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Green Building Rating of High-rise Buildings in Sri Lanka

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Abstract

In an urban-setup, constructions of high-rise buildings are a great concern as it directly contributes to socio-economic and environmental purview of the country. Meantime, a wide range of sustainable practices can be applied indifferent stages of construction including planning, designing, procurement and implementation. In order to pave the way to implement Sustainable Development Goals (SDGs), green building rating system was introduced by National Green Building Council of Sri Lanka in 2002. The rating system consist of total points of 100 and required minimum points for green building certification is 40%. Sustainable sites category includes 25% of total 100 points in green building rating system. The current practices related to sustainable site selection was investigated in five major high-rise buildings construction sites in Colombo. Two construction sites could not earn single point as it did not fulfill the prerequisites of the site section of the other three sites earned points 20, 19, 18 respectively out of 25 points. It was noted, that due to the negligence for the sustainable site selection, eligibility for obtaining the green building certification has been lowered. The minimum number of points required to obtain the green building certification is 40 points. Therefore, selected buildings which are on construction stage have higher chances of achieving the green certification by collecting points from the other criteria as well. Sustainable sites category of green building rating system supports to achieve silver, gold and platinum awards with a significant contribution. The contribution of sustainable construction and green building concept to achieving sustainable development is identified throughout this research.

Keywords: Construction, High-Rise Buildings, Green Building, Sustainability, Sustainable Development, Sustainable Sites

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Introduction

Construction Industry in Sri Lanka

Construction is a major industry in Sri Lanka, expanding from small residential projects to high-rise buildings such as office buildings, shopping malls and apartments (Nandasena, Hanifaand, Zavahir & De Saram, 2021). In Sri Lanka, construction is regulated by government agencies such as SL Engineering Corporation and Mahaweli Authority and the private sector. Construction generally includes the stages of planning, design, procurement, implementation and completion. At the procurement stage, public sector procurement arrangements must comply with the Sri Lanka Procurement Guidelines for Goods and Works (UDA, 2006). It provides guidelines on permitting activities such as construction, repair, decoration, refurbishment, restoration and maintenance of buildings and other infrastructure. Private sector construction projects must comply with the procurement guidelines established in 1998 for private sector infrastructure projects. The main contractual document is the concession agreement (Nandasena et al., 2021). Construction activities are funded by both state-owned and private banks. Construction projects must comply with a variety of laws and regulations from the planning stage to completion.

The high-rise building concept began in the late 1960s as a significant turning point in the construction industry and urban development. Sri Lanka's first skyscraper was Ceylinco Tower Colombo built in 1960. Sri Lanka now has over 200 skyscrapers (Emporis, 2000). Buildings over 15 meters in height or over 5 stories are considered high-rise buildings under UDA regulations (Urban Development Authority, Sri Lanka, 2018).

Green Building Concept/GBCSL

The National Green Building Council of Sri Lanka (GBCSL) is a non-profit organization established in 2011. Sri Lanka's Ministry of Environment and Natural Resources (2007) has introduced a National Sustainable Development Strategy. Then, in 2010, the Green Building Council was established with Tsunami Guidelines for Sustainable Buildings in Southeast Asia to achieve significant environmental, safety and financial benefits (Karunasena & Thalpage, 2016). The Green Building Council ensures sustainability in construction. They conduct research to introduce new green concepts for construction and to verify green buildings (GBCSL, 2011). Furthermore, the construction sector consumes more than one-third of the world's energy consumption, so the Green Building Council was established with the aim of achieving zero emissions in the built environment (UNEP, 2007).

Role of the National Green Building Council

Green Building Certification or Green Building Assessment is conducted by the Green Building Council of Sri Lanka. There are two main services

provided by GBCSL for green building verification. They are the Green Building Rating System and the Green Labeling System. Green Building Assessments are conducted by GBCSL when building manufacturers are interested in achieving green status for their buildings. The Green SL rating system has a points scale. Buildings that score 40 to 49 points out of 100 are certified as green buildings. Criteria of 50-59 points, 60-69 points, and 70+ points are recognized as Silver, Gold, and Platinum categories respectively in the Green Building Rating System. GBCSL issues a valid certificate when evaluating a building.

The Green Labeling Scheme is also run by GBCSL. It is a multi-step process whereby products used in construction from start to completion are certified as environmentally friendly materials and processes. These steps include verifying constructed buildings as green buildings, registering the building and products used, submitting documentation to the GBCSL, evaluating the documentation, site visits and inspections, sample testing from laboratories, final assessment and awarding green building certification (GBCSL, 2011). GBCSL considers components such as Building and Site Management (MN), Sustainable Sites, Energy and Atmosphere, Materials and Resources, Indoor Quality, Innovation and Design Processes, Social and Cultural Awareness in the national green building rating system (GBCSL, 2011).

Study justification

Implementing green building concept has economic, social and environmental benefits. It ensures sustainability in construction. The economic benefits are the reduction in energy, fuel and electricity costs. Green building concept significantly reduce adverse environmental impacts (Zulu, Zulu, Chabala, & Chunda, 2022). Also, it increases resource efficiency; minimize natural resource wastage& pollution by downsizing supply chains. Moreover, it reduces wastewater treatment costs and water usage costs(Waidyasekara & Fernando, 2012).

The social benefits are reducing adverse health impacts, conservation of water, expanding green markets, ensuring occupational health and safety, increasing alternative transportation and increasing comfort of employees. As people spend more time indoors, their health depends on indoor environmental quality. Therefore, the green building concept is important for human existence too (Allen et al., 2015).

Despite the fact that the long-term benefits of adapting green building concept is higher than conventional construction methods (Pandithawatta, Zainudeen, and Perera, 2019).Green building concept is not popular among Sri Lankan investors due to high capital investment, high implementation cost and high material cost, lack of advanced technology, lengthy approval process in planning and implementation, lack of experience in using green technologies, higher time wastage and extreme communication among

construction stakeholders. Therefore, this study is aimed on analyzing the rating system of green buildings and the following study approach was proposed for the purpose of evaluating the applicability of the rating system to the selected construction industry.

Study Approach and Objectives

Sri Lanka's Green Building Rating System evaluates and certifies buildings according to points awarded in the Green Building Rating System. The maximum score is 100 points. These points can be grouped into seven categories. They are; building and site management [4 points], sustainable sites [site selection criteria – 25 points], water efficiency [14 points], energy and atmosphere [22 points], innovation and design processes [4 points], resources, materials, Waste management [14 points], indoor environmental quality [13 points] and social and cultural awareness [4 points]. Of these categories, the Sustainable sites category contains 25 points and accounts for 25% of the total score. This category has 12 criteria, including one prerequisite (GBCSL, 2011).

It was also pointed out that the sustainable site category of the green building rating system includes the most important aspects related to the environment such as reduction of environmental degradation, protection & restoration of environment, encourage environmentally friendly processes and controlling the damage on surrounding ecosystems. Construction activities alter existing natural environments. Components in sustainable sites category minimize this environmental alteration. Therefore, this study examines the current status of implementing these criteria and improvements which are possible. The improvements will ensure sustainability, protect the environment and achieve the global Sustainable Development Goals.

Specific Objectives of the Research

- Investigate the compatibility of site selection for high-rise building sunder green building rating criteria.
- Evaluate existing practices for the site selection of high-rise buildings under green building rating criteria
- Assessing the status of green building rating of selected high-rise buildings

Literature Review

Present Status of Green Buildings in SL

There are over hundred government and private green construction projects. Some of them have achieved very high green building ratings because their compliance with green standards. Due to variations of experience levels in the construction sector personnel, the green status of building changes. The

buildings mentioned below are best examples for adapting the green buildings in Sri Lanka.

- Logistics Park, Colombo - awarded 73 points of 110 in LEED Rating system.
- Clear point Residencies, Rajagiriya – has world's tallest residential vertical garden. It reduces energy consumption for cooling and mitigate heat island effect. The building is nominated for LEED certification. The entire building uses solar energy. Also, it has a drip irrigation system and a rain water harvesting system (Jayasinha, 2018).
- Cinnamon Bey, Beruwala - the first hotel in Sri Lanka won a LEED Gold award. It has 100% energy-efficient lighting, recycled water mechanism, rainwater harvesting, and solar hot water and heat pump usage.
- MAS Intimates Thurulie, Thulhiriya – won the LEED Platinum award.
- Brandix Eco Centre, Seeduwa transformed in 2008 to standards of green building. It was awarded Platinum status by LEED. Carbon footprint is reduced by 77%. (Jayasinha, 2018).

Policies and Laws Concerning Construction (UDA Law, Landfill Law)

Sri Lanka has two types of legislations related to the construction industry. They are planning laws and environmental laws. Planning laws include Design and Measurement, Built Environment, City and State Planning laws, and UDA and Government Codes. Environmental law relates to nuisance, environmental protection, EIA, IEEE, EPL, biodiversity conservation and forest management, coastal and marine environment.

Environmental Act No. 47 of 1980, Fauna & Flora protection Ordinance, Forest Ordinance No. 16 of 1901, the Coast Conservation Act are part of the Environmental laws (Abeynayake, 2012). Environmental act covers environmental modifications permitted during construction. However, there are certain prescribed projects that require an EIA or IEE to be performed, or an EPL to be obtained to perform construction work. Some high-rise buildings can be prescribed projects. In this case, an Initial Environmental Assessment or an Environmental Impact Assessment need to be carried out by the Central Environment Authority. Moreover, this process supports the green building concept. Construction of high-rise buildings as integrated multi-development activities covering a land area of more than 10 hectares or high-rise buildings within 100m of protected areas or ecologically sensitive areas are prescribed projects (CEA).

The Coast Conservation Act and the Marine pollution Act regulate construction work in coastal areas. These acts do not allow construction

activities that adversely affect the environment or biodiversity. Therefore, environmental sustainability in the construction sector is ensured by these laws.

Physical planning of construction projects must also be carried out within the framework of planning law. If the project meets the planning laws, it is approved for construction. There are various acts and policies, including planning laws. They are:

- Town and Country Planning Ordinance No. 13 of 1946
- Housing and town Improvement Ordinance No. 19 of 1915
- Urban Development Authority Act No. 41 of 1978
- Coastal Conservation Act No. 57 of 1981
- Urban Council Ordinance No. 61 of 1939
- Municipal Council Ordinance No. 29 of 1947
- Pradeshiya Sabha's Act No. 15 of 1987 – does not have significant effect on green building concept. But house plan approval is done according to act.
- Nuisance Ordinance No. 15 of 1862 – includes social problems with construction. (Abeynayake, 2012)

All these acts enable lesser negative impacts and more positive impacts in construction.

Sustainability of Construction Sector and Related SDGs

As the industry develops, the construction became an important global activity. As construction evolves from small and medium-sized buildings to large-scale buildings, the environmental, social and economic impacts became immense. The search for sustainable construction methods began to minimize negative environmental impacts and increase positive economic and social impacts. The concept of green building is based on sustainable construction. Sustainable construction consists of four pillars; Planet, People, Purpose, Benefits (Namian, Al-Bayati, Karji & Tafazzoli, 2021). Major purposes of sustainable construction are GHG emission reduction, climate change reduction, biodiversity conservation, economic development, improve life quality.

Sustainable development goals relate with many aspects of construction. The SDGs related to constructions are clean water & sanitization (SDG 06), affordable & clean energy (SDG 07), industry innovation & infrastructure (SDG 09), sustainable cities & communities (SDG 11), Responsible consumption & production (SDG 12), climate action (SDG 13), Life below water (SDG 14), life on land (SDG 15). A large amount of water is needed in the construction activities. and water pollution occurs in construction.

Therefore, techniques should be carried out to improve water quality & purification. Therefore, it is related to SDG 06. Usage of low emission energy clean energy to construction activities refers to SDG 07. Sustainable construction introduces cost-effective, low-emission and environmentally friendly green infrastructure. Also, new innovations are being developed in construction, such as efficient machines and material extractors. This refers to SDG 09. A sustainably developed city will improve quality of life. This meets SDG 11. In sustainable construction, environmental impacts are assessed and minimized. Therefore, it achieves SDG 14 & 15. With sustainable construction, emissions are reduced as much as possible. This refers to SDG 13 (Editor, 2020).

Verification of Green Buildings: Aspects Related to Site Selection

Green building validation has many aspects. Sustainable sites have been identified as a key component of green buildings (GBCSL, 2011). There are two main components in this category. These are “location and transportation” and “sustainable sites”. The subcomponents under them are included in the International Building Rating System - “Leadership in Energy and Environmental Design” (LEED) (Ismaeel, 2019).

SL green building concept has few criteria used to assess sustainable sites. Mitigation of soil erosion and sedimentation within the site is a prerequisite to be checked and addressed before the project begins. Further points in the sector are achieved if the prerequisite is met (GBCSL, 2011).

Components relevant to sustainable site selection are Effect of Development Density and Community Connectivity on nature, Rehabilitation and restoration of green lands, green transportation towards a green construction, Rain water and storm water collection, Effective management of rain water, Heat Island mitigation, Reduction of light pollution and Effective use of light (GBCSL, 2011)

Controlling of Erosion and Sedimentation in Construction Sites

Soil erosion and sedimentation control are major aspects of the Green Building Validation Rating System. Soil erosion is the removal of the earth's surface due to various natural or anthropogenic causes. Construction activities alter the soil structure. It causes erosion. Sedimentation can also be generated by surface water runoff. The surface runoff is very high during rainy season.

Erosion damages housing. Sedimentation causes loss of aquatic fauna, eutrophication, flooding, water pollution, water supply disruptions& increasing treatment costs. Soil erosion and sedimentation affect ecosystems in site and surrounding areas (Sun, Cornish, Daniell, 2002).

Soil erosion mitigation structures are erected for erosion mitigation/ several factors should be considered in developing a soil erosion and sedimentation control plan. These are the site topography, soil type, best management

practices to be used, erosion management system, and status of site disturbance (GBCSL, 2011).

Site selection for construction purposes

Site selection and assessing sustainability practices must be conducted according to Green Building Council (GBCSL, 2011) verification criteria to achieve green building certification.

Site selection is an important task done in design stage. Some lands are not suitable for constructing buildings, roads or parks, etc. They are

- prime agricultural land
- Lands with lower elevation than 1.5m above the 50-year flood level,
- Coastal lands which are protected under Coast Conservation Department
- Lands identified as habitats of any threatened or endangered species by the Department of Wildlife Conservation
- Lands within specified distances of wetlands as defined by Central Environment Authority, or state law or the Ramsar Convention
- Lands in pre identified landslide-prone areas (GBCSL, 2011). (GBCSL, 2011).

Site Assessing in Green Buildings

After site selection identifying key components of the site will lead to find sustainable solutions to reduce or avoid natural damage. Components assessed are;

- Site topography - includes aspects such as contour maps, unique topographical features, and slope stability risks (GBCSL, 2011). Assessing topography prevent risk of disasters such as landslides and floods.
- Site and surrounding hydrology - includes flood risk areas, demarcated wetlands, lake and stream shorelines, rainwater collection and reuse opportunities, and the site's TR-55 initial water storage capacity (GBCSL, 2011).
- Local climate- Assessment of climatic conditions, insolation, heat island effect potential, seasonal sun angles, prevailing winds, monthly precipitation and temperature ranges are observed and reviewed (GBCSL, 2011).
- Vegetation - includes identification of site's dominant vegetation types, calculation of grassland size, mapping of important trees, identifying endangered species, presence of unique habitats, and identifying invasive plant species. If the site has significant green

space, sustainable technology should be used to protect at least 40% of the site's green space.

- Soil type - includes Natural Resources Conservation, Soil Delineation, USDA Quality Farmland, Soil Health Status, Past Development Activities Altering Soil, and Site Disturbed Soil.
- Human use, end outcome and human views of the project, adjacent transport infrastructure, adjacent land, and potential of building materials with potential for recycling or reuse are assessed (GBCSL, 2011).
- Adverse impacts to human (GBCSL, 2011)–consideration of adverse health effects, proximity to vulnerable populations, proximity to opportunities for physical activity, and proximity to major sources of air pollution.

Reducing Site Disturbance in High-Rise Buildings

Green building concept minimizes site disruption and damage. This includes conservation, providing green spaces and reduction of development footprint (GBCSL, 2011).Reducing site disturbance avoids biodiversity fragmentation. Downscaling construction projects reduce site disruptions (Goddard, Dougill, & Benton, 2010).

Various conservation strategies can be used to reduce site disturbance. Protecting the nature in construction sites is called site conservation. For urban sites, the environmental extent is low. In development, construction will expand to non-urban environmentally sensitive areas. EIAs or IEEs monitored by CEA are used to assess the environmental impacts of them (Hu, Shi, Xue, & Wang, 2020). Some construction activities result in pollution and destruction of vegetation (Hu et al., 2020).To mitigates this effect, most developers try to use brown fields which are abandoned lands polluted by construction pollutants. To redevelop Brown fields, rehabilitation techniques and reforestation are used.

Restoration of Damaged Areas in Construction Sites

Destroying of vegetation in construction is unavoidable sometimes. Sustainable techniques can be used to restore this destroyed vegetation. They are activities such as reforestation, leaving eco patches and creating landscapes. Restoration of damaged areas increases the green building validation score of a building.

There are different landscaping types which are used for restoration. They are;

Landscaped land patches – designing of land patch with trees or lawn which are easier to maintain because irrigation systems can be used to supply water & fertilizer (Thompson, W. J., & Sorvig, K. (2007).

Green Facades – a green wall system with climbing plants and cascading ground covers. Mostly plants with sucker roots are used to facades because they catch walls or fences.

Two types of green facades;

a. Modular trellis panel system – Blocks made out of galvanized steel; wires strong are used to grow vegetation.
b. Cable and wire-rope net systems – cables/wire ropes are used in this. Cables are acting as supporters to growing of climbing plants. To prepare the system high tensile wires and anchors are taken as material.

Living walls – vertically fixed pre-vegetated panels made of materials such as clay, coil or meshes used for both interior and exterior(Perini & Ottelé, 2012).

a. Modular living wall – Rectangular models with plant mediums. Water is supplied using drip irrigation systems.
b. Vegetated mat wall – plant grown medium made of two synthetic fiber layers fixed to the wall using a wooden frame. The fabric material retain water. Therefore, water and nutrients to the plants are allowed through it
c. Landscape walls –sloped landscapes made using plastic or concrete structures. Medium of vegetation growth is kept as stacks in the slop

Roof top Gardens –a landscaping model used in high rise buildings with less space. These models are roof tops covered up with vegetation.

Green Transportation towards a Green Construction

Access to Green transportation is included in green building concept. To ensure sustainable development people should have effective green transportation techniques (Susnienė, 2012). Therefore, a green building must have access to green transportation.

In construction sector, there are two transportation stages. They are transportation while after the construction. In construction stage transportation is needed to transport material and debris. The transportation after completion is the transportation needed to the people which use the buildings. The transportation is done by using public or private transport. Using public transport is sustainable. Therefore, in selection of sites, access to public transport is considered. Also, efficient modes such as usage of electric vehicles can be encouraged (GBCSL, 2011). In green buildings there are stations available to charge electric vehicles in the parking spaces.

Storm Water Management

Storm water management is also an important aspect of sustainable sites. Different techniques are used to manage rainwater. Mostly high-rise buildings are constructed in urban areas. The effect of rainwater is higher in these areas since the other buildings, houses and complexes are situated nearby (Zeleňáková, Markovič, Kaposztásová, & Vranayová, 2014).

Some buildings use overhead rainwater collection tanks to manage rain water. But this method is not appropriate in continuous higher rain falls (Guo & Urbonas, 2002). In such occasions underground water tanks also should be used to collect the excess rainwater. And some uses underground storage tanks or basement deposition tanks. But these basements tanks can cause flooding in some extreme climatic situations. In deciding the capacity of rain water collection tanks and the placement of these tanks, the annual rain fall and flood index should be considered (Guo & Urbonas, 2002).

This collected rainwater is used for different purposes such as flushing, washing & drip irrigation systems. Some buildings install water purification systems to purify rain water to use rain water as drinking water. (Zeleňáková et al., 2014).In present computerized integrated software systems are also being developed for rain water management. (Chen, Samuelson, & Davila, 2015). In these practices rain water management systems are integrated with computer aided design software. This is used to design and effective storm water management system and estimate the collection of rain water (Chen et al., 2015).

Heat Island Mitigation

Heat island mitigation is important in green building validation. Heating occurs due to sunlight and angle of sunlight. Reflectance reduces the heat island effect. The reflectance changes according to used materials. The reflectance is determined by Solar Reflectance index value(GBCSL, 2011).

The major reason of urban heat island effect is absorption of solar radiation from the building materials instead of reflecting them(Kleerekoper, Van Esch, & Salcedo, 2012). Other causes are reduction of wind flow, increasing vehicle emissions, heat released in industrial combustions, air pollutants such as green-house gasses, inappropriate planning of cities and use of waterproofing materials which reduce evaporation by solar radiation (Kleerekoper et al., 2012).

Different countries undergo dramatic climatic changes in different seasons. Therefore, heat island mitigation techniques are not complied with the requirements of every climatic season. But Sri Lanka’s sun light has an average intensity throughout the year. The climatic conditions of the construction sites are studied to identify suitable heat island mitigations techniques. In present, the major mitigation technique usage of solar panels to produce electricity. Green roofs and cool roofs are also used as

mitigation techniques. Cool roofs use material which absorb and reflect light. In green roofs, vegetation is grown to avoid heating and cooling is done due to evapotranspiration. (Li, Bou-Zeid, & Oppenheimer, 2014).

Methodology

This study was started with gathering information and a review literature on high-rise buildings in Sri Lanka, green building concept, green building rating system, sustainability & legislations. In considering high-rise buildings evolution & expansion of construction industry in Sri Lanka, involvement of green building council to certify them as green buildings were studied. Under green building rating system, achievement of SDGs in construction industry are studied.

Thereafter the components of green building rating system GBCSL were studied. Among them sustainable sites criteria which is responsible for 25% of score was selected. It has 11 criteria including one pre-requisite. They are erosion and sedimentation control as prerequisite, site selection(4points), site assessment and development(2points), development density and community connectivity(2points), Brownfield redevelopment and allowance for connectivity of green lands(1point), alternative transportation[3points] – [public transportation access (1point), parking capacity(1point encourage use of green modes of transport 1point] reduced site disturbance [6points] - [protect or restore habitat (2points), vertical greening (2points), development footprint (2points)], storm water design- quantity control (2points), storm water design, quality control (2points), heat island effect, non – roof (1point), heat island effect, roof (1point), light pollution reduction (1point). To study the sustainable sites criteria five buildings are selected. The selected sites are inspected and in sustainable sites criteria of each building were assessed. The criteria which were implemented in selected study sites, which are not implemented & improvements which can be done are studied.

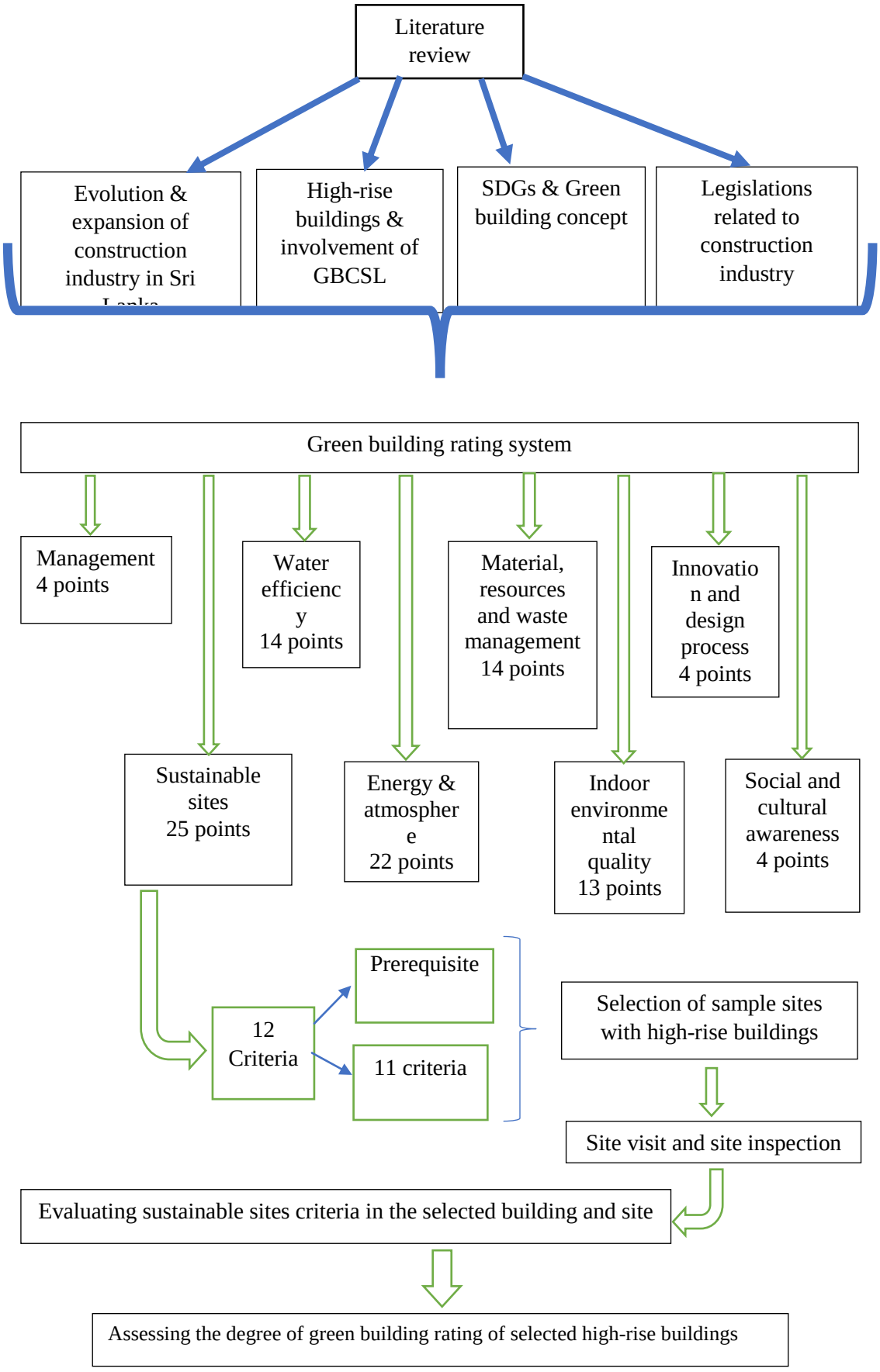

Figure 1. Methodology of Research

Results

Points given to of green rating system in observed buildings

Criteria	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**
Soil erosion mitigation	Done	Done	No	Done	No
Site selection [4]	4	4	4	4	4
Site Assessment and development[2]	2	2	2	2	2
Development Density and Community Connectivity [2]	1	1	2	2	2
Brownfield Redevelopment and allowance for connectivity of Green Lands [1]	1	1	1	1	1
Alternative Transportation					
Public Transportation Access[1]	1	1	1	1	1
Parking Capacity[1]	1	1	-	1	-
Encourage use of green modes of transport[1]	1	1	-	1	-
Reduced Site Disturbance					
Protect or Restore Habitat [2]	2	1	2	2	2
Vertical greening [2]	1	-	2	2	1
Development footprint [2]	1	1	1	1	1
Storm Water Design,Quantity Control [2]	1	1	2	1	2
Storm Water Design,Quality Control [2]	-	-	-	-	-
Heat Island Effect, non – Roof [1]	1	1	1	-	1
Heat Island Effect, Roof [1]	-	-	1	-	-
Light Pollution Reduction [1]	1	1	1	1	1
Total points can be given	18	16	20	19	18

The above point table includes the points achieved by selected buildings, under sustainable sites criteria of green building rating system of green building council Sri Lanka (2011).

Figure 2 -Site 1: IT Hub building in Malabe

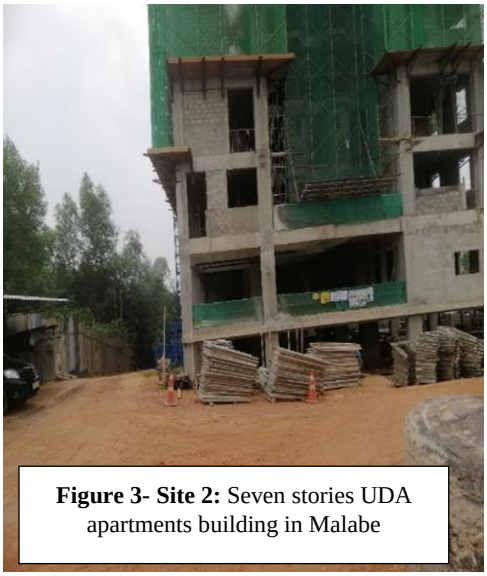

Figure 3- Site 2: Seven stories UDA apartments building in Malabe

Figure 4- Site 3: Social sciences building in University of Jayewardenepura

Figure 5- Site 4: Faculty of ICT, University of Kelaniya

Figure 6-Site 5: Management building in University of Jayewardenepura

Discussion

The inspected high-rise buildings have some components of the of green building rating system (GBCSL, 2011). Even though, to obtain the points of each category, the prerequisite must be completed. As a result, some buildings cannot be rated under the Sustainable sites category. Therefore, they lose points even if other elements of the sustainable site category are present. Without consideration of prerequisite, each building received scores of 18, 16, 20, 19, and 18 respectively. Since 40 points is the minimum for green building certification, these buildings have a chance to get certified by earning least scores in other criteria of the Green Building Rating System.

If the score is low in the Sustainable Cities category, chances of getting green certification is very low because 62. 5% of 40 points can be achieved in the sustainable sites category. Also, sustainable sites category supports significantly to achieve of Silver, Gold and Platinum awards.

Sustainable sites category ensures environmental sustainability by protecting the environment, using green transportation, maximizing use of sunlight and rainwater. This reduces negative environmental impact significantly. As a result of environmental protection, ecosystems will remain undisturbed. This supports the society to full fill their needs sustainably and to build a sustainable economy.

In present most popular activity among the construction industry is the construction of high-rise buildings. In the process of constructing a high-rise building a large number of resources & extraction processes are included. Therefore, the triple bottom line of sustainability; environment, economy and society is affected significantly in construction. Since the green building concept significantly support the sustainable development strategies, usage of the maximum effort to achieve green building certification in a good degree must be done by the constructers.

Conclusion

In overall reserch it can be concluded that among the components of green building rating system(GBCSL), sustainable sites aspect is more important. Achieving sustainability by managing natural resources in an effective manner is more effective than finding newsustainable techniques in the construction industry, since some of the new techniques have massive drawbacks included in inner parts of them.

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