

Social Sustainability Indicators in Mass Housing Construction

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In the construction industry, buildings constitute more than half of the new construction built in the world. With the rapid growth of population in urban areas and high-energy consumption of buildings, considerable attention and efforts have been devoted to creating a sustainably built environment. As a result, various sustainable rating systems, principles and tools have been developed in recent years. This paper presents efforts underway for evaluation of sustainability in mass housing construction projects in the Middle East from a social aspect. The study reviews reports, guidelines and best practices at national and international levels to detect key sustainability indicators. The paper analyzes and evaluates the social perspective of sustainable rating systems of Envision, LEED, BREEM, CASBEE and Green Globes. The research team fine-tuned and assessed the indicators extracted from these guidelines through surveys and content analysis. Based on the analysis, four major categories are identified as critical indicators in the decision-making and planning of mass housing construction. This set of criteria aim toward creating a more sustainable society, which have better community and construction interactions; improved health, safety, and livability; lower risk; and neighborhood characteristics from a project life cycle standpoint.

Key Words: mass housing, construction industry, social sustainability, sustainable development

Introduction

In Iran, large cities have been experiencing drastic population growth during the last 20 years because of national regulations encouraging families to have more children. Parallel to this rapid growth of population in urban areas, the cost of living has skyrocketed, which created challenges for families to own a house or rent an apartment. As a result, the government initiated mass housing projects in 2007 to meet the need of the growing population. According to the government's plan, affordable residential units would be constructed in a way that low income families would become the owner of the houses in a 99-year lease contract. While most of these projects were developed in some populated cities such as Tehran, the project was originally planned in undeveloped areas to reduce the overall cost of construction. This also helped to grow the economy of the undeveloped areas by creating new communities. However, mass housing in undeveloped areas requires providing urban services, facilities, and major infrastructure work. While building these mass housing projects is crucial to the community, it is often accompanied by limited studies that address the lifecycle of projects and their long-term effects. Thus, there is a need to assess the economic, social and environmental feasibility of these new developments in creating a sustainably built environment whether it is in a rural or urban setting.

The mass housing project initiated by the Iranian government is referred as the "Mehr Housing Project." The project is designed to provide approximately 4.4 million housing units. The scale of such a mega project calls for a closer look and evaluation from the aspect of sustainability. Sustainable development generally addresses the efforts for development without neglecting the future generation's needs (WCED 1987). The term sustainability has been particularly tied to the construction industry with the belief that the industry can play a major role in creating a more livable place and sustainable future. The industry can affect this development from conceptual design to operation and maintenance through the integration of materials and methods, efficient use of resources, and a better understanding of building processes from a lifecycle approach. In short, the construction industry can embrace the preservation of the environment by empowering innovation and transferability of effective approaches and methods to the next generation. This can be achieved through social inclusion and ethical standards of public consideration, use of renewable materials and energy, and resilient products to list a few.

Typically, sustainable development consists of three main pillars: environmental, economic, and social sustainability. Preserving a balance between these three objectives satisfies sustainability requirements (Sahely et al. 2005). One of the primary steps in assessing the sustainability of a project is to identify the set of indicators that are critical to the society and meets the concept of sustainable development components. As of today, a number of prior studies and research around the globe have identified various sustainability indicators. Sahely et al. (2005) identified the indicators related to sustainability assessment of urban infrastructure systems based on a dynamic interaction between infrastructure and environment, economic, and social systems. Gilmour et al. (2011) studied Scottish government policies, UK government policies, and EU policies to identify sustainable development indicators related to urban infrastructures; in their case it was the Dundee Central Waterfront project. They improved the applicability of these indicators using interviews with stakeholders involved in the project. Shen et al. (2011) examined feasibility reports of various types of infrastructure projects from the Chinese construction industry, and identified and ranked key assessment indicators for assessing the sustainability performance of infrastructure projects based on experts' opinion about the significance of each assessment indicator. The goal of this paper is to review the most common sustainable rating systems in the construction industry to extract and categorize the indicators related to social sustainability. This will help to evaluate mass housing constructions in Iran and other Middle Eastern countries in terms of addressing the social sustainability of new projects.

Methodology

Social Sustainability deals with the social well-being of people (WCED 1987). One way of recognizing social sustainability indicators is to examine existing sustainable rating systems. This is not a new approach as Andreas et al. (2010) investigated a number of rating systems including LEED ND, CASBEE, Cascadia, CEEQUAL and Green Globes, and compiled a table of the most relevant points from each rating system. This finally resulted in a new rating system called ZOFNASS. However, to the best of our knowledge, little work has specifically focused on social sustainability indicators. Given the context sensitivity of social sustainability, such a study seems crucial and this research aims to have such a contribution.

The first step employed in this study was to develop a set of social sustainability indicators by revisiting the most common sustainable rating systems in developed and developing nations. Thus, a worldwide search was conducted to find the top sustainable rating systems. The search resulted in identifying Envision, LEED ND, BREEM Communities, and CASBEE for urban development; and Green Globes for new construction.

The second step utilized in this study is a content analysis approach to extract the indicators related to the social aspect of sustainability in each rating system based on the following procedure:

1) Indicators with similar contents are detected among sustainability rating systems. These indicators were blended together to form a comprehensive indicator.
2) The indicators related to bringing "welfare" to human beings are considered as social indicators. Sahely et.al (2005) outlined some aspects of this concept under the "Engineering criteria" section.
3) The whole life cycle of a project is considered when extracting the indicators.
4) After screening local projects and careful consideration of the cultural needs of local communities, the authors determined some culturally relevant indicators.
5) Each indicator has its own sub-indicators (Example: When talking about a building, the indoor environment standards are one of the sub-indicators. However, one may define indoor environmental standards indirectly through specifications such as ventilation, lightning design, and thermal comfort. This can be even further divided into parameters to evaluate each specification.) To avoid complexity in such cases, the

authors considered the most cited sub-indicators in the rating systems and overlooked their specifications and parameters.

Finally, after implementing the procedure above, the indicators were categorized using content analysis. Using face-to-face interviews with experts in the construction field, the indicators and their corresponding categorization were verified. It is important to note that these results must be tailored in case-based studies to address particular needs, norms, concerns, and cultural perspectives of communities.

Social Sustainability Indicators

Social sustainability indicators that assess the mass housing projects were categorized into four broad categories: *construction and community*; *health, safety and risk*; *livability*; and *neighborhood characteristics*. Indicators in each category are illustrated in Tables 1-4.

Indicators related to *Construction and Community*

This category generally deals with the impact of construction on the community. The study identified 13 construction and community indicators that impact development during the construction phase. There are not similar or ambiguous terms or contents across the rating systems and the research team believed this class of indicators does not need any sub-indicators. An acceptable development is one that fosters positive economic growth, enhances improvement in the social life of local residents and preserves sensitive areas during and after construction. These indicators ensure that the interaction of the construction process and community, in developed and undeveloped areas, are positive. Table 1 shows the indicators related to construction and community.

Table 1: *Construction and Community* Indicators

No.	Indicators
1	Job opportunity creation and business attractiveness (encouraging businesses from near communities to consider new branches in the developing community because of overall benefits)
2	Community workforce training
3	Use of local firms and workforce
4	Community engagement in the process of design and construction
5	Encouragement of social interactions
6	Promotion of socially equitable communities (by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community)
7	Development based on community needs
8	Rehabilitation of the existing infrastructure assets
9	Creation of positive impacts on surrounding communities
10	Business attractiveness (businesses want to relocate to the area because of the overall benefits and attractiveness)
11	Preservation of views and local character (for example, natural landscape) and conservation of natural resources (farmland, forests etc.)
12	No use of force on local residents to move out
13	Minimization of congestion and parking lots restriction during construction as a result of location of the project site (if the construction is in a previously developed area)

Indicators related to *Health, Safety and Risk*

The main goal of this category is to assess the influence of the project on improving the health of local residents, considering safety to bring a convenient life for residents, and forecasting the risks to avoid or mitigate outcomes of catastrophic disasters in the community. Table 2 shows 14 indicators related to Health, Safety, and Risk. It is important to note that some indicators required sub-categories. In this study, whenever an indicator does not possess sub-indicators, it is marked as 'Not Applicable' (N.A.).

Table 2: *Health, Safety, and Risk* Indicators

No.	Indicators	Sub-indicators
1	Improvement of walkability and cycling among community members	N.A.
2	Improvement of physical and mental health and social capital by providing a variety of open spaces close to work and home to facilitate social networking, civic engagement, physical activity, and time spent outdoors	N.A.
3	Mitigation of sunlight obstruction	N.A.
4	Provision of surfaces with high solar reflectance index (SRI)	N.A.
5	Water-related indicators	- Provision of safe drinking water - Taking full account of current and predicted future availability of water - Provision of water and sewage treatment facility - Provision of domestic water supply in an emergency
6	Elimination of nuisances	- Poor air quality - Light pollution (lights directed skyward, street lighting, signage, etc.) - Odors, noise, vibration, and dust
7	Providing proper evacuation routes	N.A.
8	Crime prevention performance (constant surveillance)	N.A.
9	Completeness of backup systems and separation of circuits to reduce risks of service interruptions (Electricity, gas)	N.A.
10	Margin of extra capacity in equipment output and pipe and wiring spaces for district heating and cooling etc.	N.A.
11	Emergency generators (to provide power supplies for necessary loads in the event of an interruption of infrastructure in the project area)	N.A.
12	Provision of urban fire-retarding divisions	N.A.
13	Risk associated with the material, technologies, methodologies, and equipment used in construction	N.A.
14	Risk associated with the development	- Natural disasters (short-term hazards) * - Climate change (long-term hazards) ** - Man-made hazards***

*like flood, storm, earthquake, draughts, hurricanes, tsunamis, wildfire etc.
**like desertification, sea level rise, heat waver, changes in temperatures, humidity, precipitation, etc.
***like hazardous materials spills, terrorist attacks, epidemics, biohazards etc.

Indicators related to *Livability*

The goal of this category is to describe the indicators that make the development more sustainable by contributing to a better quality of life for local residents. In comparison to the first category, livability mainly evaluates facilities after the construction or commonly during the operation phase. Table 3 shows six indicators related to the Livability.

Table 3: *Livability* Indicators

No.	Indicators	Sub-indicators
1	Traffic load Consideration (For workers who works outside of the community)	N.A.
2	Jobs proximity (For workers who works outside of the community)	N.A.
3	Provision of basic services	Bank and financial institution, gasoline station, gym, health club and exercise studio, hotel and boarding house, laundry and dry cleaner, restaurant and café, reliable telecommunication services, reliable electricity (such as mobile, internet access, and telephone lines), postal facilities and reliable and effective public transportation
4	Provision of civic facilities	Adult and child care, educational facilities, family entertainment venue (theater, sports), government office that serves public on-site, place of worship (churches, mosque), cultural art facilities (like museum), hospital or medical clinic, recreational facilities, police or fire station, public library, administrative offices (municipal offices etc.), public park and social services center
5	Provision of stores	Supermarket and food store, clothing store, farmer's market, hardware store, electrical store, pharmacy store, plaza, and other retails.
6	Provision of decent housing	- Affordable housing - Diversity of housing types - Availability of affordable units to meet future demographic trends in area - Considering minimum space standard in all housing development - Design, construction, and retrofit of buildings that utilize green building practices. - Indoor environmental standards

Indicators related to *Neighborhood Characteristics*

This category specifies the indicators that make the neighborhood a more suitable place to live by considering the physical layout of the neighborhood. The provision of convenient connection, the consideration of the best location of the site and aesthetic considerations in the neighborhood are among the most important indicators in this category. Table 4 shows nine indicators related to Neighborhood Characteristics.

Table 4: *Neighborhood Characteristics* Indicators

No.	Indicators	Sub-indicators
1	Selection of a suitable location for project	- Topography is relatively flat - Building is being constructed on a previously developed site served by existing utilities before construction - Building is being constructed on a remediated brownfield site - Project is located in a place that has a connection with near communities
2	Planning of building group layout and forms to avoid blocking wind	N.A.
3	Reliable roads to connect to other cities	N.A.
4	Management of surface water run-off	N.A.

No.	Indicators	Sub-indicators
5	Reliable streets	- Availability of parking lots - Provision of street furniture - Adequate street width
6	Reliable sidewalk	- Walkable sidewalk (safe, appealing, and comfortable) to encourage walking, bicycling - Accessible to multi-modal transportation - Provision of footbridge over passes - Continuous sidewalks or equivalent all-weather provisions for walking - Appropriate lighting design of pedestrian pathways - Safe crossing points - Foot path is designed with consideration of all users including the disabled, elderly and children - Provision of shade over sidewalk
7	Aesthetic considerations in the neighborhood	- Aesthetic quality of project (for example, consideration of building colors, form, heights, materials etc.) -Use of public art in neighborhood (for example, consideration of wall cladding materials and color harmonization) - Greenery provision (trees, bushes etc.) - Designing of project in a way that maintains the local character of the community - Continuity between building style within development and surrounding area

Discussion

The indicators described in this study reflect the main concept behind social sustainability in five well-accepted sustainability rating systems. In comparison to city development plan (CDP), the concept of sustainability is more of a new trend, which started to be recognized in the 80s using different naming. Although it has been in existence for quite some time, it falls in line with CDP. For example, taking a closer look at Tables 2 and 3, the indicators are directly related to city development plan, but better thought out. This study divided the indicators based on their applications and similarities and verified the classifications using face-to-face interviews with experts. It is important to note that one can divide the indicators in multiple ways. For instance, a statistical approach such as principal component analysis can be used to identify the correlation among the indicators. This type of analysis can classify whether a community indicator is related to a non-technical indicators such as “encouragement of social interactions,” or indicators related to construction, or technical indicators such as “consideration of minimum space standard in all housing development.” Alternatively, one can classify them based on whether a mass housing project occurs in previously developed areas (like suburban areas) or undeveloped areas (in open land between two cities). However, the authors decided to have a comprehensive list of indicators to evaluate mega projects such as the “Mehr Housing Project” as a primary step in this research. It is also important to note how these indicators are measured; where some of the indicators, such as “water quality” or “job proximity,” can be measured quantitatively, while some such as “development based on community needs” can be measured qualitatively. The research team is working towards designing a novel approach that applies in the evaluation process for the case study and developing a performance matrix as a next step. Finally, it is worth mentioning that in mass housing projects, such as the “Mehr Housing Project,” there are lots of decision makers and stakeholders. In order for these players to make a huge impact in the community and make reliable decisions, the concept of sustainability must be well defined and it should be implemented from the early stage of project initiation. It must also be set under a policy by agencies such as the Ministry of Housing and Land Development.

Conclusion

This paper presents a set of sustainability indicators to assess mass housing construction megaprojects from the aspect of social sustainability. This was achieved through analysis of the most common sustainability rating systems, and adding community-specific parameters by consulting with experts. Subjectivity of the topic “sustainability” in general and “social sustainability” in particular can be mentioned as the main challenges in developing the indicators. In addition, when it comes to social sustainability, it may be difficult to apply the solution derived in one project to another. As every construction project is unique, every problem is eventually case-specific and solutions must be context-sensitive. Demography, culture, historical background, norms, and standards of a community are among other attributes that govern the sustainability of the development process. Starting from an aggregation of worldwide best practices and fine-tuning it for application at local levels is the approach followed by our research. The present paper reports an ongoing study and preliminary approach of addressing sustainability in developing nations. Classification and aggregation of indicators offered by different rating systems are involved in levels of subjectivity. In many cases, different indicators overlap or consider the same parameters of the system from different angles. Also in some cases, indicators offered for infrastructure systems are required to be tailored to fit the scope of mass housing construction. At the end, the authors believe that the proposed set of indicators can be applicable to practitioners in the construction industry ranging from designers and constructors to users and policy makers, although it may require modifications to reflect real attributes and needs of local communities. Having in hand this set of indicators, the next step in our research is to conduct an empirical case study to assess mass housing construction in the developing nations of the Middle East and Sub-Saharan Africa. The result of the case study will contribute to the body of knowledge by providing social sustainability assessment of mega projects. This will allow decision makers at the government level to make more sustainable decisions in the future for similar projects or at least make efforts to change the previous projects to be more sustainable. The result could also be of interest to similar projects in different countries. The case study is underway and the results will be reported elsewhere.

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