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Green Roof Acceptability in Lahore: Assessing user perception through quantitative analysis

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ABSTRACT

This study has targeted to evaluate the perception level of people for green roof system in urban areas of Lahore, Pakistan. A questionnaire based survey is conducted of 80 individuals,in which 58 responded, residing in the city areas of Lahore. After verifying the internal consistency of survey instrument in SPSS, frequency distribution and descriptive statistics are processed to assess the perception level of respondents against green roof's prospective, advantages, disadvantages and reasons for not installing the green roof system. Results of this survey based research showed that green roof system with more competent design and well-maintained variety of vegetable roof is preferred by the individuals. The study also indicates the misconception about green roof installation, which is the main reason proving as an obstacle against its adoption. It calls for the attention of government and non-government organizations to support green roof technology through awareness campaigns and economic support for persuading the people to show positive attitude. Future researches are directed to study with larger sample size population.

***Keywords*:** Green Roof, Social Acceptability, Public Awareness, Policy Making

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INTRODUCTION

The green roof has emerged as an innovative subject of urbanization and architectural advancements that emphasizes to execute the ecological improvements in the city areas[1] . It has seen that settlements in the urban context are continuously increasing and it is projected from the year 2000 to 2030 that the population of urban vicinities will rapidly

grow by 72%[2]. Additionally, new build-up structures in urban areas are also expected to increase upto 175%[3]. Highly concentrated urban advancements are limiting the accessibility to green spaces, which requires a serious quest for new substitutes. In this regard, the external spaces of structures offer sufficient volume for covering with vegetation; hence, green planting on roof tops and the house frontages have emerged as an innovative arrangement for urban green system[4]. During last decade, the subject of green roof has attracted many researchers worldwide to explore its diverse dimensions. White and Gatersleben shared the results of research conducted to evaluate and compare the preferred performance of green roof houses and conventional houses[5]. Others presented that the structures with green integrations are found to have significant likings, curative impacts and pleasing ambiance than the one without vegetation. However individuals in the urban areas are found to be conscious regarding the types of vegetation and safety measures[6].

Recent years have also witnessed the increased interest in urban greeneries internationally even in those areas where there is limited water. In the Mediterranean section, it is found with prospective benefits but the development in these areas is noted slow in contrast to the other regions. This slower progress of green adoptions has noted the result of reduced green awareness and lack of administrative support[7]. Results indicate that majority of professionals believed that green roofs have the significant impact for establishing the effective ecological arrangements by natural practices in the urban areas. Green roofs also offer filtering the air for suspended particles, reducing the noise and pollution, halting the electromagnetic radiations and reducing the frequency of diseases in the urban localities[8]. Additionally the impact of green roofs for decreasing the heat transformation and increasing the insulating effect for roofs is greater than the conventional roofs[9]. Comprehensively, researches show that green roofs keep distinctive potentials for improving the quality of urban environment to incorporate sustainable architecture[10]. Hence green roofs are developing architecturally aesthetic spaces, and, realizing the healthy support for city living[11].

This paper focuses on the citizens of Lahore, Pakistan, where it is considered that people are not paying attention and diverse nonsupporting factors are becoming counter productive for the green roof installation. This city experiences high temperature and pollution due to rapid industrialization, urbanization, development on agriculture land and heavy traffic on the roads, to name a few[12]. General people of the city of Lahore are reluctant to install green roof system because they are less aware of the benefits of this system. In addition to that, government seems least interested to support green roofs on any scale. The research has not related the varied income levels of the residents of Lahore with accepting the green practices but is mainly focussed to assess the perception and understanding of people for green roofs to improve the quality of urban environment.

2. Literature Review

In the recent years, different innovative proposals have emerged to construct the "eco-cities" particularly for environmentally explicit communities that support for technically fit and sophisticated designs of buildings to enjoy the healthier life. This innovative trend has seen much criticism in general communities[13].Environmental benefits of green roof system are very high and important against environmental issues especially in the urban areas. It lays the responsibility on design professionals, town planners, architects and environment managers for working together to develop the eco sustainable future of

urban areas[14]. Qazi Azizul evaluated the changed perceptions of individuals regarding roof gardening and reported the acceptance of positive change in the Dhaka residents for supporting the green environment[15].

A research assessed the public opinion for green roof designs in Iranian cities and resulted the attractive views and the enhanced visual impacts that significantly support the attitudes of residents and likings[16]. Researcher indicated that there is a need of awareness among general public to participate in developmental projects of green roofs. The study highlights the need of encouragement for policy makers, mass media, contractors, professionals and site owners to learn about increased advantages of green roofs. In order to advance in local industry, it is suggests that local government should adopt such strategies that encourage green adaptation. In this regard awareness sessions keep greater importance for spreading potential benefits of green usability in urban areas. It is highlighted that green planting deliver substantial advantages for urban population. Researchers have highlighted the need of innovative methodologies and conceptualizing the prospective economic outcomes of green spaces[17].

It is presented in the findings that though green roofs are gaining increased popularity, it is still required to conduct research that should focus on living walls and green tops so that there will be excessive knowledge for such developmental projects[18]. Researchers have not only shown the level of effectiveness for green roofs that depends upon the type of plants, localities and weather conditions etc., they have also indicated the potential advantages of green roofing, that have reduced energy consumption for air conditioning purposes in buildings, well enhanced comfort level, safeguard against story waters, decreased CO_2 and reduced noise level in urban areas[19].

Researchers have refered the green sustainable development towards local administrations to take important initiatives. There should be awareness campaign for supporting green perceptions for urban areas. These implementations will offer natural ways to reduce air pollution and provision of health atmosphere of human survivals[20].

Roofs in green construct have considered a cooling technique that cares for environment as well as for the society[21].

Sangkakool (2018) refered the green roofs as an instrument to alleviate the severe climatic changes and get improved life style in a natural way[22]. Hence for sustainable cities, green roofs prove an impactful contribution. Green roofs provides numerous types of ecosystem facilities that are frequently uncommon particularly in the city areas. These facilities accumulate welfare to metropolitans. Though, ecosystem facilities do not usually have a market price, thus we have to use ecology estimate approaches to evaluate the assistance. Based on the assessment, the most important welfares were: an improved lifetime of the rooftop, energy reserves due to increased isolation, cooling, improved storm-water management, healthier air-quality and sound protection, particularly in the air craft noise zones. In addition, other potentially significant benefits include aesthetic benefits, health benefits and enhanced biodiversity[23].

Methodologies

Research Design

This research is based on explanatory research design where quantitative technique is implemented. For collection of data from targeted respondents, questionnaires were distributed and convenient sampling technique was implemented to conduct the survey

from residents of Lahore, Pakistan. Collected response was entered in SPSS for processing the statistical analysis.

Population

Current research was designed to conduct the research survey by targeting the residents of Lahore, Pakistan. This assessment targets the potential advantages of green roof system and prospective disadvantages of this system in targeted urban areas. In this research survey, residents of Lahore city were provided with research questionnaires, and these respondents belong to varied economic strata.

Sampling Technique and Sample Size

The convenient sampling technique is adopted for this research to collect the responses of the residents. This sampling technique allows the easy available way for collecting the response from respondents; hence every person from the survey population has an opportunity for being selected for the survey. The selected sample size for this study survey is 58 responses from the urban areas of Lahore. This sample includes equal opportunities for male and female for recording their opinion level related to green roof system in Lahore city.

Instrument Development

Questionnaires are adopted as a method for surveys as this is a quick and efficient way and a large sample size can be considered for quantitative analysis. The questionnaires used to collect survey data is evaluated through SPSS. Contrary to personal discussions and interviews, the questionnaire engages the respondents for a variety of questions. They can take their time and conveniently respond after understanding the questions. The five point likert scale rating adopted for the responses is in accordance with the research objectives. Through this likert scale questionnaire, intendment variable will be optioned in strongly disagree toward agreed positions.

Data Analysis Technique

As the research methodology is primarily quantitative, the survey is focused on acquiring data from 58 respondents by processing questionnaires. The responses received from the sample units were recorded in SPSS version 20 for statistical analyses. In this social statistic tool, the reliability of the questionnaire was evaluated for internal consistency. This reliability test was conducted for each study scale and the results taken from this test as Cron Bach's alpha value were justified with standardized value for verifying the internal consistency of the scale.

A test of frequency distribution was processed against the demographic factors of the survey for evaluating the frequency and percentage of responses included in the survey. In order to assess the perception level and acceptance of advantages gained through green roofs, a test of descriptive statistics was planned to process in SPSS that offered the mean values along with standard deviation results to conclude the survey findings.

Analysis and findings, Reliability Test, Table 4.1

Summary of reliability results

S.no	Scale	No. of items	Cronbach's Alpha
1	Advantages	10	.912
2	Disadvantages	6	.859
3	Reasons	5	.903

Reliability test has processes for verifying the internal consistency of the study instrument processed in this survey. The results of reliability test in SPSS showed that each variable scale in the instrument keeps convinces cronbach's alpha value i.e. higher than .700 that is graded as consistent for proceeding the analysis.

4.2 Frequency Distribution of Demographics

Table 4.2

Summary of demographic responses

Demographics	Options	Frequency	Percentage
Age	20-25	16	27.6
	25-35	19	32.8
	35-45	13	22.4
	45 and above	10	17.2
Gender	Male	19	32.8
	Female	39	67.2
Qualification	Illiterate	6	10.3
	Matric	22	37.9
	Intermediate	14	24.1
	Graduate	7	12.1
	Master and above	9	15.5
Occupation	Businessman	23	39.7
	Govt employee	27	46.6
	Private employee	3	5.2
	Others	5	8.6
Background	Urban	27	46.6
	Rural	31	53.4

The table above reflects the frequency distribution of demographic responses. As the survey focused on diversity for age; the frequency distribution shows that 16 respondents are between 20 to 25. This group has contributed in the survey by 27 percent response as compared to the total survey groups. The participants of the age ranging from 25 - 35 are 19 in frequency and their contribution has a value of 33 percent considering the overall response. Respondents having an age from 35-45 years are 13; hence their participation makes 22 percent of the total. The respondents of ages 45 years and above are 10 in number and make 17 percent of total survey response. The variety of age groups of the respondents exhibited a diverse perception of study survey which offered a strong provision for evaluating the advantages and disadvantages of green roofs in Lahore.

This study considered both males and females for sample selection. The presence of male respondents shows the frequency distribution of 19 participants with 33 percentiles. Whereas 39 female respondents make 67% of the total i.e. twice the number of male

participants. The participation of males and females provides the view point of both the genders regarding acceptance of green roof system in urban areas.

This survey has targeted the general community which is comprised of people of multiple educational levels. The table above displays the response frequencies with reference to the educational background of respondents. Most of the participants have done matriculation and above, whereas 6 participants are illiterate, making 10 percent of total respondents. This variety in educational qualification demonstrates different perception level and understanding about green roof system.

This survey represents mixed occupational participants. The table of frequencies displayed above shows that most of the respondents are engaged either in business activities or are government employees. Their number is 23 and 27 respectively. The people doing jobs in private sector and other occupational participation are 3 and 5. These diverse occupational participants keep varied approaches towards green roof system through their economic capacities.

The participants in this survey are almost equally distributed with respect to urban and rural backgrounds. These individuals indicate both experiences i.e. in the cities and in the rural areas where there is low heat with respect to cities. Hence an effective judgment results out of such mixed responses.

Table 4.3

Advantages of Green roofing

S.no.	Advantages of Installing Green Roofs	Mean	Std. Dev.
1	Green roofs reduce air pollution	3.7931	1.10436
2	Increase biodiversity in urban areas	3.7931	1.16617
3	Improve thermal insulation of the building	3.8621	1.06702
4	Provide a new green space for recreational use.	3.9483	1.099
5	Mitigate the heat-island phenomenon in the city	3.9828	1.11594
6	Help to manage the storm water runoff	3.6724	1.14536
7	Achieve greater energy efficiency in the building.	3.5862	1.29824
8	Make it possible to cultivate vegetables, fruits and ornamental plants	3.8621	1.13088
9	Act as a barrier against noise.	3.8621	1.09941
10	Increase longevity of the roof membrane	3.7069	1.09238

The collected response of this study survey against the prospective advantages of green roofing shows the agreed option level from urban area residents of Lahore. Respondents showed agreed opinion level against potential advantages of green roofs to reduce air pollution in urban areas. This response means value of 3.79 indicated by 4 (Agree) opinion level. Other important advantage of green adoption at building tops are explained with significant acceptance, that are, increased biodiversity, providing new

green spaces in the urban areas, mitigating of high temperature in the city areas, provision of resistance on adverse weather waters, supporting buildings with energy solutions, easy cultivation of variables on roof spaces, reducing noise and increasing life of roof membrane. Respondents recorded their opinion as convinced against all prospective advantages of green roof system. This shows that general people are behaving in convinced attitude and it needs to provide sufficient support from the government to avail discounted essentials for green adoption so that residents get encouraged and take self-initiatives for green practices.

Table 4.4

Disadvantages of Green Roofs

S.no.	Disadvantages of Installing Green Roofs	Mean	Std. Dev.
1	Cause problems for people with allergies.	1.4138	0.79548
2	Encourage the proliferation of insects and rodents.	1.7759	1.02672
3	Have high installation cost.	1.6897	1.04641
4	Have an expensive maintenance.	1.8793	1.20055
5	Create problems of dampness.	1.8448	1.15168
6	Have a high consumption of water for irrigation.	1.9828	1.33102

With respect to the weaknesses, as shown in the above Table 4.4 , the three main prospective issues with strongly agreed ranking are (1) problems for the individuals which they have to face insect breeding (2) increased cost of maintenance and (3) raised issues of maintenance. The other options that may cause problematic arrangements for installing green roofs have also responded by survey participants in significant ways. Such factors are intentions of individuals with allergies and requirements of high water flow for vegetation. Respondents have agreed the the role of these factors is significant that common person may feel in the Pakistani context.

The factor of allergies due to greenry which was highlighted by survey respondents is also of key importance. Taking into account the Pakistani environment, there are environmental diseases which are caused by mosquitoes that causes dengue fever or malaria. So individuals in the urban areas are also conscious regarding mosquito breeding. It is perceived that roof gardening may keep potential of such diseases. On the other hand, issue of water flow in the urban areas of Lahore is also of prime concern. Due to electricity short fall, urban areas have to face shortage of water, even drinking water becomes scarce especially in summer season when there is maximum water consumption. Due to this issue, individuals are concerned about provision of roof water system for planting vegetation which may create problem of investing in green roofs.

Table 4.5, **Reasons of not installing Green Roofs**

S.no.	Reasons of not Installing Green Roofs	Mean	Std. Dev.
1	Encourage the proliferation of insects and rodents.	3.0862	1.43006
2	Have high installation cost.	3.2241	1.3118
3	Cause problems for people with allergies.	3.7241	1.50779
4	Create problems of dampness.	3.2931	1.48689
5	Have a high consumption of water for irrigation.	3.069	1.43713

A diverse response to the major causes that hinder the adoption of green roof system in urban areas of Pakistan is received from the study survey. Respondents have presented the major intentions for allergy problems. As residents of urban areas are very sensitive in contrast to rural areas, they showed the serious concern of allergies and linked it with green roof system in Lahore, Pakistan. The other issue agreed by survey participants is high consumption of water for irrigation. This issue is considered as disadvantage as water availability is limited for the residents. People are facing problem of daily consumption of water, they are bound to resist against the adoption of green roofs.

Dampness problem in the urban areas is also important to note where individuals have invested heavy amount on the construction of houses. These owners have responded against the adoption due to this perceived aspect that it will damage the building and will be of greater loss for them. This issue requires awareness and understanding of roofing layers and damp-proof surfaces for convincing citizens of urban areas. Heavy installation cost is another reason that halts the residents to make final decision of adopting green roof system. There is knowledge gap between invested cost and perceived environmental benefits. Individuals consider the cost of roof system high if the perspective is just green appearance. They are not aware of the advantages of eco-friendly outcomes and ranges of green benefits.

5. Conclusion

This study evaluated the perception of general public and their individual opinion for green roofs in the city of Lahore, Pakistan. Results of this survey based research show that green roof system with more competent design and easily maintainable variety of vegetable structures are preferred by the individuals than other natural alternatives. The results of this study also indicate the misconception which is proving as a hurdle against green roof installations. The findings have shown that lack of awareness among people proves as an important factor that influence the behavior of residents towards green roof technology. Local authorities and government lack to support the green roof technology

through successive advertising campaigns. It calls for attention that government and non-government organizations should support green roof technology for persuading the people to show positive attitude. There exist lots of myths and misperceptions among general public in urban areas regarding green roofs. By highlighting the preconceptions of residents about such technologies, convincing reasons need to be identified by experts and policy makers. No doubt when people will come to know about range of benefits along with government support, there will be increased positivity for installing green roof technology in the urban areas. This will not only be beneficial for the prime user but general community will also receive advantages regarding environment and health.

5.1 Contributions of the study

First and main, this research adds to the current understandings and knowledge on green roof perception among general public to understand its advantages, disadvantages and reasons of not installing the green tops.

Secondly, this study will present the notable evidence of residents through survey and a diversity in the results is presented. This way the future researchers would be able to obtain evidence of exercising green roof installations with reference to the context.

Thirdly, this study has indicated main reasons which are inconsistent to install green roof in public view point, this is a different dimension in evaluating the reasons of acceptance or rejection of this technique. The evidences will support the incoming researchers to incorporate these factors for changed populations to present comprehensive findings

Fourthly, with respect to management, the study has focused on the reasons that impact green roof installations. This research could be an opportunity for the professionals engaged in management to avoid the negative features of installing green roofs and actively overcome the deficiencies present in this technology.

Fifthly, this study indicates the requirements of special initiatives related to awareness and provision of subsidies by the government to assist the green roof system in the urban areas of Lahore.

5.2 Future Research

The very study remained focussed on a particular city with relatively small sample size. It is hence suggested that large sample-based research survey, with changed localities in Pakistan, should be carried out.

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