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Green Architecture Using the DPSIR Model

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Abstract: Green architecture is one of the most important ways to achieve sustainability in architecture. The purpose of this study is to present a model of driving force, pressure, state, impact and response in green architecture. The nine indicators can be studied in this field that were used in the green building process. These indicators are greening index, daily energy consumption index, water resources index, biodiversity index, carbon dioxide reduction index, waste reduction index, basin water index, sewage and wastes improvement index and indoor index. Thermal and air pollution and citizens' costs are among the drivers of green architecture in cities. The costs of people's lives are known as pressure, environmental conditions of cities as the State, the impact of green architecture on cleaning air and reducing wastes, as the impact and the response of urban authorities to the expansion of the green roofs uses and the greening of urban space and buildings as the response. Therefore, there is a lot of driving forces on the use of green architecture in urban spaces in the model, which will lead to appropriate responses from the urban authorities.

Key words: Green architecture, green roof, DPSIR, greening, thermal pollution.

Introduction

Green architecture encompasses a kind of design in which each building provides residents with satisfaction in all physiological, psychological fields, and it must also be exploited by sustainable development strategies. Non-harmful and sustainable natural materials are used which leads to least damage to environment (Hajj Seghti, 2015). Green architecture is one of the most important ways to achieve sustainability in architecture. The term "sustainability" was defined in the UNECE and the UN Development Program for the first time as follows:

"Sustainability is to meet the needs of the present generation without distorting the ability of the next generation to meet their own needs (Butlin, 1989)."

The performance of factories, and widespread and often non-normative construction has had irreparable effects on the ecosystem of the world in recent years. One of the hottest topics in recent decades is the green building to overcome the problems in achieving sustainable development. The green building is also recognized as an example of a sustainable building, with all stages of design, construction, and repair and reconstruction, with efficient environmental management and re-used resources (Burnett, 2007). The green building will be built for specific purposes such as energy saving, urban beauty, mental health, by reducing air pollution, increasing the efficiency of the inhabitants and reducing overall impacts on environment (Kubba, 2012; Mohammadabadi and Ghoreshi, 2011). As a building is a set of interconnected systems such as architecture, structure, coating, electrical and mechanical facilities, building materials and security, how they work together is a key point in knowing and designing green building (Baweja, 2008). Green building does not just focus on environmental factors; this type of building takes into account how the environment interacts with other factors such as cost, planning, implementation, maintenance, and other key issues (Kubba, 2012;

Jahanbakhsh et al., 2017). Green architecture defines an understanding of environmentally-friendly architecture in all categories and contains global satisfaction (Burcu, 2015), it may have many of these features: Ventilation systems designed for efficient heating and cooling, Lighting and energy efficient appliances, Water plumbing with water saving approach, Landscapes planned to maximize passive solar energy, Minimal damage to natural habitat, Alternative energy sources like solar energy or wind power, Non-artificial, non-toxic materials, Stones and local wood, Reply to the harvest from the forest, Re-use of older buildings, Re-use of architectural materials, and Efficient use of space.

Razavian et al. (2010) studied green roofs. They have argued that humans have turned from the past into creating green roofs or roof gardens as an appropriate way to reconcile with nature and change the urban landscape. In fact, the green roof is the use of unused and dead spaces of urban buildings to create green spots. In addition to the cognitive beauty of the city, this causes air clear (on the scale of micro-climax) and the reduction of air pollution and ultimately the improving the environment of the city's residents. Mahmoudi Zarandi et al. (2013) evaluated the effect of green roofs on environmental temperature reduction. Mahmoudi Zarandi and Pakari (2013) expressed the details of green roofing to reduce energy consumption of building. Keshtkar Qalati et al. (2010) studied the development of green roof system based on sustainable development criteria in Iran. The results of their study showed that one of the ways of green roof development and its justification in the country is to define and analyze the ways of its expansion based on the sustainable development criteria. The purpose of this study is to introduce the driving force, pressure, state, impact, and response of green architecture in cities. For this purpose, green building indices in cities were studied.

Materials and Methods

Green Building Indices

In this research, Green Building indices are used to study green architecture indices. These indices are as follows (The New Architectural Concept: The Green Buildings, 2018):

Greening Index: This index includes ecological green, green wall, green wall irrigation, green artificial structure method, green drainage water method and green wind resistance method.

Daily Energy Consumption Index: This index includes building construction with energy efficiency, proper rate of opening the window, sun shade, opening the glass, thermal insulation, air density, building structure, materials, roof structure and wall curtain.

Water Resources Index: It includes a water saving machine, a water use program, rain reuse and a primary source of water.

Biodiversity Index: This index includes the net green system of community, land saving system, ecological lakes, ecological waters, ecological side slopes, design of ecological hedge and porous environment.

Reduction of Carbon Dioxide Index: This index includes simple structural modelling, interior decoration, reasonable construction system, weight reduction structure and the use of wooden materials.

Waste Reduction Index: This index includes good use of re-used building materials, soil balance, dry partitions, baths and air pollution reduction.

Basic Water Index: The index includes permeable land, permeable lakes with an indelible landscape, indelible permeable environment, permeable wells, permeable cube and synthetic structures' durability.

Sewage and Waste Improvement Index: This index includes rain and sewage diversion, improved waste collection, wetlands, sewage treatment, and compost from the kitchen wastes.

Indoor Indicator: It includes indoor pollution control, indoor air purifying equipment, green colour and green building materials.

DPSIR Model

The DPSIR model provides an organized structure for analyzing the causes, consequences and responses to changes in the ecosystem (Ness et al., 2010; Rounsevell et al., 2010). The DPSIR framework is the causal links chain that begins with driving forces and ultimately leads to political responses through pressures on the state and impacts on ecosystems, human health and operations. The DPSIR model generates a set of indicators and provides a framework for widespread use in the field of environmental protection and sustainable development in the international community.

Definition of DPSIR Model Indices

The elements of the DPSIR framework are specified below:

Driving Force

The driving force is a need. Examples of driving forces for people require shelter, food and water, while examples of secondary driving force require displacement, recreation and culture (Kristensen, 2004).

In the field of environment, driving forces, any natural (biophysical) or human (socio-economic) factors that directly or indirectly lead to changes in ecosystems or socioeconomic processes affecting the ecosystem (Schrevel and Kumar, 2010).

Pressure

The driving force leads to human activities, such as transportation or food production to meet the needs. These human activities impose the pressure of production or consumption processes on the environment (Kristensen, 2004); therefore, the pressures are the next results of driving forces on the environment or any kind of socio-economic development associated with it. Pressures are how to identify the driving forces on environment and disturb their ecological state (Schrevel and Kumar, 2010).

State

The environmental state is affected by the pressure. State changes in the ecosystem can be described based on biophysical processes that determine the ecological role of the ecosystem or the basis of natural resources. These changes include changes in the quantity and quality of the various environmental elements in the ecosystem (soil, water, plants, animals, etc.) and their ability to support their demand formed on them (Schrevel and Kumar, 2010).

Impact

Changes in the physical and chemical state of the environment determine the quality of ecosystems and human welfare; in other words, changes in the state are likely to have environmental and economic impacts on ecosystems performance, the ability of ecosystems to support life, and ultimately on human health and social and economic efficiency of society (Kristensen, 2004).

Response

A response by the community or policymakers is the result of unwanted effects and can affect any part of the chain between driving forces and impacts. Responses in the environment can be formed at different levels.

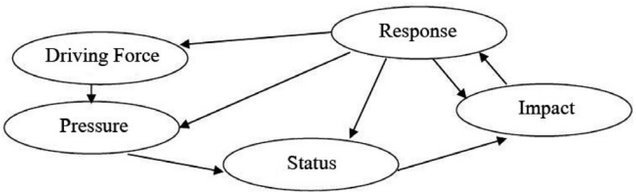

Figure 1: Driving Forces-Pressure-State-Impacts-Response (DPSIR) model (Smeets and Weterings, 1999; Zebardast et al., 2015).

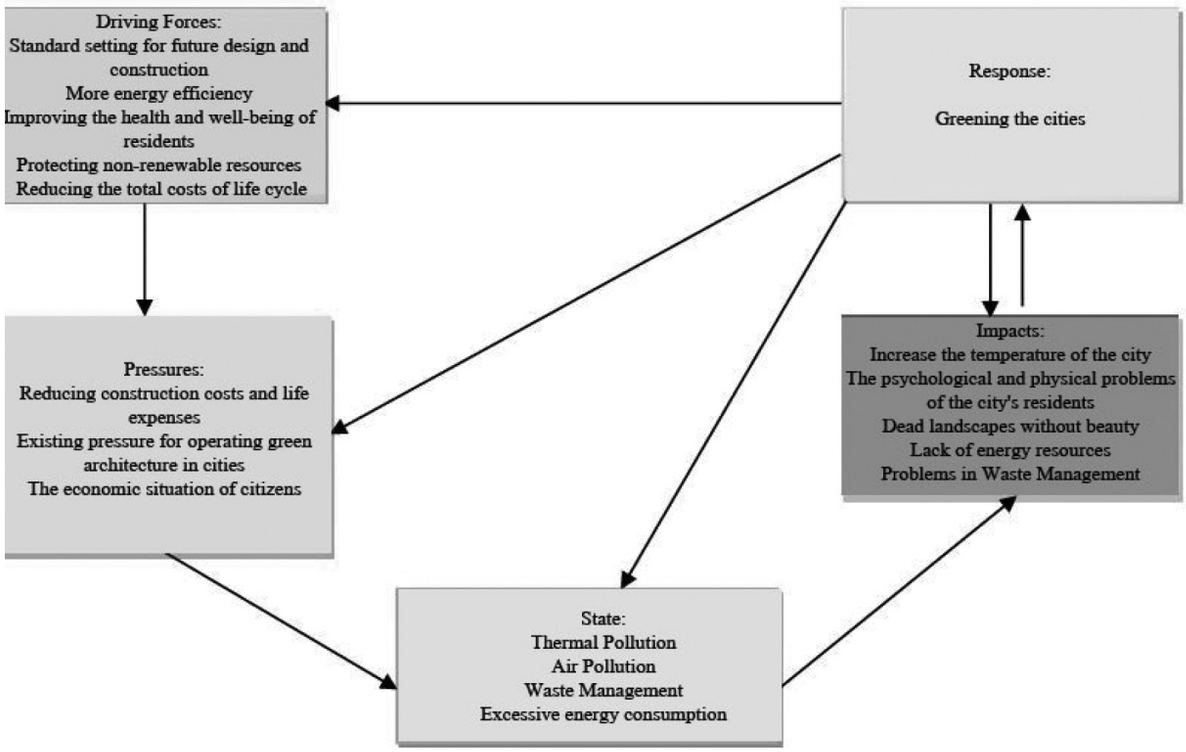

Figure 2: DPSIR model of green architecture.

Results

Driving Forces Indices (Human)

The driving forces behind green building technology in developing countries is "Standard setting for future design and construction," "More energy efficiency," "Improving the health and well-being of residents," "Protecting non-renewable resources," and "Reducing total life cycle costs." (Darko et al., 2017). Considering the green space in urban design and architecture, the existing standards in construction industry will be respected. Large amount of electrical and thermal energy could be reduced with the appropriate green space design (including greening urban space, greenecologic, green wall, green wall irrigation, artificial structure green method, green drainage method, and green wind resistance method) that leads to energy efficiency (daily energy consumption index includes energy efficiency buildings, proper rate of opening windows, sun shade, opening the glass, thermal insulation, air density, building structure, materials, roof structure and wall curtain).

Water scarcity in cities can be a driving force factor in applying the plants in urban space structure (water resources index includes a water saving machine, a water use program, rain reuse and a primary source of water). It is also necessary to increase the amount of rain penetration in urban spaces due to various constructions and different concrete; with the use of plants in urban buildings, the level of penetration to land increases. By increasing the use of green space in urban architecture, air and thermal pollution will be reduced; this will help reduce carbon dioxide and waste. With the proper design of buildings and the use of plants in the structure of public and private houses and buildings, the need for unreliable energy consumption will be reduced and living costs for people will be reduced. Preservation of biodiversity (biodiversity index including community net green system, land saving system, ecological lakes, ecological waters, ecological side slope, ecological hedge design and porous environment). Urban areas are also a driving factor for green architecture in cities. Ultimately, the proper management of wastewater and wastes involves diversion of rain and sewage, improving waste collection, wetlands, sewage treatment and composting of kitchen wastes, leading to more use of green architecture in cities.

Pressure Indices

Driven by driving forces, such as customer pressure to reduce construction costs (Akadiri et al., 2012) and living costs. The pressure available to apply green architecture in cities is the economic condition of the city's people. If the plants are properly used in design of building, energy consumption costs will be reduced.

State Indices

Depending on the physical environment (access to water and soil, vulnerability to soil erosion, land suitability for specific land use), and the extent of the area affected by thermal pollution caused by thermal islands in the cities and includes direct and indirect effects.

Impact Indices

These include urban temperature rise, physical and psychological health problems of city's inhabitants, insolent scenery, lack of beauty, lack of energy resources and problems in waste management.

Response Indices (Response)

It is related to the response of government officials to implementing urban greening plans (such as the use of green roofs, green walls and urban green spaces). With the greening of cities, many of the city's problems will be resolved.

Conclusion

Green architecture is one of the important topics of construction industry. In this study, based on DPSIR's causal model, it was determined that the concentration and population density (resident and non-resident) in cities and, consequently, the need for transportation and, consequently, the use of fossil fuels, is one of the most important driving forces causing thermal pollution inside the cities. The number of vehicles in the city is one of the most important factors affecting the thermal pollution of cities. In the pressure debate, the amount of emission from mobile resources is increasing every year. Based on fuel consumption, the largest share of the mobile resources in cities is related to gasoline, followed by oil, gas, natural gas and liquid gas (Zebardast et al., 2015). Among the various sectors and activities, the highest proportion of emission belongs to the transport sector. In the status section, the number of healthy days has decreased in recent years. The number of clean days has also been the lowest in recent years. Due to less clean and healthy days, the air pollution situation has become less desirable in the cities. The impact of air pollution is clear in human health. Existing responses have also focused on increasing use of plants and greening of landscapes and urban buildings, but the

increasing migration to cities and surrounding areas and the flow of villagers into cities has led to a reduction in impacts of the measures taken.

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Calendar of Events

Watec Italy 2018 Exhibition & Conference
24th to 27th October 2018
Cremona, Italy
Website: http://www.watecitaly.com/
Contact person: Michele Tampieri
Organized by: Kenes Exhibitions

Power of Water Canada Conference
29th to 31st October 2018
Niagara on the Lake, Ontario, Canada
Website: https://owa.ca/conference/
Contact person: Janelle Bates

3rd Asia Conference on Environment and Sustainable Development (ACESD 2018)
2nd to 4th November 2018
Singapore
Website: http://www.acesd.org/
Contact person: Nancy Liu
Organized by: ACESD

The International Conference on Energy, Water & Environmental Sciences (ICEWES)
13th to 15th November 2018
Ras Al Khaimah, United Arab Emirates
Website: http://icewes.aurak.ac.ae
Contact person: Ahmad Sakhrieh

WWEM Water and Wastewater Monitoring Conference and Exhibition November 2018
21st to 22nd November 2018
Telford, United Kingdom
Website: http://go.evvnt.com/207133-0?pid=80
Contact person: Marcus Pattison
Organized by: Marcus Pattison

8th International Conference on Water Resources and Arid Environments
3rd to 5th December 2018
Riyadh, Saudi Arabia
Website: https://www.icwrae-psipw.org
Contact person: David

6th International Conference on Environment Pollution and Prevention (ICEPP 2018)
6th to 8th December 2018
Brisbane, Australia
Website: http://www.icepp.org/
Contact person: Ms. Alice Lin
Organized by: CBEES

5th International Conference on Environmental Systems Research (ICESR 2018)
6th to 8th December 2018
Brisbane, Australia
Website: http://www.icesr.org/
Contact person: Ms. Sophia Du
Organized by: ICESR