A CONTEXTUAL FRAMEWORK FOR THE DEVELOPMENT OF A BUILDING SUSTAINABILITY ASSESSMENT METHOD FOR IRAN.

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Abstract

As one of the fastest growing countries in the Middle East, and the one most vulnerable to climate change, the main challenge now facing Iran today is how to house its growing population in a socially, economically, and environmentally sustainable way. However, in the absence of a national framework to guide the sustainable development of the built environment, responding to this challenge is problematic. The articulation of a comprehensive assessment method that would enable issues of sustainability to be addressed and incorporated within building construction projects is urgently required. The research that underpins this paper takes account of current tools in aiming to support the development of a national building sustainability assessment method (BSAM) for use in Iran that involves the identification of sources of impact, specific benchmarks, and priorities for a weighting system for assessment criteria. This paper profiles the basis of a contextual framework that will inform the development of such a regional-based tool, taking account of Iran's current climate change adaptation policies and priorities, its environmental conditions and socio-economic challenges, building typologies, standards and benchmarks.

Keywords: *Iran, Sustainability, Building Assessment Method, Climate Change Adaptation, Building Codes.*

INTRODUCTION

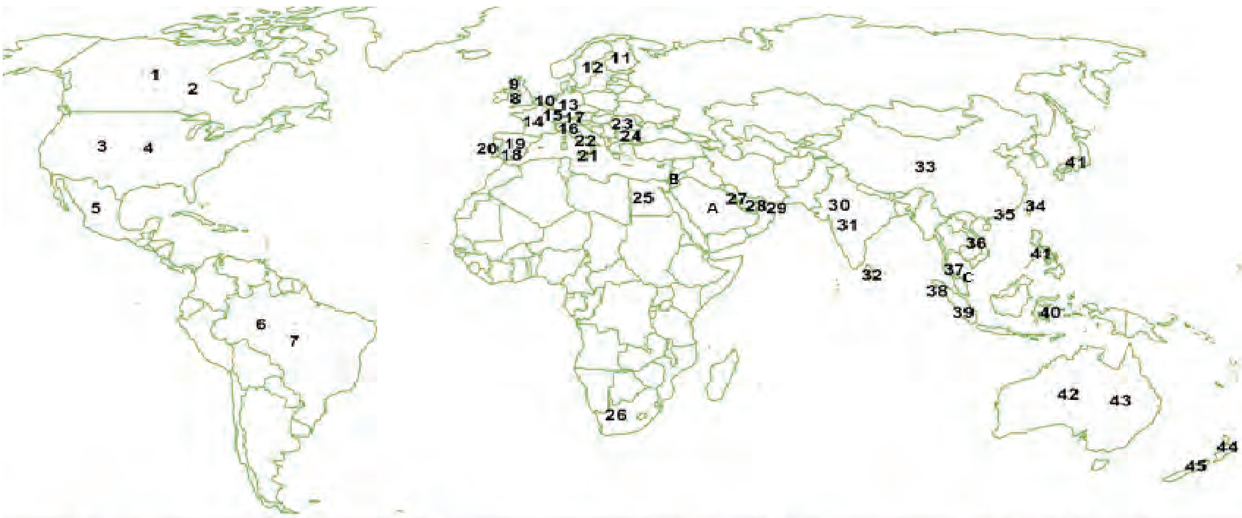
Following the publication of the Brundtland Commission report in 1987 (WCED, 1987), the concept of sustainable development has evolved significantly from a set of initially loosely related environmental concerns (Rodwell, 2007) to signify the practice of protecting the natural environment through the inclusion of social, economic, and cultural dimensions of human activities. As a result of major international action plans and agreements, such as *Agenda 21* and the *Kyoto Protocol*, sustainable development (SD) has now become a policy priority for governments across the world. Today, issues of climate change adaptation and the promotion of SD principles are acknowledged through the development of international and national policy decision-making. Most countries across the world have begun to implement required actions to achieve concrete measures in mitigating climate change through imposing new requirements and conditions on their industrial and economic activities. The construction and property sector occupies a central position in the SD process particularly because of its material throughput, its scale of resource and energy use, and its faster rate of increase in energy use compared to other sectors (Schropfer, 2012). In response to this, many initiatives are being implemented at the scale of built environment, involving, for example, the introduction of new building codes, energy regulations, technical guides, and assessment tools. Many of these responses have tended to focus on aspects of energy efficiency and performance in buildings. However, more recently the transition from energy performance to sustainable performance, involves a shift from technical-based building codes and single criteria evaluations (e.g. energy performance), to a more holistic performance-based approach - an evaluation of buildings that considers a broader range of sustainability factors (Cooper, 1999; Kaatz , et al., 2006). Within the context of this broader framework of considerations, Building Sustainability Assessment Methods (BSAMs) can contribute effective and practical tools for the built environment to *"provide a structured means of incorporating performance targets and criteria into the design process"* (Crawley and Aho, 1999).

In recent years, the important role of BSAMs in addressing climate change adaptation measures within the design and construction sectors has led to the development of several building assessment schemes around the word. Influenced by the most widely known schemes – BREEAM and LEED – many countries have now adopted one or more of the existing schemes or have developed their own national assessment methods. Although the application of most BSAMs are voluntary, their role in effecting market transformation (Cole, 2005), enforcing building codes and regulations, and serving as design guidelines have now seen them emerge as an essential tool for supporting a sustainable construction process. Indeed, some countries have now introduced them as mandatory building codes and some others have accepted them as an alternative route to complying with building regulations (Crawley and Aho, 1999). Despite an increasing demand stimulated by the introduction of national and international sustainability policies, building codes, and assessment tools around the world, Iran has yet to introduce a cohesive framework to address sustainability issues in the built environment, particularly within its construction sector. Under broader sustainable development policies, the country requires to develop objective frameworks for different sectors and organisations in order to tackle climate change and achieve its own SD targets. Considering the important role of construction, and specifically the housing sector, in Iran's economic well-being, and as a major consumer of energy and resources, this sector urgently requires a set of policies and tools, comprehensive building codes, and guidelines and frameworks to promote ecologically-based SD that are aligned with overall national policies. This research aims to support this alignment through the development of a national building sustainability assessment method (BSAM) for use in Iran involving the identification of sources of impact, specific benchmarks, and priorities for a weighting system for assessment criteria. The paper profiles the basis of a contextual framework that will inform the development of such a regional tool, taking account of Iran's current climate change adaptation policies and priorities, its environmental conditions and socio-economic challenges, building typologies, standards, and benchmarks.

CURRENT BUILDING SUSTAINABILITY ASSESSMENT TOOLS

Currently, there are two main ways to address sustainability concerns within the built environment: through policy and regulatory instrument and through assessment tools (Du Plessisa and Cole, 2011). While traditionally, national legislation, primarily concerned with the energy performance issues of buildings, was considered as the main driver to deal with environmental concerns within the construction industry (Du Plessisa and Cole, 2011), building assessment tools are increasingly addressing a broader range of sustainability issues (Cole, 1999). Although the first generation of these tools were striving solely to address environmental performance of individual buildings, most recent versions have started to consider sociocultural and economic dimensions and a wider range of applications for different projects based on their scale and function. Worldwide, there are now more than 40 assessment tools/ certification schemes available for evaluating sustainability issues of the built environment. Most of the tools developed in recent years embrace similarities in terms of their approach, methodologies, rating systems, scope of assessments, and list of criteria. All introduce a broad range of sources of impacts structured under different categories such as energy, site, water, waste, indoor environment quality, and construction process, leading to a specified rating scale which determines the overall sustainability performance of the building. In some cases the tools link to other government policies and regulations, while many adopt criteria and standards that go beyond the policy standards set in the countries in which they are used (Reed, et al., 2009).

The success of assessment tools in creating positive change by furthering the promotion of higher environmental expectations and serving as a potent mechanism for affecting change in the building sector (Cole, 2005), has resulted in a rapid increase in the number of methods being developed worldwide. However, increased international interest in developing new market-based (or research-based) tools has highlighted problems associated with the use of existing generic systems for different contexts. The demand for significant organisational and financial resources, training, technical support (Cole, 2010; Crawley and Aho, 1999), and the need to comply with strict brand rules and quality conditions present a substantial challenge in adapting an existing tool (Cole, 2006). Crucially, individual characteristics of each country, such as historical background, climate, geography, culture, type of building stock, resources, building standards, and policies and governmental schemes necessitate the development of an individual sustainability-rating tool for that country. The use of specific local indicators in the rating systems and their credit allocation methods renders the term "sustainable construction" subjective (Alyamia and Rezguib, 2012) and confirms that assessment tools are not fully applicable to all regions (Crawley and Aho, 1999). Furthermore, the ultimate success of an assessment tool will inevitably rely on its acceptance and on the recognition it receives from the local community and industry. As suggested by Du Plessisa and Cole (2011), participation and input from stakeholders is essential in achieving the most effective change in shaping design and practice. Stakeholders' engagement can provide a robust and verifiable support structure for the implementation, opera-



America			Europe			Africa and Middle East			Asia and Australia		
Canada	1	Green Globes	**UK**	8	BREAM	**Egypt**	25	Green Pyramid	**India**	30	LEED India
	2	LEED Canada		9	SPeAR	**South Africa**	26	Green Star SA		31	TGBRS India
USA	3	LEED	**Netherlands**	10	BREAM NL	**Qatar**	27	QSAS	**Sri Lanka**	32	Green SL
	4	Green Globes	**Finland**	11	PromisE	**UAE**	28	Estidama	**China**	33	BEAM Society
Mexico	5	LEED Mexico	**Sweden**	12	Miljo Byggnad		29	LEED Emirates	**Taiwan**	34	ABRI
Brazil	6	LEED Brazil	**Germany**	13	DGNB	**Saudi Arabia**	A	SEAM	**Hong Kong**	35	HK-BEAM
	7	AQUA	**France**	14	HQE	**Jordan**	B	SABA	**Vietnam**	36	LOTUS
				15	CertivéA				**Malaysia**	37	Green Building Index
			Switzerland	16	SPIN					C	MOBSA
				17	Minergie				**Singapore**	38	BCA Green Mark
			Spain	18	GBC Verde					39	SGP 2012
				19	BREAM ES				**Indonesia**	40	Greenship
			Portugal	20	Lider A				**Japan**	41	CASBEE
			Italy	21	Protocollo Itaca				**Australia**	42	Green Star
				22	LEED Italia					43	NABRES
			Romania	23	RoGBC				**New Zealand**	44	Green Star NZ
			Bulgaria	24	Bulgaria GBC					45	Homestar

A,B,C are research based Tools

Figure 1. Map of Current Global Building Sustainability/ Environmental Assessment Rating/ Certification Tools (Source: Authors).

tion, and management of an assessment tool (UCD & IGBC, 2011).

The interdependent and holistic nature of sustainability requires the inclusion of sociocultural and economic issues (as well as environmental issues) that rely on stakeholder engagement and their "stories and aspirations of place" (Du Plessisa and Cole, 2011). This inclusion of stakeholder engagement can help respond to main areas of criticism where tools are a) struggling to recognize regional distinctions, b) lacking to offer a holistic approach towards sustainability issues, and c) offering insufficient methodological transparency (Kaatz, et al., 2006).

Figure 1 maps recently developed tools including those introduced by government as a country's national tool (such as QSAS in Qatar, Estidama in United Arabs Emirates, GBI in Malaysia, Greenship in Indonesia, LOTUS in Vietnam), and those developed as a research-based tools (such as GBtool/SBtool developed as an international tool with the collaboration of 21 countries through Green Building Challenge (GBC), MOBSA developed by Zalina Shari for Malaysia, SABA developed by Ali & Nsairat for Jordan, SEAM developed by Alyami & Rezgui for Saudi Arabia). Research analysis suggests that: a) a set of core criteria relevant to the assessment context can be driven through the comparative and contextual analysis of existing assessment tools, b) regional specifications can be integrated into the assessment system through stakeholder engagement c) where metrics, data sources and reference benchmarks are not available, consensus based process is the most applicable method to develop performance criteria assessment targets (Todd et Al, 2001).

THE DEVELOPMENT OF A METHODOLOGY: TOWARDS A BSAM FOR IRAN

Developing an assessment method is a multi-aspect procedure, which requires input data from multiple sources and the employment of various methodological approaches. Assessment methods are composed of three main elements:

- Assessment criteria: identifies the sources of impacts that should be taken into account and assessed against performance benchmarks;
- Benchmarks: represent the required performance standard expected to be met by the building industry;
- Weighting of criteria: prioritises assessment criteria based on their international, national and

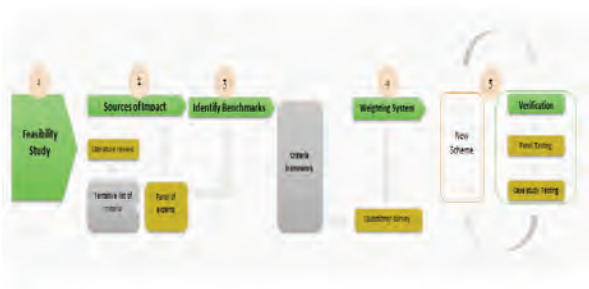


Figure 2. *Methodology for the development of a BSAM for Iran (Source: Authors).*

regional importance, and scale and duration of impact.

These core elements play a crucial role in the validation of the assessment method and have a direct impact on the outcome of the assessment practice. Our research proposes a framework for the development process consisting of five interdepended stages as follows:

Stage 1: Feasibility study

The first step is to conduct a feasibility study in order to explore the country's current progress in striking a balance between its policies and the wider sustainable development agenda, and to identify specific conditions, constraints, goals, priorities and challenges in promoting sustainability strategies within its construction industry in general, and barriers to developing an assessment method in particular. Outcomes of Stage 1 should be discussed and analysed by panels of experts at later stages of the development process, and appropriate measures should be established to overcome existing challenges and constraints and to clarify regional priorities and goals.

Stage 2: Identifying sources of impact

The next step is to identify sources of environmental, sociocultural, and economic impacts that should be included in the assessment method. It is acknowledged that a set of core criteria have global importance and relevance (i.e. are relevant all assessment methods across the world) and should be included in any new scheme that aims to assess the sustainability performance of buildings (Cole and Mitchell, 1999; Todd and Geissler, 1999). These criteria can be derived from existing assessment methods through a comprehensive comparative analysis of their content and approach, focusing on their areas of convergence and distinction (Cole, 2005). This analysis serves as a starting point in the formulation of an initial tentative list of assessment criteria as suggested by Cole (1999). The list is then subject to multiple modifications by panels of experts in order to fully reflect sociocultural, environmental, and economic requirements at both regional and national scales. Here, the composition of the expert panels is important in developing a flexible assessment method that allows for regional customisation and addresses variations under a single national scheme. Moreover, since assessment criteria are multi-dimensional and require input data from a vast range of different fields, expert panels should include stakeholders from all relevant sectors including academia, industry, and government (Alyamia and Rezguib, 2012). The composition of expert panels also plays a crucial role in receiving acceptance and recognition from relevant communities.

Stage 3: Identifying specific benchmarks

The third step is to explore current standards and industry norms, develop performance targets, and define desired outcomes of assessment criteria and the overall performance of the building. These are also identified through expert panel discussions and consensus.

Stage 4: Identifying priorities and developing the weighting system

The fourth step is concerned with identifying national and regional priorities and measuring the relative importance of various assessment criteria through a questionnaire survey. In order to develop a weighting system based on the priority sets delivered by the judgments of experts, a pairwise comparison methodology involved in the AHP technique (Analytical Hierarchy Process) is acknowledged to be the most applicable approach in synthesising the data and prioritising building assessment criteria for the given context.

Stage 5: Verification, testing, and modification

The reliability and applicability of any assessment method is subject to testing through experts' verification and industry application in case study testing (Cole and Larsson, 1999). In this regard, the new scheme should be sent to experts for verification and further modifications and finally tested through the application and evaluation of case study projects. The results of these studies should inform further refinement of the new scheme.

A CONTEXTUAL FRAMEWORK FOR A BSAM: PROFILE OF IRAN

Climate change and sustainable development

Due to its geographical location, climate, high risk of natural disasters, oil dependent single-product

Figure 3. Oil dependency, climate change and environmental problems in Iran (Source: Iran Daily, February 2015).

economy, overpopulation, rapid urbanisation, energy inefficiency, and unsustainable development patterns, Iran is classified as one of the most vulnerable regions to the impacts of climate change (DoE, 2004). Iran is the eighth largest contributor to the global greenhouse gas (GHG) emissions globally (WB, 2015). The energy sector accounts for the 77% of the country's overall GHG emissions (Nachmany, 2015). Almost all (97%) of the Iran's energy consumption relies on oil and natural gas while only 0.03% of electricity generation is from renewable sources (Nasrollahi, 2009). Over recent decades, Iran's environment has deteriorated and its natural resources have been significantly depleted due to the lack of a coherent vision for sustainable development, inadequate protective legislation, lack of regulations and enforcement, unsustainable patterns of production and consumption, and infrastructural fragmentation (UNDAF, 2004). The result is that today, Iran struggles with many environmental problems in urban areas such as a rapid increase in domestic energy and resource consumption, an increase in pollution, the degradation of scarce water resources, and an increase in the quantity of solid waste. According to Iran's Department of Environment, the average per capita renewable water availability will be reduced by 31% by 2021 compared to 2009 (DoE, 2010). The UN Department of Economic & Social Affairs has reported that 90% of Iran's generated waste is being disposed in landfills, causing environmental damage and contamination of lands and water resources (UN, 2004). Iran is already one of the most seismically active countries with fault lines covering almost 90% of the country (Mansouri, el al., 2008). As a result of the increasing impacts of climate change, it is predicted that the country will be more exposed to environmental risks and severe weather events such as earthquakes, floods, etc. over coming decades (Pahl-Weber, et al., 2013).

In response to concerns on global warming, Iran signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC) *Kyoto Protocol* in August 2005 and and established the Iranian National Committee on Sustainable Development (INCSD) under the supervision of the Department of Environment (DoE) to promote the implementation of SD approaches aligned with the *Earth Summit's Agenda 21* and related international conventions (DoE, 2004 and 2013). Although Iran has yet to develop an official national action plan for SD, a concern for climate change has been incorporated into the country's 20-year Vision Plan (20-VP), its Fifth Development Plan (FDP), as well as other sector policies and regulations (Nachmany, 2015). Iran's current SD strategies emerge from Article 50 of the country's constitution that is dedicated to the environment. According to this Article (The Constitution of the Islamic Republic of Iran, 1979):

"The Protection of the environment, in which current and future generations have a right to flourishing social existence, is regarded as a public duty. In this regard, any economic or other activities causing pollution or any irreparable damage to the environment is forbidden."

The country's 20-VP defines the direction of Iran's development in various fields such as culture, science, economy, politics, and social (EDC, 2003). While the main development objectives within the plan are targeted at social and economic advancements, environmental protection is addressed within a number of articles. The most important aspects refer to the protection of natural resources, the optimisation and reduction of energy consumption, and the promotion of public awareness and the achievement of sustainable development through the development of research activity. Iran's FDP is aligned with the principles of 20-VP and aims to fulfil its goals and objectives, by emphasising the promotion of environmental protection and climate change prevention, while mandating all relevant ministries to develop and implement programs leading to the reduction of GHG emissions. The FDP anticipates that through the adoption of policies established in 20-VP, the country will be able to reduce its GHG emission by 30% by 2025 (Nachmany, 2015). The Iranian government has also announced a further possible reduction in emissions of 34% by utilising the technical and financial assistance of international institutions (Nachmany, 2015).

Given the context of Iran as one of the major producers and consumers of fossil fuel energy, the government's climate change adaptation plans mainly focuses on the following areas: developing renewable energy plans and related technological improvements, developing a Subsidy Reform Plan, enforcing electricity duty, changing the culture of consumption and promotion of productivity and efficiency within all sectors and industries, and establishing energy standards. However, there are few policies and frameworks to directly promote the sustainability and energy efficiency of the built environment related to the construction sector. The main legal instrument in this regard is within the *Iranian National Building Code,* where there is a stated focus on energy savings at the level of single buildings, emphasising U-factors (thermal insulation properties) of a building's envelope and its components, and proper overall insulation (Nasrollahi, 2009). Iran's legislation on *Altering Energy Consumption Pattern* also calls for a change in the culture of consumption stressing on the importance of energy efficiency in residential and commercial buildings through the provision of power plants. The FDP also obliges municipalities to comply with the building codes and regulations to retrofit buildings and modify the pattern of energy consumption in buildings with a primary emphasis on residential buildings. The *National Rules of Procedure for Implementation of the UNFCCC* and the Kyoto Protocol, which were developed by the Department of Environment (and approved by the cabinet in 2009), oblige all ministries and organisations to develop their own Climate Change Action Plans, prepare relevant assessments and benchmarks, and introduce respective policies, legislations, guidelines, and frameworks. The development of a national building sustainability assessment method (BSAM) for use in Iran should help to address this obligation.

The Construction industry and housing sector

Housing is one of the most important sectors to Iran's economy attracting about 40% of the country's total annual investment, and contributing more than 20% of annual fixed capital formation. The sector generates over 8% of GDP and constitutes 12% of the employment of Iran's working population, while at the same time accounting for 33% of household expenses (World Bank, 2004). Throughout recent decades, the main challenge facing Iran's government has involved economic-related housing problems and the need to meet housing demand with an emphasis on affordable housing for lower and middle income families. Iran's housing stock of 198 units per 1,000 residents is already low by international standards (World Bank, 2004) and it is estimated that at least

Figure 4. *Construction work on a high-rise building in the foothills of the Alborz Mountains in Tehran, April 15, 2010. (Source: REUTERS/Caren Firouz, April 2010).*

4 million new homes are required to meet the demand for the next five years (Shahriari, et al., 2014). In this context, providing affordable homes and relevant infrastructure has long been an urgent priority for the government. The provision of high density residential complexes within its cities (such as Mehr Housing Scheme) and the creation of new residential towns around metropolitan cities (such as Andisheh, Pardis and Parand near Tehran) have been two key responses by the public sector to this rising demand. However, the lack of an integrated planning and management system and the very slow pace of infrastructure deliveries have hindered progress. Economic constraints and the lack of efficient building codes and legislation have also resulted in poor construction quality of those residential units provided. Additionally, as real estate development is seen as a profitable investment in Iran, developers are consistently compromising the quality of design and construction in order to achieve greater profits in a shorter period of time (Sarkheyli, et al., 2012). In many cases, developers are even happy to pay fines for violations of rules and building codes since these have little financial impact (Pahl-Weber, et al., 2013) on their profits. Consequently, this has led to the deterioration of the urban fabric and has had a significant negative impact on the natural environment.

The World Bank has reported that Iran does not have an integrated building code to support and encourage SD and the use of appropriate technology (World Bank, 2004). In order to mitigate a building's vulnerability to natural disasters, building regulations in Iran implicitly favour steel and concrete structures, thus promoting modern energy-intensive materials. Iran's building sector is responsible for 42% of total energy consumption and the fastest growing sector (Riazi and Hosseyni, 2011). The residential sector has the highest energy consumption contributing to the 23% share of total CO_2 emission in Iran (World Bank, 2004) with heating and cooling being the main consumers with 83% of total energy used (Riazi and Hosseyni, 2011). There is also a considerable amount of wasted energy in the residential sector due to inefficient construction methods and processes and energy intensive household appliances (Farahmandpour, et al., 2008). Moreover, municipality supervision lacks the capacity to perform any effective form of quality control. The lack of an integrated building code has led to the proliferation of structures in Iran that contain energy-intensive materials, consume enormous amounts of energy, release large amounts of carbon dioxide, use the most wasteful construction techniques, have poor design and air quality, and have little to offer in terms of cultural and social needs of their occupants. It is clear that Iran needs to revise urban planning regulations, upgrade infrastructure, promote cost-effective, energy-efficient, environment-friendly housing typologies and reduce the use of hazardous materials, make provisions for increasing effective life and durability of building stock, through a revision of standards, and completion of the remaining parts of Iranian National Building Code (World Bank, 2004). The development of a national building sustainability assessment method (BSAM) for use in Iran should help support this process.

Building typology and climate

Recent research work considers the natural and climatic characteristics of different regions of Iran and introduces various classifications each presenting a different approach for different purposes. Considering required thermal properties of buildings, the country can be divided into 8 large climatic zones (Kasmaei, 1992). Kasmaei's classification has been approved by Iran's Ministry of Housing and Urban Development as the authoritative document for the climatic classification for building design purposes (Kasmaei, 1992). However, his classification can also be grouped into four main climatic zones that not only represent geo-climatic variation but also represent sociocultural factors and similarities in lifestyle and building typologies. Such classification is widely acknowledged by other researchers in the field of climatic responsive architecture and is more relevant to our research as it also represents socio-cultural diversities of the regions (Ghobadian, 2015). The table below shows the climatic classification of Iran and associated traditional building typologies featuring different climatic responsive strategies based on both sociocultural and environmental necessities of regional conditions.

Despite having a rich history in climatic responsive architecture, environmental factors have largely been ignored in the formation of modern buildings in Iran, as construction shifted from craft-based to industry-based practices. Subsequently, with the introduction of new materials, building technologies and equipment, and construction techniques, building typologies completely transformed in favour of a modern lifestyle. Diversity of buildings in different climate regions of Iran has lost its ground and has been replaced by homogeneous building types in different regions of Iran. Planning controls and building regulations have also played a very important role not only in limiting and regulating construction practices but also by encouraging the introduction of new generic housing typologies. New controls have largely dic-

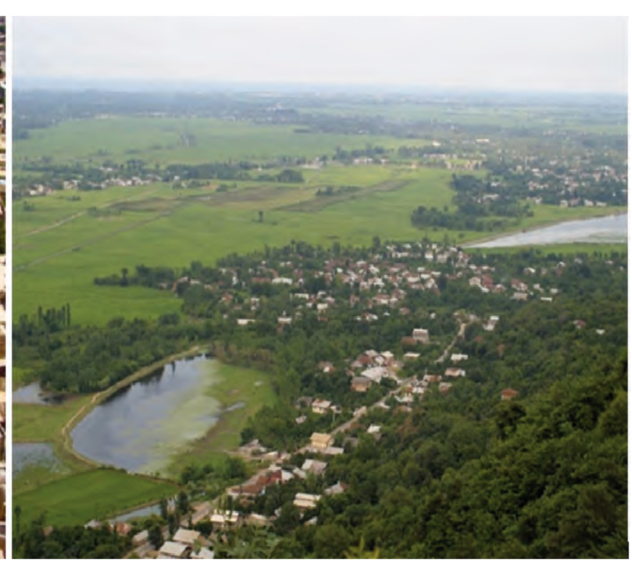


Figure 5. Different traditional building typologies in different regions of Iran. Left, Yazd in central plateau (Source: Ghods Online News, January 2014). Right, Langrood in North of Iran (Source: Pejman Marzi, March 2015).

Climatic Zones	Architectural Typology and Housing Features			
	Urban setting	Building form	Climatic responsive strategies	Materials
The Northern Coastal Region – Temperate Climate **-Plain areas with high average precipitation between 1 to 2 m annually** **-high humidity with relative humidity above 70%** **-little gap between the temperature of clod and warm seasons** **-very dense forests in highlands and vast cultivable lowlands**	Low density urban fabric Plenty of green spaces, forests, and agricultural lands	Detached buildings (mostly villas) Outward orientation Large yard around the building Four sided gable roofs Large balconies around the building No basement Higher ground floor above ground level	Multiple external openings to facilitate cross ventilation Simple interior layout Steeped roofs Large veranda around house to mitigate humidity & increase ventilation Higher ground floor to avoid damped soil Orientation based on prevailing wind	Wood, timber Interlocking log Thatch Roof tiles Mud and straw for plastering
The Central Plateau Region – Hot and Dry Climate **-Very low humidity and precipitation throughout the year with --Average annual precipitation between 15 to 30 cm** **-Covered by deserts with little vegetation cover** **-Frequent dusty winds**	Very compact urban fabric Very little green spaces only inside courtyards enclosed urban spaces narrow shaded streets	Attached buildings Inward orientation Central courtyards No external openings Ground floor and courtyard lower than entrance and street level Large basements Shaded verandas High ceilings Thick walls Vaults or domes - convex roofs	No external openings Micro climate through lower ground floor courtyard, vegetation and water features, and shading Wind towers Thick walls with high thermal capacity Multiple openings toward courtyard High external walls to provide shade and avoid sand storm	Brick, clay adobe, straw
The Mountainous and High Plateau Region – Cold Climate **-Extreme cold and warm in winter and summer** **-very heavy snow in fall and winter** **-low humidity in summer** **-Relatively low rainfall with average annual precipitation is about 30 cm**	Compact urban fabric Confined and small urban spaces, Good amount of green spaces and soft landscape	Attached inward oriented buildings Central courtyard Low ceilings Flat roofs Small or no verandas Thick masonry walls	Northeast to Southwest orientation to avoid cold and wind Thick masonry walls high thermal capacity Openings toward courtyard	Rubble or ashlars occasionally brick or adobe Timber for roofs Mats straw for roof
The Southern Coastal Region – Hot and Humid Climate **Hot and Humid climate in Northern coast of Persian Gulf** **-Relative humidity is above 50% throughout the year** **-Very hot and mild temperatures in summer and winter** **-Average annual rainfall is less than 20 cm**	Semi-dense urban and rural fabric Semi-enclosed urban spaces Little green spaces around the building only	Central courtyard A composition of inward & outward orientation Deep awnings and verandas High ceilings Ground floor above ground level	Orientation towards the sea Multiple openings towards central court yard and also on external walls facing sea Wide balconies around the house Wind towers	Stone, brick, adobe, and coral stones Timber for roof Palm tree fronds tied with ropes for roofs

Figure 6. *Architectural features of traditional houses in different climate zones of Iran (Source: Author based on Ghobadian, 2015; Nasrollahi, 2009).*

tated the emergence of typologies that have had a significant impact on urban built form in terms of land parcel, block size, proportion of built area, as well as on built form parameters such as building shape and depth mediated by building regulations (Shayesteh and Steadman, 2013). Since the main building codes apply throughout all regions of Iran there is sparse acknowledgement of regional climatic conditions, which results in the prevalence of similar, often inappropriate building typologies within different regions throughout Iran (Nasrollahi, 2009). The development of a national building sustainability assessment method (BSAM) for use in Iran that takes account of regional climatic differences, should help address this issue.

CHALLENGES AND LIMITATIONS

A review of current assessment methodologies in relation to Iran's contextual framework has highlighted a number of challenges and limitations that require consideration in the development of the new BSAM:

Building codes, legislation, and policies

An assessment system cannot be efficiently integrated into the construction process as a stand-alone tool (Kaatz, et al., 2005). For the assessment method to be feasible, practical, and acceptable, it is vital that it is integrated with relevant guidelines, building codes and regulations, regional and national standards, as well larger national and international policies and programs. In order to ensure successful application, the assessment system must take account of regulatory instruments established by the political-administrative system within the relevant context (Todd and Geissler, 1999). On the other hand, assessment methods can be used to enforce essential modifications in regulatory systems or even inform fundamental policy directives at a regional or national level (Cole, 2005). In another words, it can push the building industry towards better performance (Todd and Geissler, 1999). In the case of Iran, this seems to be substantially problematic since building codes and national policies cannot be incorporated into the assessment system in their current form. As previously discussed, the country's current building regulations can be heavily criticised in failing to acknowledge sociocultural and climatic diversity within different regions. Also sustainability thinking has yet to be embedded within all governmental organisations, executive bodies, and larger policy decisions. Such development takes time and requires fundamental financial, technological, and infrastructural changes, involving the restructuring of the entire sector.

Benchmarks

The development of relevant benchmarks or reference buildings for the identification of assessment criteria and informing the overall evaluation of a building's performance are commonly based on current performance levels and existing industry norms, which means that improvements are evaluated relative to the typical practice in the region (Cole,1999 and 2005; Todd and Geissler, 1999). Different regions possess different environmental and resource capacities (e.g. water and electricity supplies), which entail different management strategies and regulations. Similarly, socioeconomic constraints in different regions require different strategies in terms of urban development, spatial planning, and construction. As identified by Todd & Geissler (1999), "superior performance in one country would be considered standard practice in another. And, a criterion that is very important for assessing the 'greenness' of a building in one region might be of less importance in another region." This raises a significant challenge for the development of a BSAM for Iran. Firstly, due to the inefficiency of the current regulatory system, the development of criteria benchmarks and references, based on current practice norms, inevitably challenges the efficacy of the existing system. Secondly, Iran's regional diversity necessitates the development of a national BSAM that allows for customisation and integration of regional characteristics within the evaluation process. Therefore, benchmarks and references must be developed through regional comparisons while at the same time complying with national goals and objectives.

Scale of assessments

The BSAM must target global impacts while responding to regional concerns but local strategies can often have global impact and equally international policies can effect regional decisions. Therefore, the BSAM must focus on the integration of core criteria with global significance while incorporating customised elements with regional importance (Todd and Geissler, 1999). The scale of assessment can refer to assessment criteria relevant to varying geographic/ physical levels, from building elements and components to the urban, regional and national scale (Edum-Fotwe and Price, 2008). In most cases, the evaluation of an individual building without consideration of extraneous influences such as urban configuration, infrastructure, community facilities, etc. is impossible. Therefore, it is crucial to define the appropriate boundaries for assessment criteria and clarify expectations with respect to an individual building's to contribution to overall sustainability goals.

Infrastructure

The reciprocal effects of a building on its surrounding infrastructure have an inevitably important role in the performance of the BSAM (Todd and Geissler, 1999) since buildings have enormous consequences on the design and operation of the community (Cole, 2005). At the same time, access to infrastructural facilities is essential for the operation of a building. Although Iran has experienced positive social and economic development over the last decade, significant social and economic inequalities across different regions remain evident, particularly in terms of a lack of access to infrastructure and social amenities in rural areas. In this context, Iran needs to upgrade infrastructure in existing sub-standard settlements (World Bank, 2004).

Flexibility in addressing regional differences

The problematic nature of homogenisation has been widely acknowledged in the adaptation of existing assessment methods, where emphasis has been placed on regional differences between developed and developing countries (Cole, 2005). However, as discussed by Todd and Geissler (1999), defining the boundaries of a 'region' is equally important in developing a feasible and acceptable BSAM. The recent enforcement of a standardised national building code has resulted in the formation of remarkably homogeneous housing typology in different regions of Iran. However, Iran's regional diversities necessitate the introduction of a national BSAM that allows for customisation and integration of regional characteristics.

Emphasise on socio-cultural aspects

All aspects of sustainability are holistic and interdependent; hence, sociocultural, economic, and environmental aspects should be all addressed within the BSAM. However, as discussed, there are significant differences in regional priorities in how to address sustainability principals. Environmental assessment methods have originated in developing countries where social and economic infrastructures are already well developed. However, in developing countries differing socioeconomic priorities dictate that domestic constraints on environmental progress are qualitatively different (Gibberd, 2002; Cole, 2005). On a path to SD, developing countries must continue to emphasise the fulfilment of basic needs, and promotion of socioeconomic aspects, while avoiding negative environmental impacts (Gibberd, 2002).

Acceptance and recognition from industry

For an assessment system to be reliable, feasible, and applicable, it is essential to receive acceptance and recognition from the wider community as well as industry. Consequently, the development of a BSAM must involve stakeholder participation in order to clarify and meet the requirements and expectations of the community (Kaatz, et al., 2006). Assessment criteria must consider socioeconomic constraints and limitations in order to be accepted by the industry (Todd and Geissler, 1999). Since, in Iran, all resource supplies are managed by the public sector, the successful implementation of a BSAM necessitates the support of government and public organisations not least with regard to the financial and economic implications associated with its use. Aside from fundamental changes in wider policies and sector decisions that are inevitable in transitioning to SD, the economic impact of a BSAM on the transformation of the real estate market must be explicitly acknowledged. While the profit motive continues to dominate decision-making, especially in housing and construction practices, the necessary additional costs associated with implementing a BSAM to support SD needs to be carefully considered in the context of Iran's urgent need to promote the sustainability and energy efficiency of its built environment, and its public duty acknowledged in its constitution to protect the natural environment.

CONCLUSION

Iran is a vast country with abundant natural resources and renewable energy opportunities. However, the current state of energy and resource use, environmental degradation, climate change vulnerability, and urban and housing challenges requires a robust action to promote ecologically-based SD. The country's recent moves towards strategies that address global environmental concerns have been a significant step, however, to implement broader SD policies address climate change adaptation measures, Iran needs to develop objective frameworks within its different sectors and organisations. In the field of the construction industry, this will require the revision of current urban planning regulations, building codes and standards, and the introduction of a sustainability-based framework for the assessment of the built environment. This will require the development of a national building sustainability assessment method (BSAM) for use in Iran involving the identification of sources of impact, specific benchmarks, and priorities for a weighting system for assessment criteria.

This paper has profiled the basis of a contextual framework that will inform the development of such a regional tool, taking account of Iran's current climate change adaptation policies, and priorities, its environmental conditions and socioeconomic challenges, building typologies, standards, and benchmarks. The findings of this contextual study suggests the following considerations for the next stages of the development of a BSAM to be reported in future publications, involving a need:

- for integration with Iran's national building codes, and regulations, regional and national standards as well as larger national and international policies and programs;
- to set higher performance benchmarks compared to current performance levels;
- to offer integration of core criteria with global significance and customized elements of national importance in Iran;
- to acknowledge regional variations within Iran;
- to offer a comprehensive list of criteria taking into account all interrelated dimensions of sustainability;
- to promote stakeholder participation;
- to offer transparency and compatibility;
- to propose a simple, practical and inexpensive methodology for application;
- to promote performance based evaluation rather than technical assessment

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