et al.2018). However, an exact definition of this concept remains uncertain and unavailable since the definition of 'sustainability' tends to differ from one institution to the other. People view sustainability keeping in mind distinctive factors such as environmental, social impacts, health issues, economic impact etc.

Adoption of Green building is necessary for environment protection in the long run. Besides others, one of the most crucial objectives of this concept is to control the emissions of greenhouse gases, which plays a mighty role in global warming. It is known that the building construction industry is accountable for almost 30% of all the greenhouse gases emitted worldwide and the carbon-dioxide released by manufacturing of tiles, concrete and other construction materials is more than that of transport (Zhang et al., 2019).

Seeing the growing need for green building, the stakeholders of the construction industry have inserted 'sustainability' as a part of the industry (Ahn et al., 2016). There are also certain certifications and assessment tools when it comes to 'Green building,' without going through these processes it is not accurate to term that project as "green." The United Kingdom was the first country to develop a guideline/assessment tool for this concept in 1990 by the name of Building Research Establishment Environmental Assessment Method (BREEAM). Subsequently, the U.S Green building Council invented Leadership in Energy and Environmental Design (LEED) in the year 200 which is regarded as one of the most widely used assessment tool in the field of Green Building (Mattoni et al., 2018).

This paper intends to demonstrate research on the current status of 'Green building' and map out the future path and prospects for the global building construction industry as countless companies have either already adopted or are in the process of adopting this concept. After studying and analyzing this paper one will gain sufficient insights on the future of Green/Sustainable Building and its necessity in today's environment-conscious world.

BACKGROUND OF THE STUDY

Sustainability

Sustainability is something which is expected to prevail over a long period of time and is related to a social cause. An exact definition of this term remains disputed to some extent as it evolves over time (Berawi et al., 2019) but prevention of depletion of natural resources forms an accurate example. The concept of sustainability has received wider attention in various domains such as corporate governance (Singhania et al., 2023; Singhania et al., 2022), gender diversity (Gupta et al., 2023) etc. Green building, therefore, can be directly linked to 'sustainability' as its growing awareness and demand among people is what led to the origination of the whole concept of 'Green building' in the first place. This is also the reason why green buildings are often referred to as 'sustainable building'. Both terms can be used parallelly when it comes to their objectives and method of operation. Other than environmental conservation, green building also enhances the wellbeing of humans and the general community by purifying surrounding and indoor air quality. It is a 'holistic practice' (Lu etal., 2019) for attaining sustainability throughout a green project's life cycle.

Corporate Social Responsibility

According to the *United Nations Industrial Development Organization,* Corporate Social Responsibility is an initiative or management concept adopted by firms globally, where they adopt and insert various activities which are socially and environmentally concerned while keeping its shareholders and stakeholders in mind (Singh et al., 2021; Gupta et al., 2021).CSR has become so prevalent, that a CSR tax has become mandatory in multiple countries. Green building makes up an almost accurate example of this. Construction companies, instead of only building general prototype structures, have now also started to build 'green buildings' as a part of CSR activity. Moreover, various corporate houses from different industries have also ensured the CSR activities through their donations and CSR initiatives (Kalakata et al., 2021)

Green Building

The whole concept of green building first came into existence somewhere around the 1960s as people all around the world started to become extra conscious regarding sustainability and environment protection (Lu et al., 2019). Since then, the prevalence of Green Building has been growing daily throughout the realm of construction. As discussed earlier, several countries today have developed and designed their own green building rating/certification systems. Although there are many criteria's set by these respective systems, according to a recent study some of the most important happen to be efficiency in water and energy usage, indoor quality of environment, improvements in health and welfare (Tang et al., 2020). Some of the criterias for Green Rating for Integrated Habitat Assessment (GRIHA) which is the green-rating tool in India are the working of energy, water and solid-waste management systems as predicted (Gupta et al., 2018).

While during the construction phase, maximum priority should be allocated towards the opportunity and strategy for construction. This is vital for ensuring that the green project is delivered to serve the purpose i.e., sustainability. Construction opportunities consist of preconstruction services, minimization of site disturbance, sedimentation and pollution control, sustainable operations, management of green materials, indoor air quality and

various construction wastes, etc. (Ahn et al., 2016).

BENEFITS OF GREEN BUILDING

As discussed before, there are several benefits of green building out of which energy conservation, proper waste disposal, improving air quality, reduction in operation costs, etc. appear to be the vital ones. According to (Zhang et al., 2018), there are overall, five heads of incremental benefits that can be derived from green buildings which are reduced operational expenses, heightened comfort, improved health and productivity, enhanced corporate reputation and augmented market value. Scientists argue that green buildings perform better than the general ones when viewed from the point of life cycle (Oguntona et al., 2019). Some of the benefits of green building have been discussed in detail below.

Energy Efficiency

Green building proves to be quite effective when it comes to energy conservation. Conventional buildings take up huge chunks of electricity during its entire life cycle. In the US and some European nations, the building construction sector occupies 40% of the total energy consumption (Belussi et al., 2019). Energy efficiency is also considered to be one of the most integral criteria for green building Rating Systems (Alyami, 2019). Researches also show that in order to eliminate energy wasting mannerisms, the energy requirement of buildings need to be deducted by up to 17% (Pioppi et al.,2020). The greater implementation of green building has proven to be successful for some countries when it comes to energy conservation. It has been demonstrated that the LEED (Leadership in Energy and Environmental Design) certified green buildings in America consume 25% less energy, in Australia the production of the average GHGe by the Green Star certified buildings are now 62% fewer and in Africa green certified buildings can save and minimize 30-40% of energy annually (Uddin and Rafi, 2019).

The process of green building basically implements energy conserving techniques and systems to achieve the goal. Some of these famous mechanisms are- an energy efficient design by placing the windows and other openings of the structure in such positions where the amount of natural light and air witness a steep increase and artificial requirements are

very much lowered, if not fully diminished; usage of modern technology such as solar panels and water heaters; wind turbines and various other geo-thermal systems so that electricity can be generated on site and fossil-fuel dependence is reduced considerably; adoption of energy sustainable materials which do not require much energy for production, during the construction process.

Increase In Indoor Air Quality (IAQ)

Indoor Air Quality (IAQ) basically refers to the air quality inside the closed structures where people reside or spend their time in. Measurement of IAQ has become vital today, as contact with some severe indoor air pollutants like particulate matter (PM), volatile organic compounds (VOCs), environmental tobacco smoke (ETS) and nitrogen dioxide (NO2) results in serious ailments such as asthma and cancer (Babu et al., 2020). An additional factor which contributes to the emergence of IAQ is that individuals typically allocate around 90% of their time in diverse indoor settings (Jain et al., 2020).

Some of the sources of the air pollutant matters are identified to be associated with usage of cleansers, disinfectants, air fresheners and various lubricants during some indoor cleaning activities such as maintenance and housekeeping; office equipment's such as computers, copiers, printers, etc.; Tobacco products, cooking stoves, microwaves, pollens and dirt and paper products; and building materials such as plywood, medium density fiberboard, compressed wood, construction adhesives, panels and tiles. Also heating systems/devices like boilers, furnaces, generators and stoves, ventilation systems and air conditioning (Mishra et al., 2020). In countries like India, where pollution levels are generally high throughout the year, IAQ has become a big problem and hence, has emerged as an interest for researchers (Mandal et al., 2020).

Some of the ways and policies implemented on site by which the process of green buildings helps in achieving an efficient IAQ are by regularly monitoring the usage of paints, adhesives, coatings, etc.; restricting smoking inside the premises and building a separate smoking area/room for those who wish to; installing and transporting, heating, ventilation, and air conditioning (HVAC) systems with intensive care so that no dust, smoke, or harmful particles get stored in the systems and eventually spread inside the premises. Also, green

building material (GBM), a healthy and high-performance material (Khoshnava et al., 2016) is specially made up of non-toxic and natural substances that help considerably in removing IAQ contaminants (Wei et al., 2015).

Monetary Benefits

Green Buildings have various monetary gains to offer, which directly impacts certain groups of people. These benefits include a rent and other maintenance cost reductions for tenants of green properties due to its implementation of various energy saving techniques; low operation and incremental costs than the conventional buildings and higher property value of green properties as all the other benefits collectively add to its market value (Fafore et al., 2021). Research by Dwaikat and Ali (2016) which covered a range of locations, building types and rating systems, outlined that the bulk of additional expenses for every certification tier are situated within the range of -0.4%-21% and -0.4%-11%, correspondingly. Statistical investigations involving substantial sample sizes of novel constructions, nevertheless, have documented more limited ranges (Yeganeh et al., 2019).

CHALLENGES OF GREEN BUILDING

Lack Of Knowledge and Awareness

One of the major drawbacks for green building is its lack of awareness among people. According to the study in Yee et al., (2020), construction firms will face severe problems because of their staff not being fully educated on this concept. There is a lack of market understanding and demand regarding green building (Masia et al., 2020).

Higher Costs

The costs of green building may surpass those of conventional ones when it comes to technology as green technology proves to be quite expensive (Iravani et al., 2017). There is also a high initial investment needed for green building which pose an obstacle for its faster implementation and progress, especially in the case of developing countries (Shen et al., 2018).

Technicalities

The construction of a green project might involve complexities and various technicalities (Wu et al., 2019) and when these problems are not conveyed with the concerned parties

involved in the construction, there might be issues regarding the overall project (Ayarkwa et al., 2022).

Lack of Information on Sustainable Technology

When constructing a green building, various sustainable and green technologies must be used. According to Darko et al., (2017), unawareness regarding these technologies hampers the performance and innovative adoption of this concept which in turn ends up hampering the project performance. It is the responsibility of the project managers to prevent this and to ensure that the project progresses according to the plan (Barbosa et al., 2021).

IMPACT OF GREEN BUILDING ON VARIOUS DIMENSIONS

Costs and Financial Aspect

There is usually a lot of debate going on regarding how CSR activities fail to provide the firm with any financial benefits or incentives, recent studies, however, have shown that if performed more often, CSR activities can instead bring multiple financial gains (Westermann et al., 2018). CSR activities can bring a long-term benefit for the organization in terms of stock performance and generate multiple investment opportunities (Chiang et al., 2017). Green building also results in an enhanced financial performance in many cases and leads to an increased property value in future (Fuerst et al., 2017). In addition to this, it has also been proven that implementation of Green Building does lead to both monetary and energy savings (Huo et al., 2017).

There are countless benefits of Green Buildings. But what also cannot be overseen is that some additional costs do appear when compared to non-green buildings. Green buildings are extremely useful when it comes to energy efficiency. But energy efficiency poses benefitsfor only the building users, not for the developers i.e no extra revenue is generated (Sun et al., 2019). In the initial phase of construction, green buildings might account for a higher initial cost than other general or conventional buildings that exist today as the capital required for green buildings are higher than that of other conventional buildings but all these expenses incurred can be easily covered in the long run or during its operational phase, thereby making green projects more economical than conventional projects (Nagrale

and Sabihuddin, 2020). There are also cost differences noticed between buildings that are green rating system certified and those which are not. Not to mention, hefty additional costs in the form of premiums have to be paid based on rating level of the building, higher the certification level, higher is the cost (Weerasinghe and Ramachandra, 2018).

Real Performance

The real performance of a project or any concept is what decides whether that concept has performed as per predictions and whether it is feasible to continue it or not. As discussed earlier, the purpose of green building is the preservation of the environment through various effective methods. It is expected to be a healthy replacement for general buildings which consume a considerable amount of energy and natural resources. For instance, according to a study by Moore et al. (2019), that a green university in Melbourne failed to meet its designated goals and objectives illustrated by its green rating system. Also, findings in Mallory and Gorgolewski (2018) show that 9 Green buildings in Canada vary dramatically according to the building performance gap and that 3 of them miserably failed in living up to their expected performance. A building performance gap usually indicates that the green project has either failed to preserve the expected amount of energy or has in fact ended up using more energy than non-green or other general projects (Wu et al.,2019).

There is also the Indoor Air Quality (IAQ) distinction, which defines the indoor environment/ structure in general, including access to air quality (Pipal and Taneja, 2023) with respect to views, residential activities, sound situations, etc. Many green residence occupants reported in a series of surveys conducted that the IAQ in their house improved and are found to be more than that of non-green buildings (Steinemann et al., 2016). As evident from the multiple cases illustrated above, the real performance of green buildings worldwide is subject to differ. In many cases green buildings are successfully carrying out their objectives while other cases report the exact opposite.

APPLICATIONS OF GREEN BUILDING

Low Carbon Material Usage

Green buildings tend to minimize carbon emissions as much as possible and hence promote sustainable methods. As discussed earlier, carbon emissions pose a significant threat for our environment today. It plays a major role in elevating global warming. These emissions of

certain greenhouse gases also result in various social problems and energy shortage (Pokhrel et al. 2021). This is the reason why various countries have initiated targets and goals which curtail emissions as much as possible. According to Liu et al. (2022), the U.K. aims to reach "net-zero emissions" of greenhouse gases by the year 2050 and the U.S. aims in achieving carbon-free electricity generation by the year 2035 through full transition to renewable energy and carbon neutrality by 2050.

Waste Management

Construction wastes can be generally referred to as the debris/waste generated from activities such as construction, demolition, etc. According to Bao et al., (2020) majority of the waste generated generally comprises various materials such as soil, earth, rocks, etc. and all of them are appropriate for recycling or reusing for multiple purposes such as, road formation, reclamation of land, etc. Plastics, bamboo, and paper are some types of waste materials which significantly contaminate the environment.

One of the most constructive ways to achieve sustainable buildings is pollution control and responsible waste management particularly as buildings result in the release of abundant pollutants, toxic dusts, and harmful solid wastes (Amarel et al., 2020). Implementation of Renewable Energy: The construction industry is responsible for a major amount of worldwide energy consumption. Conventional buildings take up a huge chunk of such energy resources. According to Nadeem et al., (2021), this issue is solved by green buildings by proper usage of non-renewable resources such as water, gas, etc. by the adoption of solar energy.

POLICY IMPLICATIONS

The study offers various policy implications for the corporate houses as well policy makers, firstly by highlighting the benefits and challenges of green building the study shall act as an eye opener for the construction industries which can strategize their plans considering these benefits and challenges. For the government and the policy makers the study shall help in the formulation of legal frameworks and policy guidelines which are suitable for the environment and society.

CONCLUSION & FUTURE RESEARCH AVENUES

This paper and various research that has been conducted by other researchers on the topic of green building indicates that the concept of green building is only expected to grow in the future. Some of the major drivers of its popularity can surely be the growing environmentally conscious nature of the public and full support from governments worldwide to foster a sense of overall sustainable development. However, every concept has its pros as well as cons. Lack of proper knowledge and costs are still a threat to green buildings.

Some of the limitations of the article have been discussed below, but nevertheless these shall open wider opportunities for the future researchers. Firstly, this paper does not contain a quantitative analysis on the future of green buildings, future researchers can investigate this domain to have a comprehensive understanding. Secondly, proper data analysis of cost comparisons between conventional and green buildings is also required that will ascertain which type of construction proves to be costlier on an average after the final costs of both types of projects are determined. Finally, there are some elements of green building which have been explored in this article, except safety of workers and corporate social responsibility in depth which can be taken up by future researchers.

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