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Challenges Facing Sustainable Housing in Saudi Arabia: A current study showing the level of public awareness

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Abstract

Sustainable housing implementation requires strong support from the public, government and the housing industry. Lack of public awareness and understanding of the language and the meaning of sustainable housing may cause lack of public support. Salama stated that "sustainability or sustainable design is simply a rephrasing of some of the forgotten values of traditional architecture and urbanism"(Salama 2007). This exploratory paper examines public awareness of sustainable housing in Saudi Arabia.

In developing countries, like Saudi Arabia, which have been experiencing a rapid rate of urbanisation, sustainable concept intervention is essential due to the scarcity of resources (Reffat 2004a). Sustainable building methods include the full use of the site design, passive solar design, natural light and ventilation. This paper reports on an exploratory survey on understanding the potential of the implementation of sustainable housing in Saudi Arabia. The main problem is that more than half of respondents were not aware of sustainable housing. Thus, one of the recommendations from the survey is to educate the public by using local media to inform people of the benefits of sustainable implementation to both new and existing housing stock.

Keywords: Sustainable housing, public awareness, Saudi Arabia

Introduction

Saudi Arabia is a developing country in the Arabian Gulf region that has been growing dramatically over the past two decades. It is estimated that the Saudi population is about 15,588,805 and about 5,258,079 Non-Saudi residents live in Saudi bringing the total population to 20,846,884 in 2003 (Central Department of Statistics-Demogrpahic 2003). The total land space of the Kingdom of Saudi Arabia is about 1,960,582 sq. km. (climate-zone 2004). The total owned houses are about 1,526,678 and the total of leased houses is about 1,520,693. (Central Department of Statistics-Demogrpahic 2003). According to the UNICEF, 82% of the population is urbanised (UNICEF 2010).

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The urbanisation rate of Saudi Arabia has been high, thus the country faces significant urban challenges today. "Developing countries today face greater urbanisation challenges than developed countries faced…. For example, the republic of Korea was 40 precent urbanised in 1970 and 78 precent urbanised by 1990. What took the United States 90 years to accomplish took Korea 20 years and Brazil 30 years" (Henderson 2002). As growth in Saudi Arabia is estimated to rise in the coming years, the cost of living will also escalate accordingly. Henderson emphasised this point by stating "Although bigger cities offer higher productivity because of scale economies, residents of bigger cities are burdened with higher costs of living-for housing, food, public utilities, commuting, and so on" (Henderson 2002).

The high cost of living has discouraged people from implementing new 'expensive' sustainable housing. The public perception of this 'new concept' is that it is expensive, and some of the public are still not aware about this 'new concept'. "Although concerns are sometimes voiced about the initial cost of green projects, the financial benefits are remarkable in the long run" (Cityscape 2010). Housing industry/professionals have some knowledge about new concepts of sustainable development. Munton in Eden (2000) argues that "it will be the local responses to this international call to arms that will determine its success or failure as a practical programme" (Eden 2000). Eden argues, "The interconnections between local governance, the planning process and citizen involvement are critical to the sustainability programme. To enhance these interconnections, we must consider how the local public views sustainability and why they should want to participate" (Eden 2000). In terms of Saudi Arabia, this is no easy task. In the 1930's many Saudi people lived in tents, while today most live in modern houses. Convincing this population that a sustainable scheme should be applied to the housing sector is a significant challenge.

It is the aim of this preliminary paper to demonstrate the state of sustainability in the housing sector (especially new housing) in the Kingdom of Saudi Arabia. The paper also investigates public knowledge and public awareness regarding this issue. Since the Kingdom of Saudi Arabia is still under development, it's much easier to apply the concept of sustainability to new construction rather than demolishing old buildings or retrofitting existing buildings.

Current Challenges on Sustainable Housing in Saudi Arabia

Climate Challenges

Saudi Arabia faces environmental challenges caused by climate. The climate in Saudi Arabia is generally harsh, dry desert conditions with extreme temperature differences ranging from -11^{o}C to 51.1 ^{o}C (Piccolo 2010). Saudi Arabia and any Arabian country, such as Egypt, share the same climate conditions and culture. The climate of Upper Egypt is a hot, arid zone, with a large difference between day and night temperatures (Fathy 1973, 45). Another challenge that faces Saudi Arabia and other Arab countries is the scarcity of water. "Many Arab countries are reliant on non-renewable groundwater supplies to augment their scarce water supply in order to respond to growing demand." (Swain 1998). In addition, due to the staggering increase in demand for water in the Gulf Coast Countries (GCC), and extremely limited conventional water resources such as fresh surface water and renewable groundwater, alternative sources such as wastewater reclamation and desalination have been adopted since the 1960's (Stensgaard 2008). "Today, Saudi Arabia accounts for 4.5 hector of ecological footprint per person, or roughly twice the world average, and are ranked in the Top 20 most environmentally challenged countries in the world" (Al Fadl 2010).

Rapid Growth Challenges

In developing countries like Saudi Arabia, which experience such a rapid rate and ratio of urbanization, government departments should implement the concept of sustainability and enforce laws and regulations. In the case of Saudi Arabia, as well as many other developing countries, economics is not the only issue. The quickly diminishing availability of resources must also be considered. Potential methods that may be applied to sustainable housing in Saudi Arabia include the full use of the site design, passive solar design, natural light and ventilation.

Society can benefit greatly from increasing urbanization, particularly if that urbanization occurs at a high rate in a short time span. Consequential to the high rate of urbanization inflicted upon Saudi Arabia within such a short time span, we are witnessing many negative afflictions to the country. Henderson (2002) enlightens us that countries currently undergoing urbanization developments and expansions are facing more challenges than did those countries, which are considered already developed during their years of development and expansion. He gives the example of Korea, which was "40 precent urbanized in 1970 and 78 precent urbanized by 1990". His conclusion results in the mathematical deduction that it took Korea only 20 years and Brazil only 30 years to accomplish the percentage rate of urbanization, which took the US to establish in a 90-year span. Consequentially, taking into consideration the estimated growth in Saudi Arabia to rise in the coming years, costs of living will also escalate accordingly. Henderson emphasizes on this point by his reasoning that expenses for residents of larger municipalities are higher due to higher costs of living, including but not limited to necessities such as food, housing, public utilities, transportation, etc. He also mentions that these higher expenses are not weighed off in equal balance with higher productivity, as can be found in such metropolises. (Henderson 2002).

Rapid growth in cities around Saudi Arabia has lead to several dilemmas that have risen from the late 1970's during the "oil boom phase" (Garba 2004, 593). The resulting problem due to the immense growth of that period was that the demand for services from residents was much greater than what the government could respond to. Gamboa suggests, "One of the facilitating factors to the city's growth is the use of no-interest loans."(Gamboa 2008, 1). As an example of how the rapid growth took place in Saudi Arabia, the capital city of Riyadh will be discussed here. "Riyadh is one of the fastest growing cities in the Middle East." At the population rate of less than 15,000 at the turn of the twentieth century, Riyadh currently (as of 2004) has a population of nearly 4 million, with the projection of expanding to around 10 million by 2020.(Garba 2004, 594). Garba examined the state at which Riyadh has grown by stating "The city now covers an area of 1782km^2, made up of 1150km^2 of Phase One urban boundary area and 682km^2 of Phase Two urban boundary area"(Garba 2004, 601). Gamboa agrees with what Garba states as facts and illustrated this by saying "The Saudi government saw that low- to no-interest loans allowed for even small developing firms to expand as far as necessary to help the city's growth from a 1 square kilometre medina to a 3,000 square kilometre metropolitan zone in a little under a 100 years" (Gamboa 2008, 1).

Tremendous challenges of management for the public sector often accompany urban growth, and in particular when that growth is unusually rapid. The necessity of insurance of the expansion of services to meet the growing needs of the growing population, in addition to the need to ensure that growth and development occur in an orderly and sustainable fashion, are the two basic elements from which these challenges emerge.(Garba 2004, 593). One of the challenges that stood in the face of planned development was that there was no initiation of defined boundaries for the city, nor laws against those who penetrated the city boundaries, as stated by Gamboa: "The growth of the city beyond the city's original walled-medina left an infinite amount of space for growth, that in turn created several barriers for developing proper

services for its residents"(Gamboa 2008, 5). This rapid growth took place in Riyadh for one reason. "The central government adopted a policy of giving interest free loans through the real estate development funds and also giving land to citizens free of charge." (Garba 2004, 604). As a result for this vast urbanization "Riyadh has transformed from a tribal settlement of about just a square kilometre to a city of 4 million in population occupying an area of more than 1600km^2."(Garba 2004, 603).

Privacy Challenges

Privacy, or rather the breach of it, is the main issue that residents in Riyadh are dealing with today. This is the result of lack of proper building codes preventing the building of high-rise buildings in close proximity to low-rise private homes. This has caused the residents of homes to suffer a breach in their privacy, something, which is, accentuated even more in the region because of the prohibitions on this imposed by the religion and culture. This problem is what Gamboa discussed by stating "The proximity of multiple-story complexes to these homes creates social and religious conflicts of privacy widely practiced in the MENA" (Gamboa 2008, 9). Unplanned distribution of the residential areas has been the instigating factor resulting in a potentially dangerous mixture of foreign single labour forces living in or nearby previously designated family residential areas. This has led to many serious security issues across the city of Riyadh in addition to the rest of the Kingdom. Gamboa argues this point and states, "While many of residents of Riyadh enjoyed the living styles of detached single family dwellings, many of the foreign workers would rather live in densely-populated apartment complexes" (Gamboa 2008, 8).

Developing countries such as Saudi Arabia are faced with the predicament of rapid urbanization. It will take those countries collaborative efforts to eliminate what rises from the rapid growth in urban areas. In conjunction with what is stated above regarding the city of Riyadh, other cities from all developing countries suffer from the same problem. However, the developing countries were growing at a much slower pace, hence the problems occurring from the rapid growth were more manageable.

Application Challenges

The application of sustainability to a building is a complex process, not just using new 'sustainable' material. For example, using an environment friendly sheet of glass on an Arabian rooftop where the temperature can reach 51^{o}C is not sustainable. (Reffat 2004a, 2). An innovative concept for sustainable housing has risen, but a vast majority of the public are still unaware of this new possibility. Salama (2007) stated, "Sustainability or sustainable design is simply a rephrasing of some of the forgotten values of traditional architecture and urbanism". The sheer new-ness of this concept to the public has been perhaps the greatest deterrence, magnified by the perception of it being expensive. However, among housing industry professionals in Saudi Arabia, awareness of this innovative concept on sustainable housing and economical development is on the rise. Eden (Eden 2000, 114) argues that a critical element in the sustainability program is the interaction between local governments, planners and the citizenship involvement in the planning and implementation stages. He goes on to remind us of the necessity to explore how the citizenship views sustainability and how they are willing to participate in the implementation, in order to coordinate cooperation between the sectors. With the large estimated population in Saudi Arabia, it is no easy task to apply a new concept to a country that has developed from living in tents in the 1930's to having a sustainable scheme applied to the housing sector and convince them that this the right way.

How can sustainability be achieved in Saudi Arabia?

Sustainability in developing countries can be achieved for new construction with collaborative agreement between the government and the stakeholders. "Key Saudi developers are looking at sustainable construction as a key option and with increasing political interest, it is only a matter of time before green guidelines become mandatory" (Al Fadl 2010). The construction industry complains on "the lack of resources to invest in the technological changes required for the sustainable application and also their profits will be reduced" (Reffat 2004a, 3). "According to a report published by the US Green Buildings Council, a green building on an average saves 70 per cent electricity, 50 to 60 per cent of water and 36 per cent of energy" (Cityscape 2010). With this statement in mind, homeowners, investors, developers and all stakeholders in the housing industry should think more seriously about applying the concept and methods of sustainability to reduce the running costs of a house. Reffat (2004a, 7) list primary concerted actions that should be implemented by the stakeholders to pave an appropriate road to sustainable construction in developing countries include:

- Create an advisory stakeholder council Government.
- Raise awareness among government officials and politicians.
- Adopt a regulatory framework for sustainable construction.
- Introduce compulsory continued professional education.
- Provide funding to support emerging businesses and innovative technologies.
- Provide funding for training and education.
- Lead by example.
- Sustainable construction is leading to the development of entirely new market niches in terms of services, materials and tools.
- To create a market for sustainable construction, clients will have to develop their understanding of what sustainability means." (Reffat 2004a, 7).

There are several methods to introduce sustainability to the public and DuPont Chairman and Chief Executive Officer presents some of these methods, which are "six key actions" that could be used to raise public awareness and commitment to both conservation and environmental protection:

1. "The vision is clearly defined by leadership;
2. Assign an "implementer" who will develop systems to ensure implementation of the vision and objectives
3. Set goals so that everyone involved has something against which to measure progress
4. Hold strategic reviews with key organizations to discuss their role in achieving the goals; discuss potential roadblocks that might impact success
5. Develop awards and recognition to highlight key programs and significant accomplishments
6. Form relationships with key NGOs and other external groups." (Holliday, 2007).

The government, developer, designers, landowners, and the general public who are affected by the construction can form stakeholders in the housing industry. Miranda states "Governments are the ones to initiate changes with the development of a legal framework to encourage the application of appropriate standards and procedures. It is known that unless pressured, the construction industry will not introduce the required adjustments. A key factor is to change the way of thinking of private sector professionals and of the public in general. They need to realize the benefits and advantages of a built environment which is safe to both nature

and to the people." (Miranda and Marulanda 2001, 4). "In most countries there are financial incentives to retrofitting or building using 'green' principles that business owners should take advantage of. Or soon legislation will force the issue." (Cityscape 2010). In contrast to the fact that it is the responsibility of the governments to implement regulations ensuring that sustainable projects are initiated, governments in most developing countries have yet to consider the magnitude of the issue; hence external governments influence developing countries governments. Miranda supports this when she states "The results of urban development in third world countries show that sustainable construction and sustainable development are not yet a priority. This is a concept managed by professionals in certain fields and only recently have governments begun to pay attention to it, due more to international pressure than to internal conviction." (Miranda and Marulanda 2001, 3)

Many architects and designers agree to the fact that traditional architecture or vernacular architecture achieved sustainability more efficient than modern buildings. This was because people several decades ago did not have the luxury of modern reflecting glass, so they built their windows looking inwards into a courtyard in the centre of the house, which did not omit direct sunlight into the house, but instead it omitted natural light with natural air ventilating the house. Another method that was used in traditional houses was the use of thick mud walls that kept the temperature of the house warm during winter and cool during summer. This act is achieved in modern buildings by insulation but it does not achieve the same aesthetic atmosphere as it did in traditional buildings.

Solutions

Site design and layout is one of the most important aspects when implementing the concept of sustainability. The project starts with a site that most positively will have terrain and/or some natural landscape, and what most people do when they first get their hands on a piece of land is strip it from it's natural envelope and level the site for a new project. Sustainability starts in a project from the site design and how to incorporate the building with the site and it natural envelope. Reffat tells us that "the most environmentally sound development is one that disturbs as little of the existing site as possible" (Reffat 2004b, 3). He also tells us that an ideal site plan is one that is developed based on site data covering the larger macro-environment and includes historical and cultural patterns of the community.

One way to solve the problem of how to use daylight as a form of sustainable integration in the building is by combining daylight with electrical lighting and preferably at the same location. In this situation day light can be used during the day with possibly a dimmed electrical lighting support and then can be fully electrical during the night. "Day lighting design is the use of good design sense, not the application of technology. It is the pattern of light in the sky told as a story in the building's form and details." (Loveland 2002, 31).

Passive solar design is one of the most efficient ways to reduce the use of non-renewable energy. "The basic idea of passive solar design is to allow daylight, heat, and airflow into a building only when beneficial. The objectives are to control the entrance of sunlight and air flows into the building at appropriate times and to store and distribute the heat and cool air so it is available when needed."(Reffat 2004b, 5). There are many ways that passive solar design can be implemented into a building to make it sustainable. According to Reffat, passive building design begins with study of the building site, day-lighting opportunities and the whole building concept. From there building systems are considered. Nearly all elements of a passive solar design is for more than one purpose: landscaping beautifies while shading or promoting good airflow, window shades are a decorative asset while providing interior shade, a sunny room is a bright space as well as good task light, etc.

In Saudi Arabia approximately more than 75 precent of the year, sunlight is clear and can be harvested if designed daylight systems are integrated into a building. Abraham in Reffat (2004b, 5) says that "day-lighting significantly reduces energy consumption and operating costs", so much so that a properly designed day-lighting strategy can save 50 to 80 precent of lighting energy. Following are some of the principles that can contribute to this:

- "Avoid direct sunlight on critical tasks.
- Bring daylight into the room from a high location, such as windows, skylights, roof monitors and clerestories, the windows being the less effective of all because of the great brightness levels they provide.
- Filter daylight using trees, plants, draperies and such.
- Bounce daylight off of surrounding surfaces by means of light shelves, blinds and such.
- Integrate daylight with other building systems and strategies which work coinciding with the building system or design, not against it". (Reffat 2004b, 5)

Methodology

This paper uses data, which was collected from a web-based survey that was distributed on Saudi residents. The reason for using this web-based survey is because it can be handled remotely outside Saudi Arabia. The survey consists of quantitative and qualitative data that will be analysed in separate sections. The targeted participants were from the Saudi Council of Engineers. The SCE is a society that groups all fields of engineers that include Architecture, Civil engineering, urban designers and other fields of engineering. The reason for selecting the SCE is because there is no other society that groups all types of engineering and can be targeted for research purposes that are currently present in Saudi Arabia. All architects and designers are categorised as engineers in Saudi Arabia and are members of the SCE. The web-based survey was designed in Arabic language to reach wider Saudi participants. The total number of participants was 693. The majority of participants of this survey are male, consist of 620 male and 73 female. Figure 1 shows that the majority of participants are between 21-40 years old (77% of total participants).

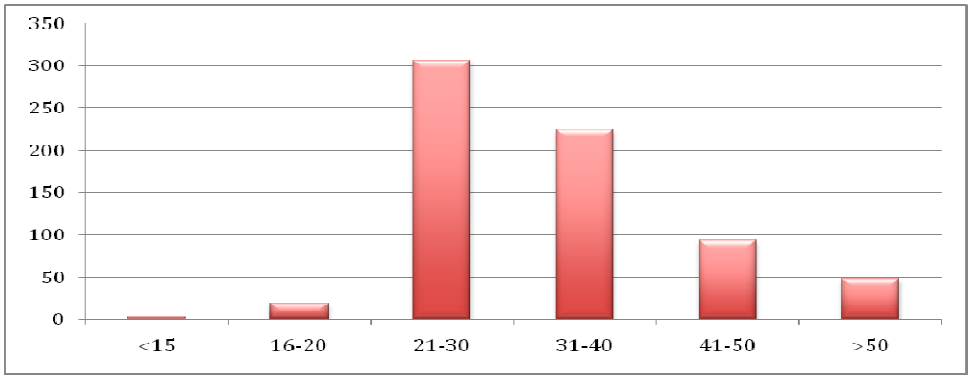

Figure 1 Age Distribution

Quantitative data analysis

In general, over 52.2 precent of the participants are not aware on this issue and have not heard the term "sustainable housing" before participating the web-based survey. However only

3 precent of participants said that sustainable will not save money. More than 70 precent of participants agreed that sustainable housing will save energy bills (electricity and water).

Only 21 precent of the participants thinks that there are sustainable houses in Saudi Arabia. The rest of the participants do not know or do not think there are any sustainable houses in Saudi. However, over 71 precent would participate to retrofit their house to be sustainable when possible. Figure 2 illustrates the respondent's willingness to participate in retrofitting.

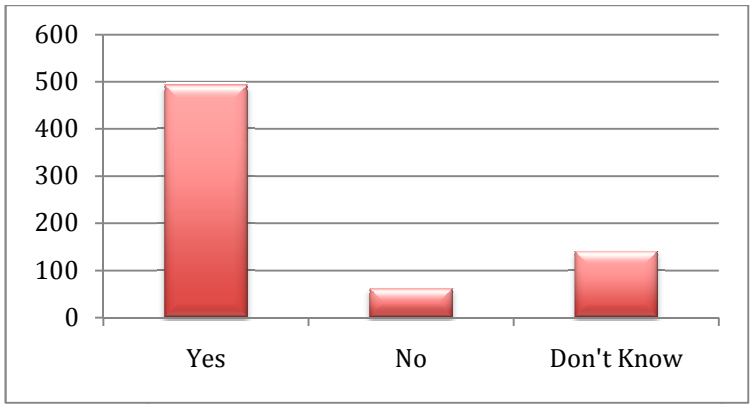

Figure 2 Participation to retrofit to sustainable buildings

Table 1 compares the importance of sustainable housing according to participants. Majority of participants suggested building new sustainable housing is very important (nearly 50 precent). The participants have a range of opinions in regards to retrofitting existing buildings to become sustainable. As mentioned in the literature review, majority of people live in the rental housing and mixed responses on the retrofitting existing buildings between investors and users (renter) spread their opinions.

Table1 Market acceptance on sustainable housing

	Not Important	Somewhat Important	Important	Very Important
Building Traditional Houses	27,0% **(187)**	39,4% **(273)**	25,4% **(176)**	8,2% **(57)**
Building Sustainable Houses	5,1% **(35)**	13,7% **(95)**	31,9% **(221)**	49,4% **(342)**
Retrofitting existing buildings to become sustainable	11,7% **(81)**	25,3% **(175)**	33,0% **(229)**	30,0% **(208)**

Although nearly 80 precent agree to use natural light, a large number of participants still do not agreed to use active sustainable features. Sixty percent of the participants agreed to switch from non-solar heating water tanks to a solar heating system. The participants are split into half-half on their opinions to collect and reuse rain water . This is mainly because of the lack of rain in Saudi in general and the use of water collecting tanks would be useless in a desert climate region. Public awareness on sustainability features, such as solar heating water and rainwater tanks need to be investigated in future studies that consider culture and local climate.

Outcomes of Quantitative Data

- There is a trend in Saudi Arabia that is moving towards sustainability but with the lack of knowledge that the public have of this concept then the application of it would be difficult.

- It is easier to apply sustainability to a developing country than in a developed country because in a developing country the construction is still under way and can be applied while the construction is still underway.
- Methods that can be used in Saudi buildings include the use of the site design, the passive solar design, the use of daylight and the use of natural ventilation.
- The main outcome from the survey that was distributed on Saudi participants was that there seems to be a general lack on knowledge of the concept and how it can be applied in real life.
- After the participants were introduced to the concept of sustainable housing, more than 71% were more than satisfied to apply it to their existing houses and those that are still under construction if it was presented to them

Qualitative data analysis

Responses to questions asked were used as qualitative data. The analysis of those questions is shown in this section of the paper. One question focused on the participants' understanding of sustainable housing. Of the 693 participants, the following responses were useful for this paper. Most responses were inadequate and some were repeated. The responses were then combined in the following groups; education, design, regulation and cost.

Education:

- "1- it is a required technique for the future. 2- it should be introduced to the public. 3- it should be included in local building codes" (Respondent 1)
- "It is a good idea, yet it has to be accompanied with a change in people thinking." (Respondent 2)
- "I think sustainability has a great benefit on the environment and humans. However, it should increase people's awareness about this term to gain maximum advantages." (Respondent 11)

Design:

- "I really encourage adopting sustainability at the outset of the project life cycle. In most cases it is feasible to change current buildings to sustainable ones. However, this can be considered in the maintenance process, by fitting new systems, instead of defected ones, that are more sustainable." (Respondent 4)
- "Also the environment that it is intended for (i.e. Saudi Arabia is very hot and very shiny state) therefore using sun light to light the house will be offset by having to install a huge HVAC system to cool the house." (Respondent 2)
- "It is imperative that we, in Arab countries start considering sustainable houses when we build our homes. I'm strongly in favour of green houses and sustainable systems" (Respondent 5)
- "The idea of sustainability must be applied in all areas and not confined to the field of architecture. Sustainability is to build for the long-lasting, taking into account the materials used such as building materials or the techniques used, such as air conditioning, lighting and others. Sustainability is a broad concept and all countries in the world, especially the developed countries take into account this concept and apply it in construction, transport, education, management and others." (Respondent 6)
- "The need to find a healthy environment, sound and atmosphere appropriate for the family within the home requires us to take these techniques to result in positive effects on community family - and the ensuing generations of sound, which in turn promoted the community, and these are a series of interrelated construction requires treatment basis, and this vision, I think it is necessary to test, develop and create other solutions that are compatible with our society to address the physical and social environment in the cities of the Kingdom." (Respondent 7)
- "I totally agree to apply this method on Saudi's buildings such as the use of solar energy because it is available a lot there." (Respondent 11)

Regulation:

- "I wish houses could be built this way in Saudi Arabia, and I also wish it was mandatory and enforced and an essential part of the forthcoming Saudi building code. But before that awareness is necessary to convince owners to go that way. All existing public buildings should be refurbished and made greener and cleaner." (Respondent 8)
- "I think that the idea of sustainable buildings should not remain an idea but it must be included in the Building Code and applied gradually so as not to become a choice but become a necessity for the design and construction. I think that the main role here is located on the engineering bodies and governmental institutions to try to enforce these systems on each of the works in construction" (Respondent 9)
- "It should be promoted by all involved parties; government agencies, designers, contractors, suppliers, and press." (Respondent 1)
- "I think it's time to be a gesture of genuine, backed by the official authorities in charge of Saudi Arabia to the application of approaches and styles of traditional and sustainable harmony on parallel tracks to improve the environment construction, especially since the demands of life and climate requires us." (Respondent 7)

Cost:

- "I am very convinced of the need to make our houses and structures more and more sustainable. The savings in energy, water, will be tremendous. The quality of life also will be better as we will be more compatible with nature." (Respondent 10)
- "Sun light also can save people money by using it in the day to reduce electricity consumption." (Respondent 11)
- "It is very important to find a way to make our lives better. The principle of using the green house is a must nowadays. That is because the high need of saving in the cost "even construction or running cost" & energy also environmental." (Respondent 12)
- "I am confident that implementing and adapting sustainable houses will eventually reduce the house cost considering the life cycle and will be more environmentally friendly as well." (Respondent 13)

Recommendations from the Qualitative Data

- Introduce the concept to the public by using the local media, newspapers, television and radio broadcast to inform them of the benefits of the concept and how important it is to apply it now while we still have a chance.
- Encourage the government to apply sustainable codes to be applied on current constructions and in future ones and offer incentives to whomever wishes to retrofit their house.
- Regulate seminars and workshops for designers, engineers and any stakeholder in the construction industry to educate them on how to achieve sustainability and how important it is.
- Incorporate local engineering bodies to legislate the implementation of sustainability after it has been introduced to the public and recommend it to the involved ministries to legislate it regionally on the whole Kingdom.
- Migrate some of the construction methods from traditional architecture of the Kingdom to new modern construction buildings because it is evident that the recent method of building is costing too much on energy bills.
- Introduce sustainability courses to the public so that if any one who is interested to learn more, he/she can enrol and educate him/her self.

Conclusion

Saudi Arabia is one of the developing countries in the Gulf region and the implementation of sustainable housing is easier because the country is still under development and the construction rate is higher than ever. The use of local materials and knowledge of how the historical buildings were built must be considered together. It is recommended that the use of natural resources, for example solar power is crucial for the success of the application of the concept. Local engineering bodies and the government must work together to legislate the concept of sustainability. Understanding and knowledge of the community is also crucial to the successful implementation of the concept. It is recommended that further research of public awareness needs to be conducted to apply sustainability in a context where the majority of residents are renters.

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