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RESEARCH PAPER

Navigating the Dual Crisis: High-Performance Housing as a Solution for Climate and Socio-Economic Challenges in Multan, Pakistan

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ABSTRACT

The study intended to assess how the public in the selected areas deal with effects of climate change through high-performance architecture prioritization in future. Like many other countries in the world and cities including Multan, Pakistan suffers from the consequences of climate change including heatwaves, flooding and energy crises. These woes are compounded by the fact that Multan has not developed optimized housing to any extent. A cross sectional survey was done in three city zones adopting open ended questionnaires using a purposive sample of 75 respondents. Analysis showed that there was heightened need for enhanced housing, however due to decline in economic cycles, socio-economic status, poor inter-relational frameworks, and lack of sound governance, people cant afford to opt for high-performance architecture. It was proposed that these challenges be met through proper planning and integration of public-private partnership.

Keywords: Climate Change, Socio-Economic Crisis, Multan City, Housing Challenges, High Performance Architecture

Introduction

Climate crisis has taken up Pakistan with a storm over the last few years and the impacts have been so severe that Pakistan is now considered as the 5th most vulnerable nation effected by the Climate change across the globe (Carter et al., 2015). One of the major causes of climate change is through carbon emissions through burning of fossil fuels. These have lead to spread of green house gases and impacted the whole atmospheric disruption in the climate. Being a non-reversible process, climate change has lead to higher risks and is now considered a major threat across the globe. Pakistan has been at cross roads with multiple challenges over the last few decades, but recent climate change issues along with higher population and severe shortage of housing has lead to a multifold issue of severity leading to extreme conditions for the public at large (Rehan, 2016). The situation has already been worsened by introduction of allied burdens in the form of epidemics and recent pandemic in Pakistan (Bhatti et al., 2023). This has not only increased burden on the healthcare infrastructure and burden of disease but also has strongly negative impacts on the population life expectancy and livability.

Pakistan is suffering from the acute housing scarcity which is one of the most significant social and economic issues of the contemporary Pakistan (Shah et al., 2023). There is an ever-growing population, poor urban planning, and pressure on such resources as water and energy, and all of this is getting worse. This housing deficit is not only a problem of the millions of people who dwell in poor living conditions but also a compounded problem of the already chronic energy and water crises which the country is facing across all major cities, urban centers and large rural settlements as well (Ahmed, et. al., 2015; Tariq et al., 2024). With increasing urbanization, the people are shifting to the urban centres such as Karachi, Lahore, Islamabad and Multan to avail more employment options. The increase

in the population density especially in these urban areas has been dramatic and faster than the ability of cities to provide for their population's housing needs. Preliminary data state that there is the deficiency of 1 million housing units in Pakistan and requirement is augmented by 700,000 units per year. This has been equally contributed by the existing energy crisis in Pakistan which remains a key challenge to the construction of new units besides the improvement of the existing ones (Aleha et al., 2024).

Currently, Pakistan energy structure is very weak and unable to fulfill requirements of growing population in the country. Power blackouts, or what people in Pakistan call 'load shedding' are a daily phenomenon in the country irrespective of geographical location which is either in the cities or the rural areas (Manoo et al., 2023). Another threat that has been affecting Pakistan includes shortage of housing and energy and water crisis where Pakistan is severely affected. Pakistan is ranked among the twenty-five world's most water-deficit countries and unfortunately, the per capita water availability here is shrinking rapidly (Habib et al., 2019). Even worse, population growth, climate change and poor water management gives an indication that the situation could get worsen in the coming years. One of the causes of the problem is the constant and uncontrolled growth of the population which leads to the growth of the urban areas in Pakistan. Metropolitan growth has seen most cities grown out of control resulting in the development of houses and buildings on cultivable land and even forests (Aleha et al., 2023).

In the current scenario, it is need of the hour to shift to energy efficient and climate responsive housing design solutions to address these gaps. However existing research lack the exploration to identify the adaptation challenges the current population faced towards adoption of high performance housing under the current socio-economic and financial crisis. Hence the research set forth the objective to identify these gaps and how far people are able to cope with these challenges towards adaptation of these opportunities. The research findings can contribute towards better planning as well as intervention design for existing as well as future design of housing in the explored context to help improve the quality of life of people in Multan city and its similar context.

Literature Review

The average long-term weather in a place is called its climate. Climate change is defined as a deviation from those typical situations. People are the main source of the current, rapid climate change because they use coal, gas, and oil in their homes, businesses, and vehicles. Carbon dioxide (CO_2) makes up the bulk of greenhouse gases emitted during the burning of fossil fuels. These gases' capacity to hold onto solar heat causes an increase in the planet's temperature. The world is currently 1.2 degrees Celsius warmer than it was in the 19th century due to a 50% rise in CO_2 levels in the atmosphere (Khelil et al., 2019). The impact is shown below in figure 01.

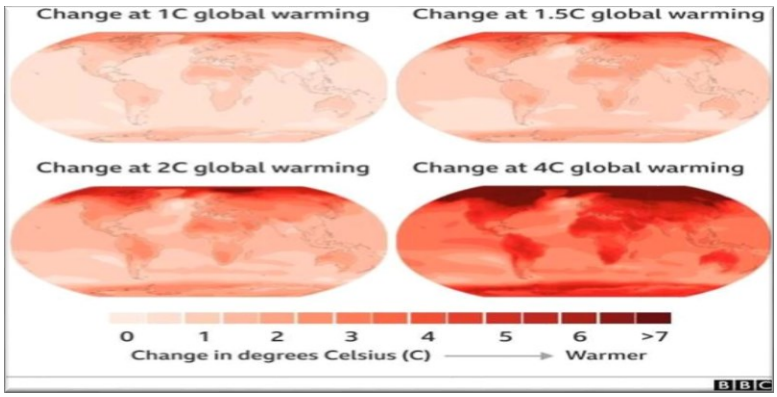

Figure 01 Global climate change impact through temperature rise variation for 1-4 degree Celsius (BBC,2021)

Climate change poses a major and multidimensional threat to Pakistan that has ramifications on the quality of life of the population; especially those who live in substandard housing. The country is ranked among the top five countries most at risk through climate change impacts while it has less than one percent global emissions (Bhutto et al., 2020). It is imperatively affecting the country through extreme climate systems, rising temperatures, flood and drought incidence as well as shift in rainfall patterns that are all which puts at risk of life supporting infrastructures; the housing and energy and water supply systems. Compound with climate change, issues like having access to poor quality housing as the dangerous cocktail potentiating adverse consequences on the lives and future of the most vulnerable populations (Ullah et al., 2020).

Pakistan has not remained immune ro even able to cope with climate change as there is an increase in intensity and frequency of such calamities as floods and similar other severe natural disasters. Today the country's environment can range from floods causing havoc to intense heat waves, all within a short span. For instance, through the 2022 floods, millions of people were affected, which led to the displacement of several families, and loss of homes and infrastructure. Entire communities were marooned in Sindh and Balochistan, the process of rehabilitation continues even up to now (Asif et al., 2023). In the same regard, the intensity of heat is changing and contributing to heat waves that were previously seen occasionally, are now experienced frequently i.e., Karachi and Multan Heat Waves. Increase in temperature has over the years had fatal repercussions and in the year 2015, Karachi experienced a heat wave that led to the death of more than 100 people. It is believed that experts are expecting this trend to get worse and that average temperature in Pakistan may rise by 1-3 degree centigrade by 2050. Such high temperatures augmented by the irregular rainfall pattern make its future uncertain in terms of agriculture, water resources and energy sector. The role of climate change as a threat increases day by day and as a result the country is exerting more and more pressure on existing systems (Irfan et al., 2018). As it is witnessed, the changes, in this case, are being effected in the most appropriate manner through the poorest of the communities. Instability in the climate has seen many areas experience both floods and heat with the poorly constructed homes proving to be very ineffective in protecting the occupants (Badarneh&Zoubi, 2015).

Housing in Pakistan is in a terrible state and there is severe shortage, the quality is poor and people have unequal access to decent affordable shelter. There is said to be a housing backlog of over ten million units and majority of the population resides in substandard and insecure houses. Housing conditions of the poor families are poor; many of them live in slum areas many of which are located in disaster-prone areas such as floodplain, landslide prone areas, and areas with extreme temperatures (Aslam et al., 2012). In Pakistan, housing can be categorized as being of high, medium, and low standing according to the income bracket. In the urban slums, and rural areas, walls may be constructed using poor quality materials, whereby structures offer little protection against floods, droughts among other climatic conditions. The constructor of these homes did not provide for insulation, proper roofing, and proper air circulation, hence the homes are unsafe, and uncomfortable during the hot summer and cold winter seasons. In floods, these homes are flooded and most of them collapse when the water rises to high levels, while in the heat waves they cause discomfort to the residents and some people even die from heat diseases (Bhatti et al., 2024).

The people are living in poor living standards in these homes, and, therefore, climate change is aggravating the situation. Whenever these unfortunate occurrences, such as floods occur, the vulnerable houses mentioned above end up collapsing or being seriously damaged and families find themselves being thrown out in the cold with nowhere to turn to (Ali et al., 2017). Moreover, when homes are still habitable, transport networks including roads and electric power delivery networks are destroyed meaning the survivors are always locked out from accessing basic services. Re-construction in these communities is a slow

and costly affair and most of the times, houses are reconstructed with the same substandard materials which create room for the same calamities in the future (Salavatian, 2020).

Pakistan is, as it is well known, plagued with a constant energy crunch that continues to worsen due to climate change compounded by poor housing stock. Housing in Pakistan is not capable of offering shelter from climate conditions and is also energy inefficient because of the energy crunch in the country (Akbar et al., 2012). With the increased temperatures people switch on electric gadgets such as fans and air conditioners, therefore using electricity during the summer season. Thus, the necessity to provide sounds and heat insulation as well as more proper design is still unfulfilled in many homes (Jamil et al., 2022).

Currently, the energy fundamentals of the country are compromised with load shedding making millions of its population to experience power outages daily. They use substandard methods of energy system to meet their need since the quality of their houses in those area is poor. For example, the houses with low density insulation need more energy to cool them in summer and heat them in winter year (Antonio et al., 2018). This leads to a cycle of energy demand that actually puts pressure on the national grid which in turn results to more power failures and energy crises. Interestingly, the use of fossil fuel in electricity production is also an indication that the country is part of the problem because it is deepening the climate crisis that has worsened both housing and energy woes. The high reliance on coal, oil and natural gas results to high carbon foot print and high electricity tariffs which is hard for low income earners to afford. Since access to cheap and clean energy sources is still limited, several homes turn to the use of wood, coal, and kerosene to prepare food and to warm their homes, all of which exasperate air pollution and other ecological problems (Tarek et al., 2024).

The situation is not better with Pakistan who is experiencing severe water scarcity compounded by climate change. Unfortunately, the country is also struggling to maintain adequate water sources with per capita water access also decreasing in the last few decades. Now Pakistan's water resources are emptier because of poor water management, increase in population and shifting of rainfall due to climate change. For millions of feeble housed population, availability of slab and pure water is a question mark on daily basis (Reyes-Barajas et al., 2020). Most of the people especially those living in the slums or other rural settings, their houses have not had water facility pipe borne water and so the people have to rely on wells, water tanker or even unsafe water. The water problem is worsening due to climate change that has led to alteration of rainfall distribution resulting to droughts in some areas and increased flooding in other areas (Khelil et al., 2022).

The housing crisis and hardly any water provision correlate since the state of the housing usually dictates the quality of the water supply. Flooding contributes to loss of lives, displacements, destruction of homes and other structures as well as pollution of water sources by sewage and other risky materials yielded out by heavy rains. Thus, in the areas affected by the drought, homes do not have a chance to receive the water they need for drinking, kitchen use and personal hygiene (Bhagat et al., 2023). This is one of the most pressing issues of Pakistan's social affordability where the country lacks construction of climate adaptive and resilient houses to protect the citizens against disasters that come with harsh weather conditions. This entails constructing houses that not only consume minimal energy but also well-engineered to survive floods, heat, among other difficulties caused by weather changes. This will inevitably involve a major outlay on the country's housing stock but particularly in the BCCs which are the areas with the highest demand (Athmani et al., 2022).

The construction of climate resilient housing also mean job opportunity whenever there is an energy and water crisis. It is possible for Pakistan to implement renewable energy systems, for instance, through installing solar panels in homes as a way of cutting on the costs of energy from fossil fuels. In the same way the country contributes to tackling the

effects of water shortages and certainly, by investing in water saving housing systems to ensure that there is enough water and that future housing construction is also environmentally sensitive to the phenomenon of water shortages (Alyahya et al., 2018).

However under the current socio-economic crisis and poor financial conditions across the nation, there has been a major issue ascertaining to either people be able to cope to these issues through adopting to energy efficient houses or they will continue under the current burden of crisis. Hence it was needed that the areas in Multan city where these transformation have a better probability based on recent developments and occupancy would be identified and explored. Hence based on the issues explored through multiple research publications and existing reports, the research followed a methodology shared below which focused on public interaction through visiting these premises and exploring how they feel about the current challenges and what they propose should be consider with respect to the future direction of this transformation which may help them evolve back and be able to cope with these social, financial and environmental challenges.

Methodology

Moving forward with the research exploration, the devised research phases and major aspects are shown below in figure 02.

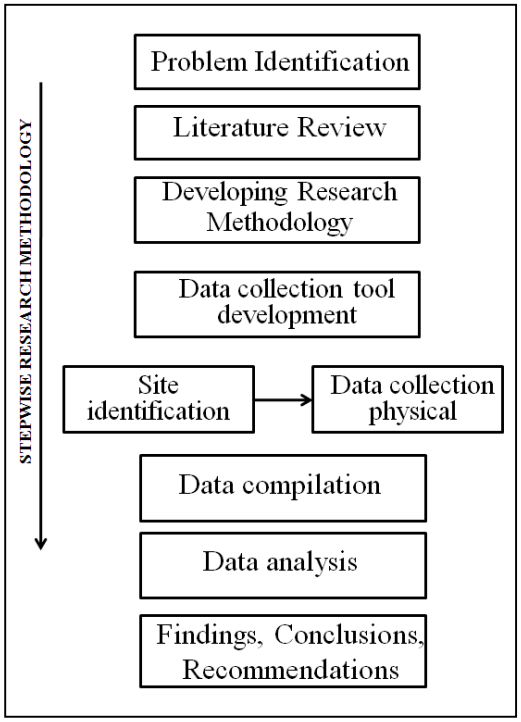

Figure 02 Phase-wise research program and major steps

The research endeavor was taken forward with devised line of action as shown above in the figure 02. Purposive sampling was adopted with 25 respondents as part of the process responsible for data collection from each identified site in the Multan city. Focus was to enable better true representation of the middle and lower middle class as the true representation along with people who have serious concerns or challenges faced due to lack of improved housing conditions. These areas mainly included Mumtazabad, Shah Rukh e Alam block and Pak gate chowk area. With identification of sites, data collection tool was evolved based on the review of the literature with focus on identification, sensitization, prioritization and adaptation capability towards energy efficient as well as high performance housing design for the people in Multan.

Results

The research endeavor was taken forward with identification of three sites to collect respondents data. The three selected sites are shared below:

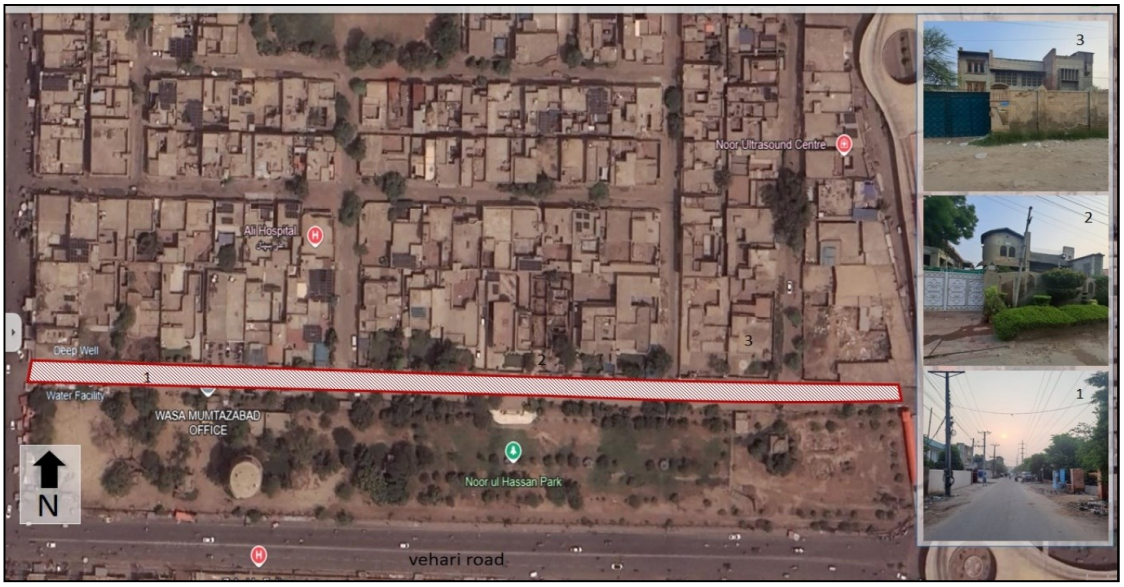

Figure 03 Mumtazabad Street

Figure 04 PakgateChowk Street

Figure 05 Astana Shairf Street

As evident from the figure 03-05, three locations from different parts of the city were explored and identified as the potential respondents zone. Each street with multiple houses were identified through random sampling method and data from collected from 25 houses from each street and its neighborhood. The respondents basic demographic data is shown below in Table 01.

Table 01
Demographic data

Basic Demographics	Count	Percentage
Total Respondents	75	100%
Male	53	71%
Female	22	29%
Employed	72	96%
Unemployed	3	4%
Rented House	41	55%
Own House	34	45%

As evident form the table 01 shown above, the data was collected from three locations stated earlier and 25 houses with one representative of the house was primary respondent for the house. The target sample entails 75 respondents with slight variation in gender distribution. Men are also the majority respondents analyzed by gender with 53 respondents primarily participating in the survey which is 71% of the respondents. Males account for 71% of the respondents with 54 of them while females account for 29% with 22 of them.

These findings could probably be attributed to gender factor in which the survey is conducted, with such issues as culture and social structures dominating the male gender. From the table it was found out that the respondents hold high employment status with 96% (72) of them being employed and 4% (3) of them being unemployed. Such a high employment rate may suggest that the sample population was taken from a group of people who are likely to be in the workforce, probably the high skilled workers or professionals. The respondents are divided between renters and home owners or those who own the house they're living in. A little above half of the respondents, 55% are renters while 45% own their houses. Here, the 45% of respondents who stated that they are home owners means a large representation of the adult population who have the capital base and more importantly, the endowment to invest in home as seen to be reliable wealth and economic security assets in the long run or could also have inherited the house. The high level of employment also indicates that most of the samples are economically active. The housing data looks promising in a way that it provides equal proportions of homeowners and renters which may shed light on the socio-economic position, affordability issues, or preferences of such group towards prioritization for high performance houses. The related respondents data with respect to the higher performance architecture or housing prioritization is shared below in table 02.

Table 02
Respondents data towards shift and challenges of transformation to high performance houses

S.No	Aspects	Totally Disagree	Disagree	Neutral	Agree	Totally Agree
1	Is energy crisis an issue for you?	1	3	7	39	25
2	Is water crisis an issue for you?	2	2	12	16	43
3	Do you think house design has any link with these issues?	0	1	3	65	6
4	Is electricity billing an issue for you?	0	0	3	71	1
5	Do you think these issues could be resolved through better house design?	2	4	11	55	3
6	Have you ever heard of high performance houses?	2	8	23	41	1

7	Will you agree for any house transformation analysis proposed, free of cost for your current house?	0	0	2	72	1
8	Do you think it will improve the house value ?	1	1	0	45	28
9	Will you prefer to opt for transformation?	8	11	15	35	6
10	Will you prefer to opt for buy a new house?	33	21	15	5	1
11	What are the major challenges you face towards such transformation? Share.	Cost, finances, guidance, trust, lack of technology knowledge, cost of consultancy, rented house, lack of resources, etc				
12	Will these changes have a positive impact on your quality of life?	2	5	15	48	5
13	Do you believe that you will need some financial help in this transformation?	1	3	3	65	3

As evident from table 02 above, most of the aspects inquired related to the high performance homes identified gaps which can be addressed and issues which can be resolved through proper planning of high performance architecture to meet the current needs of the people.

Discussion

As shared above, with respect to energy crisis that majority of the respondents consider energy crisis as a major issue. only one of the respondents totally disagreed this statement, 39 respondents agreed with the statement, and 25 of them total agreed with this statement – that is why 85% of the sample sees the energy crisis as an acute problem. But this response is a proof that people are aware of the energy problems, because the energy shortage, rising energy price, and the search for new efficient energy sources are still the main concerns for the local community of Multan. That energy consumption and costs are important for most consumers speaks to larger societal issue that is not only recognizing the burden of inefficiency, but is also most likely seeking a solution. This issue connects with a number of socio-economic and allied environment problems such as climate change and availability of clean energy sources.

The second question is focused on the water crisis which is an essential problem of the contemporary world. Here 43 totally agree and 16 agree on this statement which indicates that respondents view water shortage as a serious issue. This proves that as much as 78% of the respondents have felt the pinch of water scarcity meaning that the populace is conversant with the problems that arise as a result of inadequate clean water supply. However, the overall trend indicates that lack of water is a major concern to almost all the respondents, especially where availability of water is observed to be reducing due to some factors such as; environmental factors, population, and poor infrastructure in developing proper systems.

The third perspective focuses on whether or not the respondents have an opinion that house design has relationship or impact with energy and water. The results are clear: 60 of participants feel that there is correlation between house design and issues with energy and water inefficiency, while 6 strongly agree. What this insight also reveals is a growing appreciation of how architectural design affects life, especially in the realm of sustainable living and use of resources. The general public knows that proper architecture can reduce the amount of energy used as well as effectively use the limited water sources available. This could also be attributed to increased focus towards green homes or energy efficient homes as a major need in the present as well as future times.

In the same regard, the respondents perceived electricity billing as a major concern with a staggering percentage of 89 % agreeing with the statement. Of the respondents 71 agreed and 1 totally agreed implying that electricity costs are on the minds of people. With the growing energy costs in Pakistan, people have witnessed an increase due to inflation

and undulating fuel prices, therefore, it is not awe inspiring the level of acceptance that is given to this aspect. This has been attributed to the fact that the home layouts, many of the homes in the market are inefficient hence leading to expensive electricity bills. Lack of or inadequate insulation, older or poorly energy-efficient appliances, using too many ACs or heaters also lead to high electricity bills for the electricity consumers. The responses here touch on someone's burden of electricity on that household and therefore becomes compelling for potential home change in order to upgrade their efficiency.

Respondents were also asked if they think that the aforesaid problems including the energy and water crises could be addressed by improving house design. Two-thirds of respondents expressed their opinion stressing that better design could help, 55 agreeing and 3 totally agreeing; and in this sense, architecture and engineering are considered to be fundamental to face sustainability issues.

Though there is understanding of the link between design and sustainability, there is relatively low knowledge of "high-performance houses". Twelve respondents believe that high-performance houses are completely unfamiliar to them and 41 affirm they have a prior knowledge of high-performance houses; however, 23 respondents are indifferent with their opinion and 8 are negative about the information regarding high-performance houses. This suggests that despite the fact that there is a widespread appreciation of the need to incorporate sustainable housing design, people are still not very well informed about the ideas. The concept of high-performance houses that are intended to be resource-efficient, environmentally friendly homes are considered to be the solution to many economic and environmental problems. But, this data implies that there are still great opportunities for increasing education and promoting awareness about such homes and the value as well as the possibility of possessing them.

Responding to the question as to whether or not they would agree to a house transformation analysis that is free of charge, 72 respondents agree while one strongly agrees. I wondered if a different response would have been obtained if the study was a mere prediction of the probability and not associated with 'no risk' financial incentive, as done here; nearly everyone was positive about the possibility of home improvement. This willingness is due to its focus on providing solutions for situations people are facing in their daily life to include high electricity, water bills, among others. It also implies that people are willing to receive advices and professionals' opinions if these suggestions are given at an affordable price. This could imply the existence of unrealized demand towards the delivery of programs or campaigns that would offer free or low cost home assessment.

There was also agreement on the belief that home transformations could result to an addition to property value. Most respondents affirmed these changes regarding comfort, sustainability and profitability as 45 of the respondents agreed with 28 totally agreeing, thus hinting at the fact that people see these improvements as valuable improvements on investment with the end result being increased property value. This belief may make more homeowners undertake sustainable home changes as such changes could invariably improve the value of homes that homeowners seek to resell. It also stresses the necessity of publicizing the financial aspects of advantages of energy efficient homes which will help persuade some who are leery of the costs of remodeling in undertaking green home improvements. If respondents were asked whether they would rather select for changing their current house or buying a new one, most of the respondents were more inclined in transformation. About the question, 35 respondents agree, 6 totally, with respect to the preference of renovation over relocation.

As for the problematic visions for such transformational change, people have cited actual obstacles and barriers to change of different forms: cost, finance, lack of guidance, trust, and technology literacy. Several respondents also pointed towards the problems of consultancy regarding costs and the rental issues which may also hinder home

improvements. These challenges therefore call for improved market solutions and proper information to the existing homeowners. However, it should be noted that lack of trust and guidance also contribute a great deal to people's inability to undertake various changes in their homes sustainably where financial constraints are the most typical hindrance.

On the positive side as many as 48 respondents agree and 5 completely agree with the statement that with such changes, their quality of life would increase. From here, it seems that although all these respondents find themselves facing barriers, they also understand the potential convenience improvements that could be brought from home transformations and the improved living conditions that this would offer, in terms of warmth, cheaper costs and health. This was however only manifested by 7 respondents with 5 respondents disagreeing and 2 totally disagreeing that such changes would have a positive effect. It can be those people who do not believe in the real-life advantages of home transformation or those have no need for it because they are comfortable with what they have.

Lastly there was a question whether they were going to need financial help to bring these changes into reality, to this a huge number of 65 participants agreed and 3 totally agreed. This response also reveal that people do desire various home improvements but financial help is necessary to make change happen. From this discovery, there is a necessity to ensure that there are financial programs, subsides or incentives that can be offered to the home owners for an improvement of their homes through sustainability. If such assistance is not availed then those may again suffer from the constraints mentioned above including cost barriers.

Conclusion

The respondents data analysis showed that energy and water crisis, high electricity bills are major concern among most respondents and there is a high degree of perception that improved design of House could handle these problems. Many people have a high acceptance of home transformations and this could be attributed to the fact that they can be relatively cheap or one can be compelled to seek financial support at times. That being said, the process is not without its problems, namely cost, lack of direction, and general unfamiliarity with high-performance homes. In conclusion, although people realize what new homes' improvements might do to enhance the quality of life, the support financially and the improved knowledge is needed so that more people could make such changes possible.

Recommendations

- Higher level sensitization for the public with respect to energy efficient architecture and high performance architecture to be developed through awareness.
- The need for the transformation of existing built houses is more critical as compared to design of future houses since people under the current socio-economic crisis are unable to cope with these burdens.
- Existing built for analysis with respect to potential for renewable energy extraction and optimization for local use should be prioritized.
- Design professionals need to evolve solutions to this two way issue where lack of sustainable design and increased cost of energy is a dual burden on the public at large in Pakistan.
- Public – private partnership must be a key solution based provision where integrated approach may help evolve better integration in the trust deficit minimization and improving the potential of public gain at large.

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