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Developing a green building assessment tool for developing countries – Case of Jordan

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ABSTRACT

The purpose of this research is to contribute to a better understanding of the concept of green building assessment tool and its role for achieving sustainable development through developing an effective green building rating system for residential units in Jordan in terms of the dimensions through which sustainable development tools are being produced and according to the local context. Developing such system is becoming necessary in the Developing World because of the considerable environmental, social and economical problems. Jordan as one of these countries is in need for this system, especially with poor resources and inefficient use. Therefore, this research studied international green building assessment tools such as such as LEED, CASBEE, BREEAM, GBTool, and others. Then defined new assessment items respecting the local conditions of Jordan and discussed them with (60) various stakeholders; 50% of them were experts of sustainable development. After selecting the assessment items they were weighted using the AHP method. The outcome of the research was a suggested green building assessment tool (SABA Green Building Rating System) – computer based program – that suits the Jordanian context in terms of environmental, social and economical perspectives.

1. Introduction

Green building has now become a flagship of sustainable development in this century that takes the responsibility for balancing long-term economic, environmental and social health [1,2]. It offers an opportunity to create environmentally efficient buildings by using an integrated approach of design so that the negative impact of building on the environment and occupants is reduced. Rating system provides an effective framework for assessing building environmental performance and integrating sustainable development into building and construction processes; as it can be used as a design tool by setting sustainable design priorities and goals, developing appropriate sustainable design strategies; and determining performance measures to guide the sustainable design and decision-making processes [2,3]. It can also be used as a management tool to organize and structure environmental concerns during the design, construction, and operations phases.

Green design does not only make a positive impact on public health and the environment, it also reduces operating costs, enhances building and organizational marketability, increases occupant productivity, and helps create a sustainable community [4]. Generally, green buildings are energy efficient, water conserving, durable and non-toxic, with high-quality spaces and high-recycled content materials, which presents solution for large part of Jordan resources problems.

Cam and Ong (2005) defined the roles of building environmental performance domain that can assure innovative design. They argued that there are roles should be taken in concern, particularly the following three: first; being an institutional setting to raise awareness of building environmental to different players in the design and construction sectors in delivering environmental-friendly housing, second; setting benchmarks for building environmental practice to safeguard the minimum performances standards, and evaluating architectural design against these benchmarks; and finally providing a platform for inspiring new designs, ideas and technical solutions [5]. Cooper (1999) on the other hand, clarified the issues that are needed to be defined at first; which are the issue of absolute vs. relative assessments – absolute assessments are considered to be more appropriate and meaningful in assessing sustainability, and the issue of scale – individual building is considered as too small a scale to address sustainable development issues [6].

Using green rating (assessment) system in the design/build process can produce significant benefits that are not likely to result

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from standard practices. Assessment measurements based on building life cycle can produce significant long-term benefits for building owners and occupants [7]; as this system helps for solving existing building problems, limiting environmental impacts, creating healthier and more productive places, and reducing building operations cost. Life cycle analysis takes into account all costs of acquiring, owning, and disposing of a building system. It is especially useful when project alternatives that fulfill the same performance requirements, but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings.

However, making green building practices easier to implement; we should develop technical services and resources for determining the "greenness" of building based on an appropriate green rating system that suits the Jordanian local context.

Building sector has witnessed the development of two types of assessment tools. The first group of these tools includes those, which purely based on criteria system. The second group includes those tools that use life cycle assessment (LCA) methodology. The criteria-based tools can be defined as a system of assigning point values to a selected number of parameters on a scale ranging between "small" and "large" environmental impact. These tools are considered as comprehensive environmental assessment schemes. Among the criteria-based tools are BREEAM (Great Britain) – BREAM (2005); GBTool (Canada) – IISBE (2005); LEED (US)-USGBC (2005); EcoProfile (Norway) – Byggforsk (2005) and Environmental Status (Sweden) –Miljöstatusföreningen (2005) [8–12]. However, since the late 1990s methods for environmental assessment of buildings based on LCA have been developed for the building sector. Most of these methods have aimed to be used for selection of building design, building material, and local utility options (energy supply, waste management and transport type) during the design phase. Within life cycle assessment, different weighting methods based on different basis for valuation are used. Examples of tools of this category that contain LCA component are Bees (USA)-OAE (2004), Beat (Denmark)-DBRI (2005); EcoQuantum (Netherlands) and KCL Eco (Finland) – KCL (2005) [8–12].

Another comprehensive framework for classification of green building assessment tools was established according to the potential functions (applicable areas) of the tools. According to this classification there are two types of tools; the first (D-Tool), tools within the stakeholder and building activity category that are designed primarily to optimize, select, check, predict and evaluate decisions, they include issues describe the methods of green building practice which lead toward certain performance targets. The second (P-Tool), tools within the performance category that are designed for performance comparison and rating, they include issues describe the targets of building activities, which are raised from building environmental science researches. Such issues are in nature more general and stable. In existing tools, P issues and D issues are usually mixed together and listed in one hierarchy framework [13].

Gibberd (2005) stated that sustainable development in developing countries should address social and economic issues as a priority; he suggested, that environmental sustainable development objectives should be acknowledged and addressed in interventions designed to address urgent social and economic priorities [14]. Libovich (2005) also believed that nations of the developing world, cannot afford to be looking at environmental performance only. The social and economic problems are at the top of these countries' agendas. As a result, the development of building assessment methods is becoming necessary in the developing countries in order to diagnose the building-stock's performance and to encourage the building industry to get into sustainable track, and thus by default will directly support social and economical aspects [15].

2. Concept of green buildings in Jordan

According to Agenda 21 (Johannesburg Summit 2002); "Jordan is highly dependent on its poor environment, ensuring that environmental resources -water, soil, plants and so on - are used in a sustainable manner is one of the most urgent obligation to the principles of sustainable development confirmed at the Earth Summit in Rio de Janeiro in 1992" [16].

Jordan is a developing country suffering from the global problems of energy and the increasing of pollution, especially with poor resources of energy and inefficient use of it. In light of this situation, the development plan in Jordan which is being implemented to improve the quality of life for the Jordanian expected that the demand for energy will grow to high levels reaching 3% annually and around 6% annually for the electric consumption. This situation, in addition to the regional development of 2003 have pushed the energy bill to around 800 million JD annually constituting 13% of the gross domestic product (GDP) and around 45% of the value exported goods which is considered by international standards as a heavy burden in addition to the burden of investing in energy production, refining, transport and distribution which amounts to around 150 million JD annually [16–19]. Due to economic growth and increasing population, energy demand is expected to increase by at least 50% over the next 20 years. This state force Jordan to adopt a number of policies that enhance energy efficiency, develop investment energy proposals, supports the sustainable development by using clean and environmentally friendly resources, and apply baseline parameters in accordance with international standards [17].

Jordan has a range of geographic features from the Jordan rift valley in the west to the desert plateau of the east, with a range of small hills running in between. It can be divided into three physiographic regions, each with a distinct climate:

1. The highlands consist of mountainous and hilly regions that run through Jordan from north to south. Their altitude varies from 600 to 1600 m above sea level. Generally wet and cool, also varies from one area to another. The average temperature in Amman ranges from 8.1 °C in January to 25.4° C in July. The temperature during the hottest spells reached 42.8° C.
2. The desert region is an extension of the Arabian Desert, and forms around eighty percent of the country. There is an extreme variation in the climate of the desert between day and night, and between summer and winter. Summer temperatures can exceed 45 °C, while winter nights can be bitterly cold, dry and windy.
3. The Jordan Rift Valley which also runs along the entire length of Jordan. The Rift Valley plunges to over 400 m below sea level at the Dead Sea, becoming the lowest spot on earth, and reaches a maximum width of 15 km. The Rift Valley ends in the south at Aqaba, a tropical resort surrounded by mountains [20].

Jordan is classified among few countries of the world with limited water resources and it is one of the lowest on a per capita basis. The available water resources per capita are falling as a result of population growth and are projected to fall from less than 160 m^3/capita/year at present to about 90 m^3/cap/year by 2025, putting Jordan in the category of an absolute water shortage. The scarcity of water in Jordan is the single most important constrains to the country growth and development because water is not only considered a factor for food production but a very crucial factor of health, survival and social and economical development [21].

The concern of environment and sustainable development has been increased recently in Jordan. Therefore, Jordan established different institutions that concern sustainable issues – environmental,