Urban Greenry and Its Impact on Cooling Cost in Peshawar

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Abstract

With progress there is decline in both numbers of trees and jungles, areas converting from rural to urban, more industries leading to more pollution and thus increasing Green House Effect resulting in increase in global temperature. The effects of these industrial wastes and green house can be controlled by decreasing the pollutants production and by more plantations making the areas greener. Greenery not only counter affects the environment but also gives us recreational and picnic spots. The air stays fresh and cooler. This cooling may decrease our dependency on coolants like air conditioners and room coolers in extreme summer temperatures and thus might help us save energy and money as well. And in this study we have showed that greenery does have an effect on bills of areas with more greenery than on bills of area with less greenery.

Introduction

Coming in contact with the nature is very healthy for our physical and mental health. High standard changes brought in an area including the planting of trees is a nice investment. It has a calming and relaxing effect on the environment. Talking of which brings us to our main topic that is the urban greenery.

What is urban greenery? When the word urban greenery is used an image of green pavements, parks, footpaths with greenery is set in our mind. A biologist E. O. Wilson had coined a word "biophilia" which means the love for living. It has been described as the love of us humans for nature. We all need green time. Most of us when imagine a relaxing scenario in our mind think of green fields. In our country most of the greenery is found in the rural areas, but the urban areas too need more green area. Urban greenery becomes more and more important with the passage of time as the temperature in our cities keep increasing.

The increase in temperature is due to different factors most common of which is the Green House Effect due to industrial waste that is persistently filling our atmosphere. Also there is an increase in mass cutting of trees due to requirement in different industries like furniture and paper etc. This gradual increase in temperature is specifically affecting our life style, as in our country all four weathers are present and all four of them come in their extreme ranges. For example, in summer the temperature may touch 51 Degrees Celsius as in Sibbi, and in winter it may be as less as -15 Degrees Celsius especially in northern hilly areas. This variation in temperatures in different seasons also compels us to deal with them accordingly.

It is also worth mentioning that duration of summer in our region is more as compare to winter. So people are more challenged by summer rather than winter and that is the reason different types of coolants like Air Conditions, Room Coolers and Fans etc are used to deal with it. Due to the intense temperature in our area people tend to use these coolants and also for greater duration that ultimately lead to increased consumption of power which in turn leads to increased amount of bills. Sometime the bills are so huge that one simply cannot afford to pay them.

Another problem we are facing because of increase power consumption is the shortage of power. Our demand for energy production is increasing than we are able to produce which results in load shedding, i.e. unavailability of power. To overcome this problem there is also a growing trend of underground construction in homes that, to some extent, decreases our dependency for cooling on power.

 A new concept of dealing with high temperatures is currently on the rise that is "Increase Plantation". It has been scientifically proved in different studies that greenery of an area has a major effect on decreasing the temperature of that specific area resultantly causing cooling and cleansing of air, a reason our rural areas are comparatively cooler than urban areas which has less plantation and more pollution. The new concept is to increase the plantation in urban areas as well so as to reduce the effects of pollutants and green house effect on its temperature. Different researchers from different countries around the world are working on this very issue of greening the urban areas.

In continuation of these new research projects , my study is also to compare two parts of the city in Peshawar, one of which has more greenery i.e. Peshawar University Campus with the one that has less greenery i.e. Hayatabad. My study is to find the effect of greenery on the use of coolants and to see its effects on the bills. If there is an increase in amount of the bills in Hayatabad as compare to Peshawar University then it would mean that greenery of Peshawar University is decreasing the use and duration of Coolants thus decreasing the bills.

The results would help us support or reject the fact that greenery affects the temperature of the specific area.

Literature Review

Lehrer, J. January 2, 2009. How the city hurts your brain - And what you can do about it. Boston Globe. Claims that   Living in a city may dull the mental abilities of a person. Berman, M.G., J. Jonides, and S. Kaplan. 2008. The Cognitive Benefits of Interacting with Nature. Psychological Science 19, 12: 1207-212 research work claims that the traffic and crowds of a city may cause the loss of memory and the loss of self-control. Looking at the greenery may help in better brain activity.

Nyuk Hien Wong, and Chen Yu from the Department of Building, School of Design and Environment, National University of Singapore presented a paper which was accepted on 12th April 2004 regarding the Urban heat island (UHI) effect. Greenary in the cities is thought to lessen the UHI. They investigated the extremeity of the UHI effect and also the cooling effect due to the greenery at a large scale in Singapore. This paper states a powerful connection amoung the temperature decrease and the greenery in the city. The paper states a change of 4.01 °C.

In addition to this, Erica Oberndorfer, Jeremy Lundholm, Brad Bass, Reid R. Coffman, Hitesh Doshi, Nigel Dunnett, Stuart Gaffin, Manfred Köhler, Karen K. Y. Liu and Bradley Rowe wrote an article on "Green Roofs as Urban Ecosystems: Ecological Structures, Functions, and Services" in 2007. This paper discusses regarding the greenery on the roofs claiming that it has its effect in the urban areas on the surrounding which includes the fitter or superior setting of the temperature in the building and that it also helps in the reduction of the UHI effect and this also results in better urban fauna domain. The article also observed the living and non-living factor contribution on the surrounding in order to understand and work better on the roof greenery in the urban areas.

Similarly, Edward Ng, Liang Chen, Yingna Wang, Chao Yuan presented a paper "A study on the cooling effects of greening in a high-density city: An experience from Hong Kong". It was accepted on 12 July 2011. The paper claims that in elevated density areas like Hong Kong urban greenery proves to cool the atmosphere which results in low consumption of the energy by the buildings. In addition to this, amny other researchers argues on the same topic claiming that greenery in an area is a good method for fighting the outcome of UHI. Different case studies were conducted while working on this paper and the researchers also came to the point that the greenery on the roof of the high buildings is inadequate for the heat consolation for the people on ground. They recommend trees to be of better outcome than grass in the walking areas temperature decrease. It said to lower the temperature by 1 °C.

Correspondingly, Nyuk Hien Wonga, Steve Kardinal Jusufb, , , Nedyomukti Imam Syafiic, Yixing Chena, Norwin Hajadia, Haripriya Sathyanarayanana, Yamini Vidya Manickavasagama in 2011 presented the paper on "Evaluation of the impact of the surrounding urban morphology on building energy consumption". For a long time period the air temperature for Singapore territory were made and certified in factual models of minimum, and and maximum air temperatures Tmin, Tavg and Tmax respectively. There are considered to be three urban factors that effect the urban temperature locally. They are said to be the green areas, the pavements and the buildings. Apart from these factors others observed which are correlated to these include the sky view and the green plot ratio and the surrounding building thickness or density, the walking area and the proportion of the incident light or radiation that is reflected by a surface are were also examined to understand better the effect of improved urban shape and structure on the expenditure of energy. The main purpose of this research was to find out the effect of the temperature variation in urban areas on the use of energy by the buildings in Singapore. For this purpose various methods including calculatiosn and building stimulatiosn were used. Different cases in various urban areas were studied considering the different effecting factors of an urban area which included the altitude, different densitites and the green area density. The outcome of the research proves that green plot ratio has the most effect on the energy expenditure by the reduction of 2 °C.

Again, N.H. Wong, , Steve Kardinal Jusuf, Aung Aung La Win, Htun Kyaw Thu, To Syatia Negara, Wu Xuchao conducted a study in 2007 on "Environmental study of the impact of greenery in an institutional campus in the tropics". The paper states that the environmental conditions of the urban areas keep getting worse year by year. And the temperature in the urban areas is continuously on a   rise and ways have to be adopted to lessen these effects. Adding greenery to our environment is one of the best ways to lessen the UHI effect. And the parks in the cities enhance this effect. In this case study National University of Singapore (NUS) was taken under observation. The campus is so big that it can be called a city on a small level. The greenery on the campus gives it a look of a rural area with cool temperature. Methods that were used in this study included satellite image, field measurement and computer simulations. The hot and cool places were identified using the satellite imaging at the university campus. The real temperature distribution was studied with the help of field measurement. And with the help of computer stimulation predictions regarding some scenarios with varying conditions was made. The outcome of the study reveals that the buildings which were close to greenery or were surrounded by greenery had lower ambient temperature than those buildings which were away from the greenery and that greenery does help in reducing the temperature of the environment. This study also conveyed the knowledge that greenery on the top of the roof of various buildings at the campus did result in the cost saving of

the cooling energy.

Likewise, Limor Shashua-Bara, Ioannis X. Tsirosb, Milo E. Hoffmana presented "A modeling study for evaluating passive cooling scenarios in urban streets with trees. Case study: Athens, Greece" which was accepted in 2010. The study was done investigating the differences in the temperature in city streets with trees in Athens far from the center of the city and from the center of the city. The factors were the tree coverings, the traffic, varryign light reflection from the surface, the ventilation of the streets. The thermal effect of each aspect was observed using a the Green CTTC analytical microclimate model. The models were first endorsed with the data and then used to study the out-turn of the urban factor variations in the decreae of the temperature in the streets under observation and the conclucion shpwed that the reduction in the air temperature in the street may be uptil 5 K in the noon with an average of 3 K cooling daily. It also helped reveal information regarding the passive cooling methods in the urban streets.

In the same way, M. Santamouris presented, "Cooling the cities – A review of reflective and green roof mitigation technologies to fight heat island and improve comfort in urban environments" This study states that similarly that the urban area heat increases due to the UHI effect and the climate changes. This increasing heat problem increases the energy problem of the cities and puts in stake the solace state and the population of people in the area and increases the pollution problem. To bring balance in such a condition important weaking methods have been introduced. In these technologies increasing the surface light reflaction in the cities and using greenery on the roofs happen to be better in reducing the UHI. When the entire increase in the city albedo is consideredthen the temperature decrease is 0.3 K in 0.1 rise of the albedo and the peak average decrease of the temperature is 0.9 K. Apart from this when the roof is only taken under consideration then the data shows urban temperature decrease rate is 0.1 and 0.33 in 0.1 increase of the roof albedo and the mean is close to 0.2 K.

Diana E. Bowler, Lisette Buyung-Ali, Teri M. Knight, Andrew S. Pullin published "Urban greening to cool towns and cities: A systematic review of the empirical evidence" and the paper claims that the urban greenery is one way of reducing the consequences of the heath of the people due to the increased temperature which is the outcome of the climate change. The main emphasis of the study was on whether green areas are cooler than those which are not green. The air temperature was analyzed. The results depicted that the places with trees, parks, and the area beneth the trees was cooler than the rest of the place. Results show that the park was 0.94 ∘C cool in the daytime. And further the study reveals that parks which are larger and have more trees are more cooler in the day. But then again we come to a point saying that these studies are on studying a small area and to know whether the cooling effect in the urban areas is solely because of the greenery alone is still to be found.

Elisabet Lundgren Alm published "Visualizing Urban Green Qualities in Sweden: A Way of Raising the Quality of the Urban Landscape". This paper argues regarding urban greenery stating that the focus from green areas should be shifted to green qualities as this will make it for sure that urban planning is not just about parks, roads, buildings and houses. This paper further discussed regarding the different challenges in this due to different aspects in our society.

Environmental goods provides special challenges to demand theory due to lack of markets and cost of provision. Environmental goods creates utility which includes direct impact as in material damage or health and impact on echo system. Consumers perceive the use and non-use value of environmental goods. Non-use value refers to existence value, bequest value, and altruistic value. Different approaches are used demand for environmental goods which includes house hold production, and hedonic prices based on revealed preferences, contingent valuation based on stated preferences and several other methods including experimental and constructed markets. Compensated demand curve keeps the utility constant and see the relationship between quantity demanded and prices. Ordinary demand curve keeps the income constant and see the relationship between quantity demanded and prices. Since environmental goods ads to the utility of consumers so improvement in urban greenery will increase the unity of people living in the neighborhood. Thus welfare of the whole society will increase.

Due to all these studies and work in this specific field the researchers and the urban planners have come to a point where they have a better understanding of the policies to be made, and the principles to be set Shiro Kawai,Kouchi Tonosaki and Kouji Tokoro presented their work under the title "Investigation on the cooling potential ofurban greenery spaces in summer". This paper states that the urban greenery has various functions that it plays in our surrounding which includes purpose of refreshment, beautification and amusement, the conservation of the green life. Apart from these scientists also have a firm believe that urban greenery plays a role in the conservation of biodiversity, contribution in the ecological system, taking up of the greenhouse gases that are released, and also help in making the surrounding cooler. In all these roles that urban greenery plays the one that the scientists give more importance to is the cooling of the environment due to the reason that the UHI is becoming a major issue around the globe specially during the summer season. This paper mainly had discussed the urban greenery's ability to cool down the air during the summers. It had already been noticed that the heat released and the green area has a great influence on the temperature of that area. The data for this paper had

been collected from various positions in Minato-Ku, Tokyo. After this, it had been confirmed that the green areas do help in cooling the environment. Regression analysis method was used for this study. Since the green areas does help in the air temperature reduction, therefore it will also result in the less use of air-conditioners due to which less consumption of energy occurs. The anthropogenic heat released by 70 buildings can be overcome by the green area of around in 22,500 square meters.   In the end, it is concluded that the green area does result in the cooling of the surrounding. in the populated urban areas to result in a   better environment for the humans living in it.

Methodology

My research emphasis is on the urban greenery and its effect on the cooling cost. My observation and data collections were made in Hayatabad and University of Peshawar (UOP) campus and was completely a primary data. Both these locations are away from the center of the main city. Hayatabad is a suburb residential area, it was made in the late 1970's. In Hayatabad there are not many parks or green areas. This very big residential area has 5 main parks namely Bagh-e-Naran, Khyber Park, Shalman Park, Ghani Bagh, Tatara Park. Most of the trees found here are in the lawns of the houses. On the other hand the University of Peshawar campus is spread on a very large area. It is among the old universities of Pakistan. It was started in the 1950's. The campus apart from the academic departments also has its own residential area. It may not have any specific park but it has large lawns all around the campus. A large number of trees and bushes are found around the campus and near the pavements. There are large lawns in the houses on the campus. As compared to Hayatabad the greenery at the University campus is much more.

My method of data collection included questionnaires that were used specifically for finding out a relation between greenery and the bills.

The questionnaire included 19 questions that were focusing on the social status of the users. In my studies I included only middle class families and those with one split Air Conditioner that is the main cause of increase in bills. I had already defined the families on the basis of their incomes as shown in table 1.

Table 1: Classification of Families on the basis of Salaries

S.No	Class	Income
1	Lower Class	Less than or equal to Rs. 50000
2	Middle Class	Rs. 50000 to Rs. 250,000
3	Upper Class	Rs. 300,000 and Above

According to these criteria I selected hundred houses in each area and went door to door and asked those questions from the residents of the house. Bills for the months on May, June, July and August were asked and averages of those bills were included in our study. Luckily the load shedding in both areas was almost the same i.e. 8 hours.

I also asked about the other main power consuming appliances that included refrigerators, televisions room coolers and fans etc.

Averages of the bills and other appliances were taken and then all the averages of both the areas were compared. The results were analyzed in Excel 2007

Results and discussions:

The data was collected in the form of questionnaires and Microsoft Excel 2007 was used for its analysis. Data from both areas that is from Hayatabad and Peshawar University Campus were compared. Minimum, Maximum, Mean and Standard deviations of the entire column were calculated and listed in the form of table as shown in table 2.

Table 2: Data Analysis of Bills of Both Hayatabad and Peshawar University

| S.No	100 Houses at University of Peshawar				100 Houses of Hayatabad			
	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Members in Family	3	15	6.22	1.85	3	25	8.23	3.61
Area of House	20	80	34.4	22.76	3	20	8.13	4.29
Number of Electric Meter	1	2	1.03	0.17	1	2	1.04	0.2
Average Electricity Bill For May, June, July, August in Rupees	6375	43750	17585.75	7599.62	9250	73600	23735.95	12187.13
Number of Splits	1	1	1	0	1	1	1	0
Number of Refrigerators	1	3	1.26	0.46	1	3	1.32	0.49
Number of Televisions	0	3	1.35	0.72	0	4	1.27	0.71
Increase in bill due the coolant appliance %	40	90	63.05	9.37	40	200	70.1	29.8
Income in Rupees	50000	250000	119700	37576.99	50000	200000	108850	39923.25
Percent income consumed by Electricity bills.	5	39.6	15.096	5.93	7.71	44	22.71	7.99
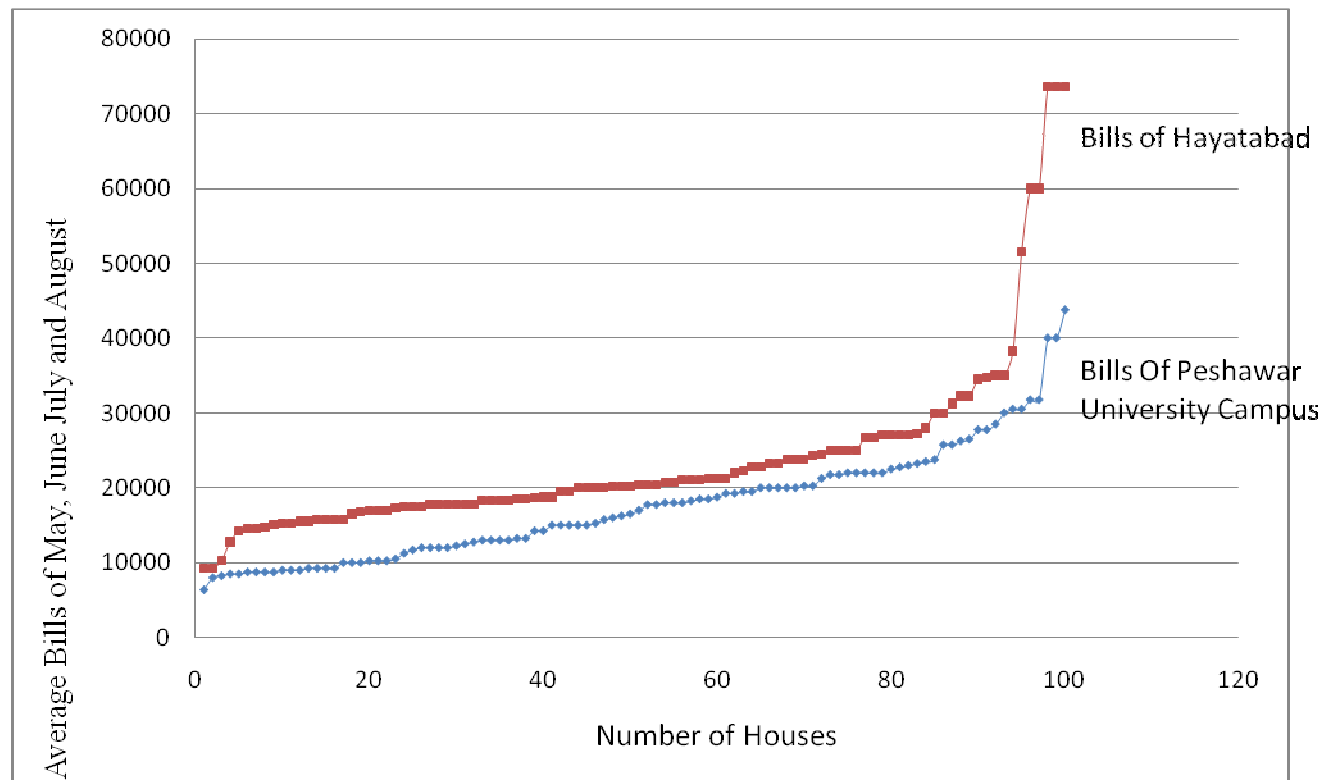
Figure 1: Comparison of Bills of Hayatabad and Peshawar University Campus.

Comparative graph of the bills of the areas was also made with the help of Microsoft Excel07 as given under in Figure 1.

From the table 2 and Figure 1 presented above, it is very clear that the average Bill of Hayatabad for the months of May, June, July and August is almost 5000 more than the bills of people living in Peshawar University campus. Also it is quite clear that there is an increment in bills in summer as compared to winter, which is mainly due to the use of split air conditioner.

From the graph in figure 1, it is depicted that difference between the two values remains the same from bill worth Rs. 10,000 to bill worth Rs. 40000. There are a few values that come above the values of Rs.40000 that can be ignored as it constitute very small amount of our data.

It is also worth mentioning that the average income of people living in both areas is almost the same, so there are no chances of questioning the affordability of the consumers.

So keeping the environmental conditions of both areas under considerations, that Peshawar university campus has more greenery as compared to Hayatabad, we can relate these conditions with our data results and conclude that the greenery of Peshawar university keep that area cooler and because of that people of Peshawar

university use less coolants there which decrease their consumption of energy for cooling and leads to less bills.

Discussions:

We have also mentioned that there are refrigerators and televisions that are used in all the houses that were included in our study. But as we know that refrigerators and televisions are used in winter equally as they are used in summers. And from the data we see that the average number of televisions and refrigerators are almost same in both areas. So we definitely can ignore their cost as it will be same in both winters and summers and same in both areas as well.

Also in Hayatabad we see that there two persons more at each home in Hayatabad but since in summer we see that families gather in one room, so the number of individuals are not gonna affect the consumption of Power.

The areas covered by the houses at Peshawar university is way more than that in Hayatabad but no relation could be fine between the area and the increase in the bills as the energy consuming appliances in houses of both the areas are the same.

Conclusion:

My results shows that there is mass difference between the bills of both areas and the only reason i found was the that Peshawar University campus is more cooler than Hayatabad and is because of more greenery.

So from my study i suggest more plantation should be done in urban areas so as to minimize the energy consumption for cooling.