Green Buildings, Sustainability and Value Premium:
An Empirical Study of Pune

Ramakrishna Nallathiga [1,*], Abhijeet Raipure[2], Prateek Ate[3], Ankit Singh[4]

[1] *Associate Professor, National Institute of Construction Management and Research, Pune*
[2, 3, 4] *PGP PEM Student, National Institute of Construction Management and Research, Pune*
[*] *Corresponding author. Email: nramakrishna@nicmar.ac.in*

ABSTRACT
The concept of green buildings is getting well entrenched into the construction of buildings in Indian cities. In fact, the notion of green buildings is built upon the concepts of sustainability, which include: the conservation of resources (reduce), the reuse of materials (reuse) and the recycling of materials (recycle). However, they are also linked to sustainability in terms of reduced impacts during the whole life cycle of buildings i.e., construction and occupation. Besides, they also contribute to reducing global greenhouse gas emissions while also promoting energy and resource conservation. Given these advantages, green buildings should offer good value proposition to their buyers in terms of the reduced costs during building construction and operation stages. Therefore, there tends to be a 'value premium' associated with such green buildings in the property market. This paper reports the existence of such 'value premium' associated with green buildings through an empirical study of Pune city. A questionnaire survey was done for a sample of green buildings located in Pune city and data analysis was done. It is found that the Green Buildings have better green facilities but do not have infrastructure advantages. The study findings reveal about 5% value premium associated with green buildings in Pune city in the form of higher property value, though it varies across areas

Keywords: *Green buildings, Sustainability, Green facilities, Property value, Value premium.*

1. INTRODUCTION

A Green Building uses less energy, water and other natural resources in the process of construction and creates less waste from it. As sustainable development pertains to the conservation of all natural and energy resources, green buildings lead to the development of a clean environment, water, and healthy living in cities [18]. Green Building is about creating buildings that optimize the local ecology, use of local materials and most importantly they are built to cut power, water, and material requirements. Buildings are a major energy-consuming sector in the economy and about 35 to 40% of total energy is used in their construction. The major energy consumption is not only during building construction but also later during occupation and use through efficient lighting or air-conditioning systems. Green buildings minimize energy consumption, which in turn leads to a reduction in global Green House Gas (GHG) emissions, thereby contribute to global sustainability.

Green buildings, also called as green development or sustainable buildings, alludes to utilizing the practices and procedures that lead to energy and resource conservation all through a building's life-cycle: planning, development, operation, maintenance, redesign and destruction. It requires close collaboration of stakeholders: developers, technical and design professionals, construction personnel and consumer groups. Although new advances are produced to supplement current practices in making greener structures, the goal of green buildings is to decrease the general effect of the assembled environment on human wellbeing and common habitat by:

- Efficiently utilizing energy, water, and different assets.
- Protecting tenant wellbeing and enhancing representative profitability
- Reducing waste, contamination and environmental degradation.

Some of the salient features of Green Buildings in promoting sustainability include: -

- Reduced energy and water consumption without sacrificing the comfort level.
- Significantly better lighting quality including better daylight harvesting and use of shading, greater occupancy control over light levels and less glare.
- Improved thermal comfort and better ventilation.
- Limited waste generation due to the recycling process and reuse.
- Increased productivity of workers and machines while following greenhouse norms.
- Reduction of operating and maintenance costs by about 25-30%.

The Green Building movement in India was started in 2003 and received a major impetus when the CII – Sorabji Godrej Green Business Centre Building in Hyderabad became the first green building in India. It was awarded the prestigious and the much-coveted LEED (Leadership in Energy and Environmental Design) Platinum rating by the US Green Building Council (USGBC) and also became the world's greenest building in 2003. Whether Green buildings are really green is to be decided against predefined rating systems. There are three primary Green Building Rating Systems in India, which certify green buildings based on their own set of criteria:

- The Energy Research Institute (TERI) – GRIHA System
- Indian Green Buildings Council (IGBC) – LEED System
- Bureau of Energy Efficiency (BEE) – EPI System

Given the topical importance of green buildings, this paper focuses on the Green Building construction projects in Pune in terms of the availability of various green features (or, sustainability practices) in Green as well as Non-Green Buildings. It, therefore, makes a comparison between Green and Non-Green Buildings with respect to Green facilities provided as well as infrastructure facilities prevalent in their vicinity. We also attempt to study whether Green Buildings command any 'value premium' when compared to Non-Green buildings at the property acquisition stage.

2. LITERATURE REVIEW

Most of the literature concerning green buildings in the Indian context merely focuses on the environmental sustainability aspects viz, energy consumption, water efficiency, thermal comfort and greenhouse gas emissions as well as other technical aspects as case studies. However, international literature sheds more light on the developments. Here, life cycle assessment approach, which is extensively applied in the environmental aspects of green building, can be a useful tool for habitat sustainability, but not studied much in the Indian context. New rating tools are developing rapidly worldwide and India also adopted them, but more studies are required to further improve and apply these new rating tools and also assist in decision-making for real estate investors as well as developers. Also, the awareness of green buildings (underlying concept) and their benefits in long term are not fully known to people [17].

The existing literature is classified into five major categories, in which the review is presented hereunder:

- Green building concept and ratings
- Feasibility and costing of Green buildings
- Valuation of Green buildings and issues
- Comparison of Green and Non Green buildings
- Policy support and tax incentives for Green buildings.

(i) Green buildings concept and ratings

WGBC (2020) discusses the technical aspects and economic benefits of green buildings based on the economic, environmental, social and technical factors both at country and cross-country level. Sinha et al (2015) present how beneficial it can be, when the Life Cycle Analysis (LCA) is included in green building rating systems and introduces an integrated design concept for green buildings. They particularly discuss the effective use of wood through the value chain that can lead to sustainable development.

(ii) Feasibility and costing of Green buildings

Dwaikata and Ali (2018) note that life cycle costing has been gaining attention in the context of sustainable construction. They demonstrate how life cycle cost analysis can be conducted for a green

building and find that reduced energy consumption in a green building is the most influential factor to reduce total life cycle cost.

Halil et al (2016) explore the concept of a feasibility study and economic assessment in Green Building Projects. They note that the preparation of financial feasibility study enables the clients to decide with considerable confidence whether or not the project is feasible and worth pursuing. They study the completion of evaluation and the decision to proceed further with reference to a green building case project in Malaysia.

Wan Norhishamuddin et al (2015) assess the rate of depreciation for certified green and conventional purpose-built office (PBO) and assess the relationship between building categories and green building classifications toward influencing the rental depreciation using cross sectional survey of twenty-seven buildings in Golden Triangle area of Kuala Lumpur. Results imply that age, building categories and classifications were strongly correlated to the rental depreciation.

(iii) Valuation of Green buildings and issues

Pitts and Jackson (2008) note that as the design and development of buildings with green features becomes more prevalent, the appraisers need to consider green or sustainable elements in their valuations as well. Such valuations must be based on the market evidence of the enhanced value due to these elements present in them.

Lozano (2009) finds that while the initial driver for going green was social concern, in recent years, a 'business case' has emerged for sustainable construction, particularly for commercial building. As a result, the market for green buildings is increasing. A growing number of property developers are capitalizing on this trend, achieving higher visibility and positive market exposure in the process. The valuation of green buildings is in its infancy, but the trend is growing and so will the need for appraisers who are knowledgeable and can provide value opinions in this area.

Wise et al (2010) note that Green infrastructure practices produce a range of economic and social benefits; incorporating the value of those benefits into investment decisions is essential. They review current methods, tools and case studies of the valuation of economic and social benefits produced by green infrastructure practices, particularly as they are applied in urban settings. They define a framework for assessing the economic benefits of Green infrastructure practices on site and community scales.

Warren-Myers (2012) synthesizes the research on the relationship between sustainability and market value in real estate, by critically analysing the application of sustainability and value research in valuation practice. It highlights the limited applicability of research in regard to the relationship between sustainability and market value due to the lack of historical evidence, data or information on the quantifiable effects on market value of sustainability.

Ciora and Anghel (2016) note that urban sprawl and economic development brought new ways of bringing efficiency and performance, and green buildings are emerging. They discuss the issues in valuation while assessing green buildings and present a step-by-step approach in understanding the need of specific correlation between valuation measures and actual financial performance of this type of buildings, relative to value, rent premium, occupancy premium or even increase in productivity. Their analysis suggests that appraisers should take into consideration the positive effects of green buildings in their valuations.

(iv) Comparison of Green and Non-Green buildings

Shreshta and Pushpala (2012) note that while green buildings are designed to reduce operating costs by reducing energy consumption they can cost more than non-green buildings. Based on the study of 30 Green and Non-Green School Buildings in the USA, they find that that the construction cost per square feet of a Green building is significantly higher than that of Non Green building. Also, construction duration is significantly greater in green building than in non-green building.

Shazmin et al (2016) identify green envelope components of residential buildings applicable under hot and humid climates and analyse the effect of these components on building value. Consequently, a quantitative analysis was conducted to determine the effect of these green envelope components on building value through a questionnaire survey of property valuation practitioners in Malaysia. Their findings show that of the ten green envelope components certified under GBI Malaysia, three components increase property values and eight of them do not have any effect on building value.

Rahman et al (2017) shed light on the economic performance of green buildings by evaluating

whether LEED for Homes and properties capture higher market valuations and lower vacancy rates. They did not find any conclusive evidence that there exists a "green" premium in real estate market with respect to market valuations. They argue that it may largely be due to current appraisal methods not incorporating sustainability factors.

(v) Policy support and tax incentives for Green buildings

Runde and Thoyre (2017) note that, with the demand for green buildings on the rise, the support policies, incentives and regulations that affect it can emanate at federal, state, and local levels. They discuss the influence of rebates, financing, and tax incentives, which reduce the cost disparity between conventional and green commercial buildings.

It can be seen from the review of the literature on green buildings that the feasibility, costing and valuation aspects have been picked up by researchers to conduct the studies and provide inputs to the developers and investors of green buildings [15]. However, a critical view of whether green buildings command any value premium has also been catching attention of researchers, with which the current research paper is also concerned. Further, some studies use cost/value differential between green and non-green buildings, which we also attempt hereunder.

Lastly, literature is just emerging on policy support, tax incentives and other government support for green buildings. This is important as green buildings also give external or social benefits that accrue to local and State governments in the form of reduced energy demand, reduced material/ resource use and reduction in the effort of local government in providing civic infrastructure services. Such government support and incentives can further give a fillip to the green buildings development and demand in the Indian cities.

3. METHODOLOGY AND STUDY APPROACH

The current study is aimed at analysing the green facilities and other infrastructure facilities in both green and non-green building projects and thereby assessing the value differential between them. Figure 1 shows the methodology adopted for the execution of the study.

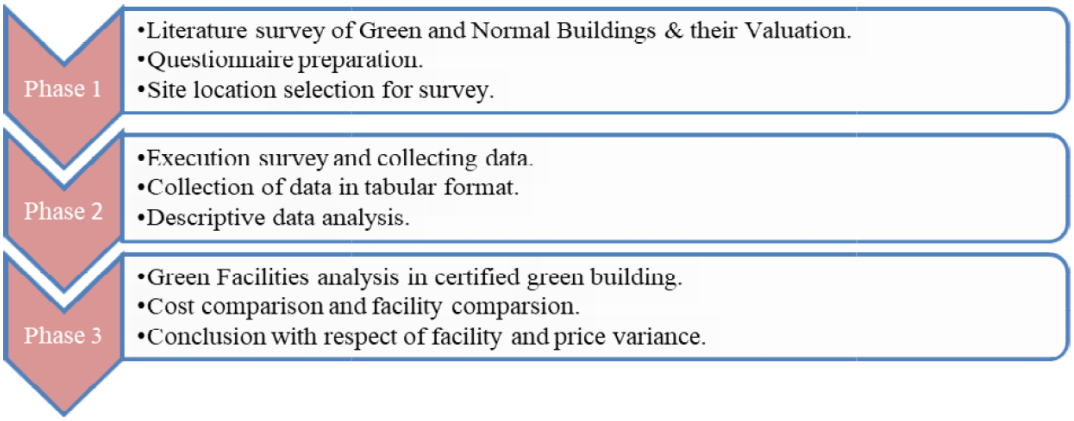

Figure 1 Study Methodology

The approach of the study involved primary research by employing a questionnaire survey for the collection of data from building construction projects in Pune city, India. Asample of 50 building construction projects was chosen for the study conducted during the year 2018; 21 of them were green building certified and the remaining 29 projects were non-green buildings. The study area chosen for the primary survey of building construction projects was Pune city comprising the Pune Municipal Corporation (PMC) and Pimpri Chinchwad Municipal Corporation (PCMC) areas. We visited all the 50 building project sites to collect questionnaire data from the project managers/developers. The building construction project sites were located in different areas of Pune city viz., Baner, Hadapsar, Wanwadi, Saus, Satara road, Pimpari Chinchwad, Deccan, Wagholi, Kondwa, Bavdhan, Wakad, Kothrud, Hinjawadi, Chikhli, Dattawadi and Warje.

4. COMPARATIVE ANALYSIS OF GREEN AND NON-GREEN BUILDINGS

In this section, we make a comparative analysis of the Green and Non-Green Buildings surveyed in Pune city in terms of Green facilities prevalent and utilized as well infrastructure facilities surrounding them.

4.1 Prevalence of Green Facilities in Building Construction Projects

Green facilities are the sustainability features that lead to energy and environmental conservation, which benefit building occupants as well as public at large. Some of the major green facilities provided in buildings include: (i) Rain Water Harvesting (ii) Solar Panels (iii) Natural Ventilation (iv) Use of Eco-friendly bricks (v) Use of Volatile Organic Compounds (v) Use of solar reflective glasses (vi) Recycling of grey water (vii) Solid Waste Management (viii) Reuse of Debris.

Figure 2a shows the green facilities prevalent in the sample green building projects in Pune city. It shows that they universally use Rain Water Harvesting facility and Eco-friendly bricks. Solar panels and natural ventilation facilities are also widely prevalent.

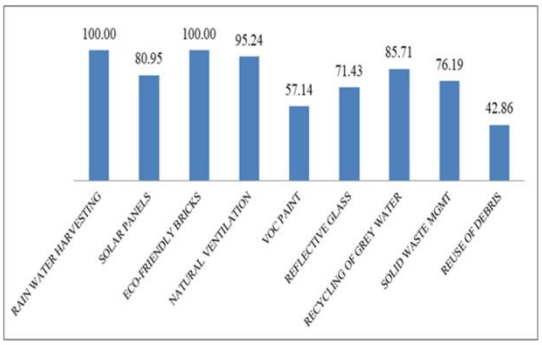

Figure 2a Green Facilities in Green Building Projects

About 60 to 80% of the projects use solid waste management during the construction phase of the project and provide reflective glasses as a green facility in their buildings to reduce heat storage in the building and temperature regulation/ maintenance. Also, around 40% to 60% of green certified projects use VOC (Volatile Organic Compound) and facility to reuse the debris in manufacturing of some other component.

Figure 2b shows the green facilities prevalent in the sample non-green building projects. Green facilities like rain water harvesting, solar panels, eco-friendly bricks, natural ventilation and providing facility for recycling of grey water in the projects are the mostly prevalent at 60 to 80%. Reflective glasses and solid waste management are prevalent in 40 to 60% of the building projects without any green building certification. The VOC Paints and reuse of debris in the project is prevalent in up to 20% in the projects without any green building certification.

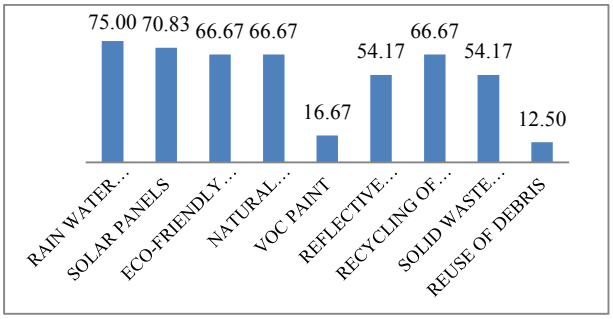

Figure 2b Green Facilities in Non-Green Building Projects

4.2 Utilization of Green facilities in Building Construction Projects

Figure 3a shows the utilization of green facilities (as per cent of the nine green facilities mentioned above) in green building projects. While five projects out of total 21 projects show a use in a range of 80% to 100, fifteen other projects size show a use in a range of 60% to 80%. Only one project shows a use in the range of 40% to 60% of green facilities. Hence we can interpret that among the green certified buildings majority of the projects show a use in a range of 60% to 80% of green facilities out of total facilities.

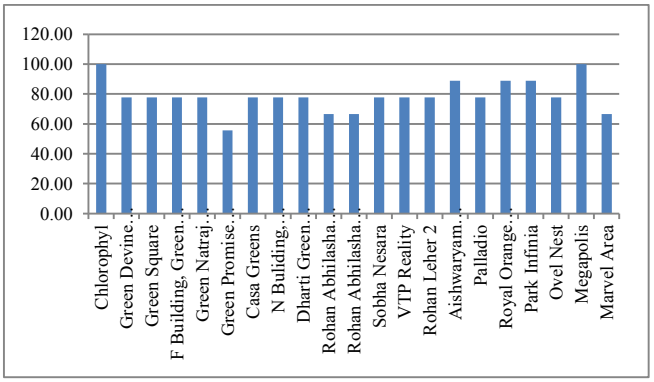

Figure 3a Utilisation of Green facilities in Green Building Projects

Figure 3b shows the utilization of green facilities (as per cent of the nine green facilities mentioned above) in green building projects. While two projects

show utilisation in a range of 80 to 100%, twelve projects size show utilisation in a range of 60 to 80%. Three projects show utilisation in the range of 40 to 60% of green facilities. Only two projects show green facility utilization of 20 to 40%. Significantly, four projects do not have green facilities to utilize. Hence we can interpret that among the green certified buildings majority of the projects show a use within a range of 60% to 80% of green facilities out of total facilities.

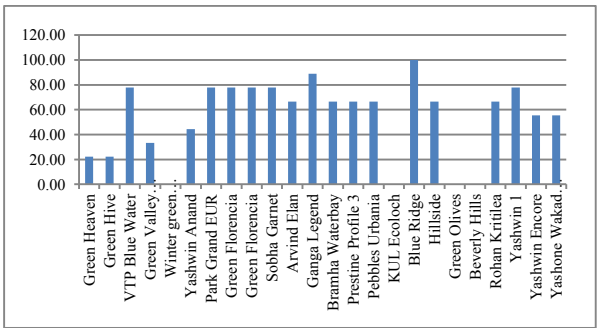

Figure 3b Utilisation of Green facilities in Non-Green Building Projects

4.3 Prevalence of Infrastructure Facilities in Building Construction Projects

Figure 4a shows the prevalence of infrastructure facilities available near various green building projects. As shown in it, almost 80% of projects with green building certification have school/college, shopping centre and hospital around them. Also, we can see that 40% to 60% of projects with green building certification have entertainment centre, parks/gardens and sports facility around them. Hence we can say that majority of projects with green building certification have school/college, shopping centre and hospital as an essential and common facility around them. Whereas minority projects with green building certification have parks/gardens and sports facility as an essential and common facility around them.

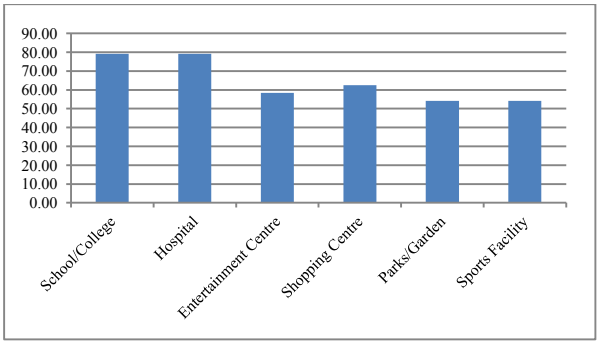

Figure 4a Infrastructure Facilities near Green Building projects

Figure 4b shows the availability of various infrastructure facilities like School/College, Hospital, Environmental Centre, Shopping Centre, Parks/Gardens and Sports Facility) around the Non-Green building projects. As shown in it, more than 80% of the projects have schools/colleges, hospitals and shopping centres in the surrounding areas. More than 40% have entertainment centres in the neighbourhood. Parks /gardens and sports facilities are prevalent in over 20% of building projects.

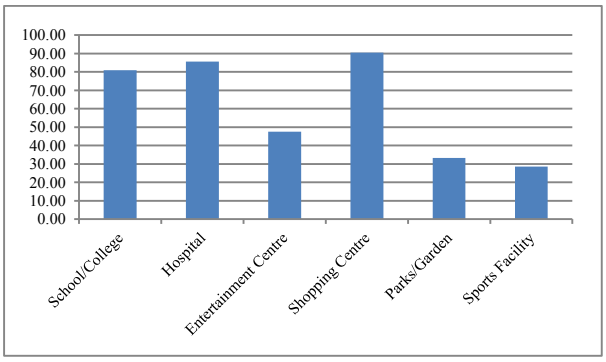

Figure 4b Infrastructure Facilities near projects without green building certification

4.4 Availability of Infrastructure facilities around Building Construction Projects

Figure 5a shows the availability of various infrastructure facilities around the projects with green building certification in terms of per cent of such facilities prevalent. As shown in the figure, six projects have 80 to 100% infrastructure facilities, three of them have 60% to 80% facilities, eight projects have 40% to 60% availability of various facilities and two projects have 20% to 40% availability of various facilities. Only one project with green building certification does not have any availability of facility around it.

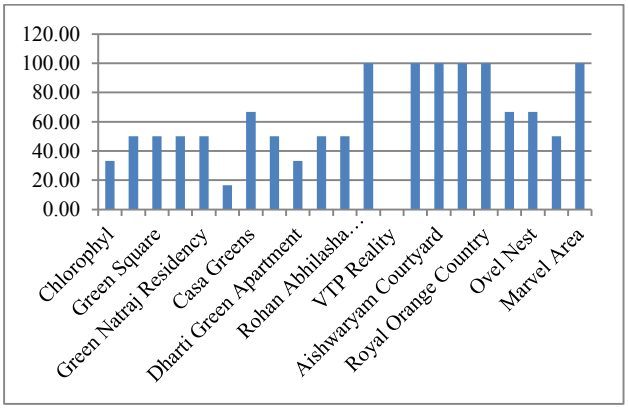

Figure 5a Availability of Infrastructure Facilities around Green Building Projects

Figure 5b shows the availability of various infrastructure facilities around the non-green building projects in terms of per cent of such facilities prevalent. As shown in the figure, six projects have 80 to 100% infrastructure facilities, three of them have 60% to 80% facilities, eight projects have 40% to 60% availability of various facilities and two projects have 20% to 40% availability of various facilities. Only one project with green building certification does not have any availability of facility around it.

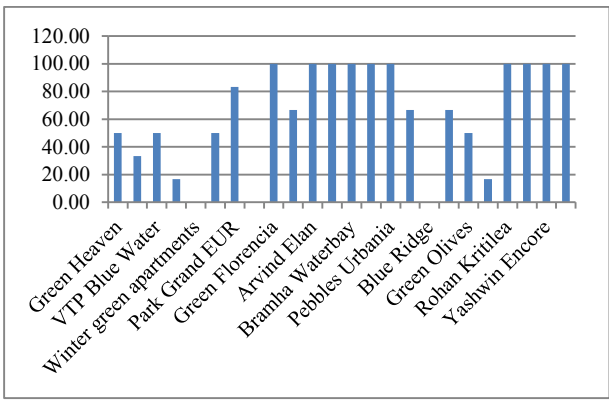

Figure 5b Availability of Infrastructure Facilities around Non Green Building Projects

In summary, the green building projects in Pune are also somewhat advantageously located (when compared to non-green building projects) in terms of community infrastructure facilities like entertainment centre, park/ garden and sports facility. They are at par with non-green building projects in terms of social infrastructure like education and healthcare facilities. Finally, they are somewhat disadvantaged (when compared to non-green buildings) when it comes to the prevalence of commercial facilities like shopping centres.

5. COMPARATIVE COST VALUE OF GREEN AND NON-GREEN BUILDINGS

Given the energy and natural resource conservation advantages, green buildings should offer good value proposition to their buyers in terms of the reduced costs during building construction and operation stages. We also surveyed the green building projects in terms of the cost value that are charged on the buyers. This cost value is essentially the 'offer price of property' of project developer to potential property buyer [16]. We included the price offerings of the developer for all project units developed under the project e.g., one, two and three bed room property units to work out the average/mean unit price of the property. Further, we also arrived at the value of green and non-green building projects in all major locations by taking the average price of such projects in those locations, again using the developer price offerings of respective properties.

Table 2 provides a summary of the value of green and non-green buildings in terms of property value (or, price) per unit area in various areas/locations in Pune. The area/locality mean values of properties are based on the primary survey of project managers/ developers surveyed through questionnaire.

Table 2. Area/locality wise property prices in Pune

Area/Locality	Mean Value of Green Buildings (Rs/sq ft)	Mean Value of Non-Green Buildings (Rs/sq ft)
Baner	4866.67	3550
Hadapsar	4560	3800
Satara Road	3800	
Sus	3500	4500
Wagholi	4200	
Kothrud	3800	
Hinjawadi	2400	2840
Chikhali	2150	
Warje	3500	
Pimpri-Chinchwad	2900	
Chikhali	2150	
Wanwadi		3400
Deccan		4000
Kondhwa		3700
Bavdhan		3850
Wakad		2066.67
Dattawadi		2700

Source: Authors based on the Study

Table 3 summarises the analysis and shows the mean/average value of green and non-green buildings with respect to various locations/ areas in Pune city. There is a clear difference in these values with the green buildings commanding a higher value when compared to the non-green buildings in Pune. This clearly implies that the green buildings are attractive to the potential buyers due to the various advantages in the form of green facilities and they need to pay a 'value premium' to acquire such properties in Pune. Some developers are aware of their offerings and clearly price-in the advantages of green features into their projects. The variation in value, however, is more in green building projects rather than non-green building projects.

Table 3. Summary Values of Green and Non-Green Properties in Pune

Building Projects	Mean Price (Rs/ sq ft)	Standard Deviation (%)
with green building certification	3761.82	1558.60
without green building certification.	3291.67	813.43

Source: Authors based on the Study

6. CONCLUSIONS

We conclude that buildings with Green Building certifications (provided by LEED, IGBC or GRIHA) are better placed in terms of the prevalence of green facilities and their utilisation. However, they do not have similar advantage when it comes to infrastructure facilities around them. Green buildings are comparatively more costly when compared to non-green buildings, as evident from the higher cost value attached to them. Specifically, green buildings are costly at about Rs. 470.15 per sq ft when compared to the non-green buildings. Therefore, we conclude that there is a 'value premium' associated with Green Buildings to an extent of 4.7 % in the case of properties with Green Building certification i.e., Green Buildings are almost 5% costlier than Non-Green buildings. It needs to be mentioned that the Pune Municipal Corporation (PMC) already provides tax incentives to the buildings with some of the green features in their premises e.g., solar water heating system, rain water harvesting system and vermi-compost facility, in the form of a reduction of 5 to 10% on annual property tax. While this is an encouraging support to the green facilities, the PMC needs to undertake more comprehensive approach by extending additional (top-up) benefits to certified green buildings so that the city and its habitat move more towards sustainable development path.

ACKNOWLEDGMENTS

The corresponding author would like to thank the anonymous reviewers for their comments on the earlier version of the paper, which helped in improving the paper contents substantially.

REFERENCES

[1] Ciora, C. and I Anghel. "Is the higher value of green buildings reflected in current valuation practices?" Journal of Accounting and Management Information Systems 15(1) (2016) 58-71.

[2] Dwaikata, L. N. and K. N. Ali. "Green buildings life cycle cost analysis and life cycle budget development: Practical applications" Journal of Building Engineering 18 (2018) 303-311

[3] Halil, F M, N M Nasir, A A Hassan, A S Shukur. "Feasibility Study and Economic Assessment in Green Building Projects", Procedia Social and Behavioural Sciences 222 (2016) 56-64.

[4] Lozano, G. Going Green, Volume 53, Book 1, Canadian Property Valuation, 2009.

[5] Pitts, J. and T. O. Jackson. "Green Buildings: Valuation Issues and Perspectives", The Appraisal Journal (Spring 2008) 115-118.

[6] Rahman, F. "Do green buildings capture higher market valuations and lower vacancy rates? A Canadian case study of LEED and BOMA-BEST properties", Master's Thesis, (2014), University of Waterloo, Ontario, Canada

[7] Runde, T. P. and S. L. Thoyre. "The Role of Incentives in Green Building Valuation", The Appraisal Journal (Summer 2017) 205-216

[8] Shazmin S., A. Azis, I. Sipan, M. Sapri, R. A. Jalil and I. S. Mohammad. "The effect of green envelope components on green building value", Property Management 35(2) (2016) 181-201.

[9] Shreshta, P. P. and N. Pushpala. "Green and Non-Green School Buildings: An Empirical Comparison of Construction Cost and Schedule. Construction Research Congress 2012, American Society for Civil Engineers, USA

[10] Sinha, A., Gupta, R. and A. Kutnar. "Sustainable Development and Green Buildings", Drvna Industrija 64(1) (2015) 45-53

[11] Wan Norhishamuddin, Wan R, T K Hwa, Nur M M, A S Said, M I Abdullah. "Depreciation between Conventional and Green Office Buildings", Procedia Economics and Finance, 31 (2015) 661-670.

[12] Warren-Myers, G. "The value of sustainability in real estate: a review from a valuation perspective", Journal of Property Investment and Finance 30(2) (2012) 115-144.

[13] WGBC (2020), The benefits of green buildings, World Green Buildings Council (WGBC), New York.

[14] Wise, S., J. Braden, D. Ghalayini, J. Grant, C. Kloss, E. MacMullan, S. Morse, F. Montalto, D. Nees, D. Nowak, S. Peck, S. Shaikh, and C. Yu. "Integrating Valuation Methods to Recognize Green Infrastructure's Multiple Benefits", Low Impact Development Conference 2010, American Society for Civil Engineers, USA.

[15] S.S. Rout, B.B. Misra, S. Samanta, Competency mapping with Sugeno fuzzy inference system for variable pay determination: A case study, Ain Shams Engineering Journal, 9 (4) (2018) 2215-2226. https://doi.org/10.1016/j.asej.2017.03.007.

[16] A.K. Nanda, S. Samanta, Mainstreaming tribals through financial literacy – a review of literature, International Journal of Social Economics 45 (2) (2018) 437-444. https://doi.org/10.1108/IJSE-12-2016-0371

[17] S.S. Rout, B.B. Misra, & S. Samanta, Load Allocation in Academic Environment: A Multi Objective PSO Approach, GSTF Journal on Computing (JoC) 3(4) (2014) 9-20. https://doi.org/10.7603/S40601-013-0036-7

[18] S.Samanta, J. Gochhayat, Critique on occupational safety and health in construction sector: An Indian perspective, Materials Today: Proceedings, 2021, https://doi.org/10.1016/j.matpr.2021.05.707