Urban Sprawl in Lahore and the Architect's Role in the War against a Waterless World

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Lahore is one of the East's legendary cities, its origins lost in antiquity. Today it is an ever-growing city of over seven million inhabitants and capital of the Pakistani province of the Punjab. The city was adorned with mosques, palaces, museums and other architectural monuments during its Mughal, Sikh and British administrations. Traditionally, its design and landscape remained in reasonable harmony with its intense climate of long hot summers, heavy rainy seasons and cold winters.

Of late, however, a new approach has been adapted towards its growth and development that is in marked contrast to the vision of its earlier planners, who once nicknamed Lahore "The City of Gardens". In fact, it is only the older parts of the city that have major green space, such as the Lawrence Gardens, Race Course Park, Nasir Bagh, the world-famous Shalimar Gardens and Jallo Park. The only additional major green space is about one thousand square kilometers of newer growth in the Lahore Wild Life Park, situated in Raiwind. However, the latter remains more of a commercial venture than one intended to preserve a balance in the water cycle and water table of the area in which it is found.

This is just one of the many alarming features of Lahore's urban sprawl, a phenomenon that has become necessary to house the city's rapidly growing population. Migration is a common feature for urban centres all over Pakistan because rural areas experience little to no infrastructural or educational development. In fact, about 65% of urbanization in Lahore is due to an influx of migrants. Despite a rising trend in migration, architects have been unable to alert the government to the impending catastrophic situation of water shortage and drainage collapse if more sustainable and smarter growth is not forthcoming. There are many lessons to be learned from urban models like Singapore (where rainwater accounts for about 10% of the national water supply) or the Thar Desert of Sindh's catchment systems. It is thus odd that planners and clients both prefer to opt for expansive suburban American-style housing models and Middle Eastern commercial developments, both of which are now proving to be environmentally unfriendly and socially taxing.

This paper will consider a few principles for alternative urban growth in Lahore, as an example, and in Pakistan generally. Its success could be replicated the world over in similar environments. We begin with a redefinition of the formula of $E=mc^2$. With reference to water sources, it is when men produce and consume more water than they send back into the aquifer that the equation no

longer holds. Destruction of one resource appears to be producing no other source of "Energy". It is only producing waste, pollution, and a general distaste for urban growth.

Here we focus on water scarcity as opposed to its complete absence. This may be due to depletion of water sources (especially ground water) or because of reduced availability of water fit for human consumption due to its inferior quality. Both can be the grave consequences of unchecked and unplanned urban growth.

Sustainable development, according to the renowned Brundtland Report, is a concern that actions taken today should not come at the expense of future generations. But it also refers to the growth and development of cities and economies in a way so as not to outstrip the available resources that are the inputs of that growth. In essence, it is the drive for sustainable development that raises the question of whether urban sprawl is a viable option to take into the future.

There are many ways in which the term "urban sprawl" can be analyzed. Sprawl has been defined as "the lack of continuity in expansion". It can refer to dispersed development which increases pressure on local government resources such as public transport or water and sewage. Population density in a given area may be low, but the total area that requires servicing to meet human needs is large and usually keeps growing. Another way of looking at the phenomenon is a reference to low-density urban and suburban development of previously undeveloped rural land. This generally situates people far from where they work, study, shop or recreate. Hence, urban sprawl increases the need for cars to remain mobile. Another characteristic of such developments is that they spread onto farmland, forests and even coastal lands lying on the outer edge of cities – from which their negative implications probably originate.

Many alternatives to urban sprawl have been suggested and practiced over time. Compact cities are characterized by high population densities over an area in which there is a concentration of urban functions to achieve social and environmental sustainability. "The Garden City" lays stress on the need for, and benefit of, greenbelts in urban planning. This concept, originally developed by Ebenezer Howard, envisions a central town of not more than 58,000 people surrounded by smaller self-contained garden cities of 30,000 people in each. About 5,000 acres of each garden city should be devoted to green spaces. Transit villages are also proposed as a means to overcome many urban problems, such as expanding water and sewage networks. The idea is to group living spaces and commercial areas close to transportation hubs to reduce the need for expanding cities horizontally and focus more on controlled vertical growth. "New urbanism" is a strategy for urban growth along the lines of a Main Street model, on which a mass transit rail system connects to pedestrian walkways and mixed housing is located close together to reduce "personal" space in domestic buildings.

Lahore is one of the flattest cities in the country with an almost uniform elevation of 712 feet above sea level across its entire span of around 1700 square

kilometers. This contributes to water stagnation, stressing the need for a well-developed and efficient storm water drainage system. The city has only one drainage system, in which rainwater and sewage are mixed -- thus rendering a source of clean water useless without extensive treatment. Much of Lahore's sewage is directed either into the Ravi River or the Main Canal that runs the length of the city. This has turned both bodies into massive drains, an extreme compromise of otherwise reliable sources of clean water.

New developments are now being situated directly on sewage drains. Examples include the Maulana Shaukat Ali Road-Akbar Chowk drain, which was filled in further up towards Peco Road for road expansion. Grey water, black water and

Figure 1. Grid-based expansion of self-contained town units separated by green spaces proposed for Lahore.

Figure 2. Map of Lahore today. The shaded area represents Lahore in the 1930's. The lined area is industrial estate around which heavy urbanization was allowed. Arrows indicate urban expansion onto village/farm lands.

refuse now contaminate the ground because they no longer follow a direct drain path. The Shahu Garhi-Durand Road intersection in North Lahore is in a similar situation, unable to sustain flash floods due to its filled-in drains. The Lahore Development Authority's latest expansion in South Lahore is also planned along a wide, open drain.

A classic example of water channels and natural filtration techniques was found in the old infrastructure of Shalimar Gardens; it recycled water between the River Ravi and the Gardens. However, its waterways and filters have also been damaged or filled in for urban expansion. This has caused a significant depletion of water in the Ravi as the streams are obstructed from returning to the river.

Lack of contiguity in major avenues and roads has encouraged the further paving of surfaces (inner streets, access roads, etc.) to connect various residential colonies. For instance, the Lahore Development Authority could have employed

a checkerboard pattern of residential towns expanding from Model Town into neighbouring developments like Faisal Town, Johar Town, and others. These could have alternated with major green spaces (figure 1).

Suburban development is usually a source of various contaminants such as grease, oil and toxic chemicals from road surfaces and these are carried by rainwater towards local surface water sources, again reducing water quality. The poor state of public transport and pedestrian walkways in Lahore is also a cause for concern as it encourages people to use their personal vehicles. This not only adds to air pollution but also becomes the major reason why further road construction is undertaken.

The Lahore Development Authority's inappropriate strategy for identifying land for residential development has facilitated political coercion to purchase fertile land at cheap rates. This was seen in Defence, Phases 6 and 7, along Burki Road; the University of Engineering and Technology, Valencia and Eden Housing Schemes along Raiwind; and Air Avenue opposite the new airport along Bedian Road. Vegetative growth, natural streams and ponds that have been replaced by paved surfaces further block branches of the main Hudiala Drain. The adjacent agricultural soil was contaminated through the mixing of floodwater with sewage water. Inefficient landfills in urban spaces allow synthetic materials like plastic bags and cups to build up non-biodegradable layers in both urban green spaces (for example, at Milad Street, Faisal Town) and agricultural lands (at Raiwind). Additionally, residential construction adjacent to industrial areas, like Packages Industrial Estate, Kot Lakhpat, etc, induce effluents and chemicals seepage into the ground and into the water supply of residential area at nearby Defence, Police Lines, and Qainchi Chowk (figure 2).

With increasing numbers of people living in poorly planned and congested urban spaces, the use of water and energy eventually starts to increase. Such lifestyles can lead to suburban or periurban heat islands that ultimately require greater use of water for cooling, bathing and washing purposes. Statistical studies have found that in Phoenix, Arizona a 0.5° Celsius increase in temperature can be associated with an average monthly increase in water consumption by about 290 gallons for a single-family unit in more compact developments. In a city like Lahore, where the average summer temperature is in the high 40's Celsius, paved surfaces are commonly washed with water prior to sunset for cooler evenings. Such a practice can be expected to expand as temperatures rise further still due to greater congestion within living spaces.

There is a new trend of constructing "farm houses" on the outskirts of the city; they serve as lush weekend retreats for wealthy families away from the noise and heat of the city. Thus, one family may own multiple homes within the same city, which means the city is expanding without fulfilling the needs of the poorer working/migrant classes. In addition, farmhouses are often constructed on an acre of land, with only about 9000 square feet of it covered. The remaining space is

largely flat green lawn exposed to an average of thirteen hours of sunshine a day. This naturally requires constant irrigation to battle the amount of heat and light plants are exposed to daily.

Construction in Lahore today utilizes an excessive amount of concrete, cement, glass and steel while several cheaper and more climate-friendly alternatives remain unused. For instance, lime and gypsum plaster could be substitute for Portland cement, which requires more time and water for setting. Both of these materials are in abundance in Pakistan, and while cement requires processing temperatures of about 1450° C, gypsum plaster needs only 120°-150° C temperature. This replacement would also reduce water consumption on an industrial scale. In addition, gypsum acts as a humidity controller and has thermal and acoustic insulation features that would make it ideal for more natural construction in new houses.

Lime and clay mortar can be used for adobe (earth brick) construction. Research shows the utility of lime amended adobe bricks in construction in regions with climate similar to Lahore's. In addition, adobe makes use of clays and sands, both of which are abundant throughout the country. It would be a useful material for domestic consideration.

Traditional models of housing for regions with climates as hot and arid as Lahore's often include courtyards. This allows centralization of household activity in an internal courtyard (*sahan* in Urdu) around which living, cooking and bathing quarters are built. The courtyard's position allows for natural screening from the sun, cooler temperatures within the living chambers and acts as an alternative to expansive private lawns. The traditional *sahan* would have shaded trees and a small pool to facilitate convection currents.

The provision of courtyards for neighbouring houses would allow several houses to be located in close proximity to each other, further reducing their exposure to direct sunlight and promoting cooler temperatures within the house. Not only does this require less consumption of artificial cooling methods, but it also allows houses to reduce the amount of windows needed for ventilation purposes. Reducing the use of glass and electricity in a house implies conservation of water as without water they cannot be produced on an industrial scale. However, the courtyard has completely disappeared from urban housing models, replaced by models of broad lawns surrounding a house.

Another traditional element of Punjabi domestic architecture is the *roshandan* (wind and light-catchers). This is essentially a wide but short window fixed at an elevated height that provide light but limits the amount of heat that enters a room. It is a very rare sight in newer houses today which often have floor to ceiling windows.

In the early years of Pakistan's existence there was a great reliance on the services and design ideas of foreign architects. This was primarily due to the fact that the country did not have adequate professional architects of its own. Often

Figure 3. WAPDA House, Lahore. Edward Durrell Stone, architect.

their philosophies, vision and architectural inclination were at odds with local conditions, native techniques and designs, and the cheaper materials available here for construction. All of their decisions influenced water consumption in architectural activity in Lahore. Consider the American architect Edward Durrell Stone's design for the Water and Power Development Authority (WAPDA) building in Lahore, an amalgamation of concepts including a corrugated façade, a perforated canopy and a huge plastic dome (figure 3). All of these elements lead to increased heat in the building and increased the need for air-conditioning, in a country already facing hydroelectricity shortages due to depleting water sources.

Today, Pakistan has more than fifteen architecture schools and has produced several internationally renowned architects. Yet, reliance on foreign design and supervision continues, particularly for the newer gated communities such as Eden, Defence, Lake City, and Bahria Town. This is largely due to the marketing strength of foreign architectural groups supported by development corporations such as Eden Housing Limited or the Defence Housing Authority.

There are several possible remedial solutions for these problems: key area between residential developments should be identified, where man-made lakes can be dug out to store storm water runoff from paved surfaces in urban spaces (figure 4). These can be linked by sloped/angular waterways that direct rainwater

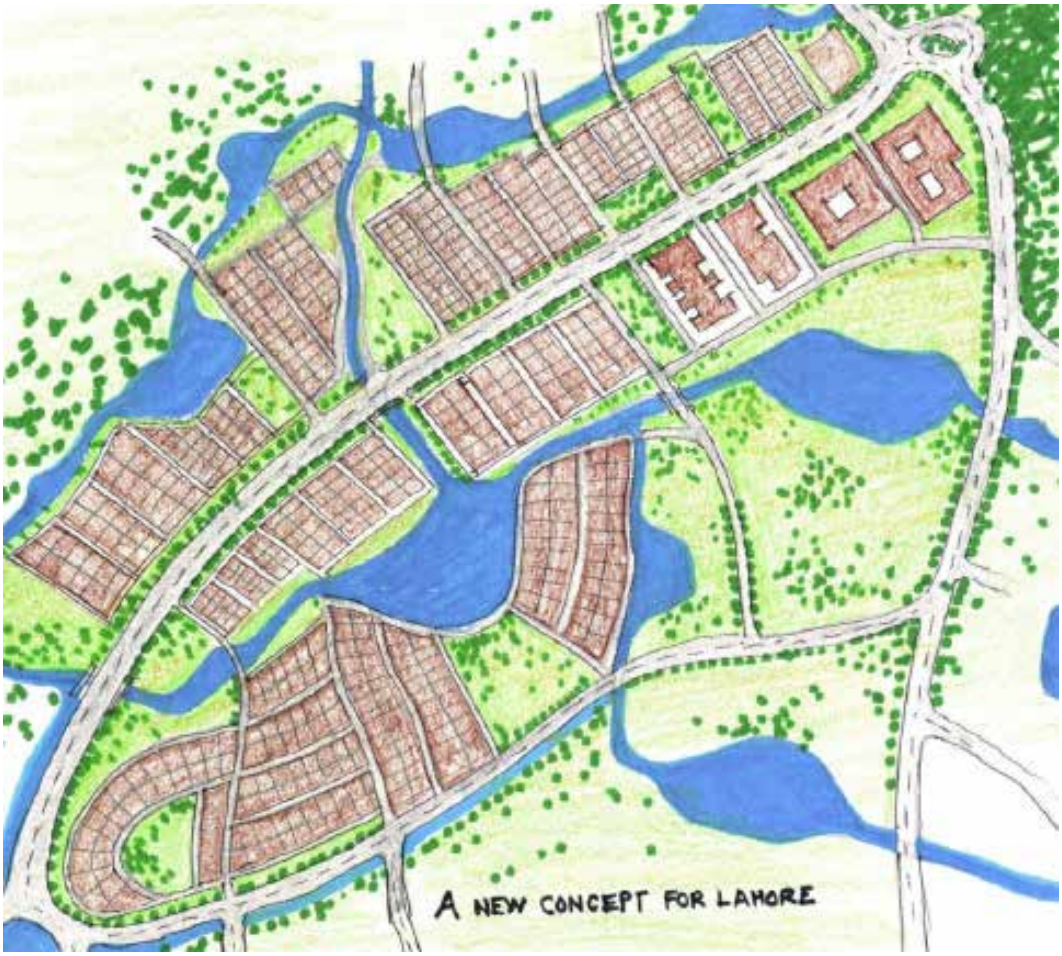

Figure 4. A plan of man-made lakes dug out to act as natural rainwater collection basins, connected to aquifer through wells.

towards lakes containing wells that have been drilled to aquifers in the ground (figure 5). Not only can such a method aid in the faster recharging of groundwater, but it will also provide an alternative to stagnant rainwater within city spaces that is especially common in a flat city like Lahore. A good example of where such a mechanism has been tested and proven successful is at the University of the Punjab where basement wells were built to drain rainwater directly back into the aquifer when large amounts of rain during the monsoon season annually flood the university campuses.

The urban drain system for sewage must be separated from storm water drains within the city. Interconnected culverts on both sides of city roads can be laid down to develop a storm water drain network independent of the sewage drains. Such culverts and a system of linked rainwater catchments can be dug down through sealed wells to direct water towards storage plants through a natural filtration system of soil and charcoal. This water system can be used to overcome

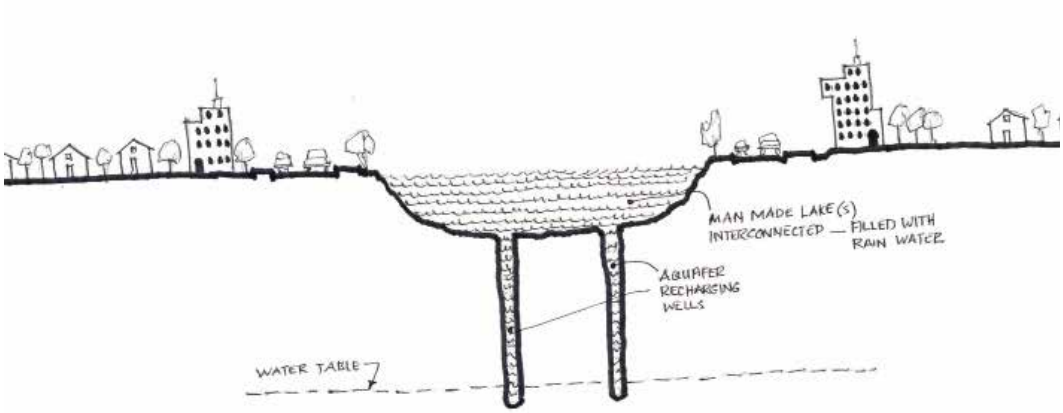

Figure 5. A section of a man-made lake dug out to act as natural rainwater collection basins.

flooding during the rainy seasons and for the irrigation of parks and city green spaces instead of treated water.

Communal rainwater and precipitate collectors can be installed to store rainwater or humidity from the air. Recent technologies have emerged which make use of simple compounds that have the ability to absorb precipitate in the air and condense it into potable water. This could prove particularly useful in Lahore, where the average annual humidity is 38% and reaches 80% during the monsoon period that continues from July to October.

The creation of wide botanical breathing spaces between settlements within the city, using indigenous flora and fauna to provide a natural landscape, can help sustain a healthy water cycle. Local plants that are adapted to the arid climate of the city are known to consume less water. These spaces also act as a countermeasure to urban heat islands that are bound to be created in a mega-city like Lahore. The concept of "The Garden City" should also be explored, as should limits on population in a self-contained administrative unit.

Lahoris must revive the use of native materials and traditional building methods. These include lime and gypsum plasters, clay mortar and stucco/adobe construction. It also refers to the functional use of space, light and shade, all of which are greatly interlinked with water consumption, as discussed previously.

Architects must play a greater role in alerting society to the need for conservation and restoration of buildings and to the use of wiser new developments. According to many architects in Singapore measures taken to protect extant buildings are far cheaper in terms of energy usage than razing buildings/homes and erecting new ones.Water strategies must be incorporated into architectural and urban planning at the very beginning of a project. Too often, cognizance of a water problem takes place towards the end or after a project has been completed. This means that the problem is either ignored or further costs are incurred in tackling the issue. Hurried construction leads to the application of insubstantial construction methods. Consequently, newer construction within the

city of Lahore has been found to be more prone to fires caused by short circuiting, water leaks and seepage into walls, poor foundations and collapsing structures, especially during the monsoon seasons. All of these are prime examples of the ways in which poor construction leads to wastage of materials including large amounts of water necessary for industrial produce.

We have looked at issues concerned with Lahore's urban sprawl from multiple perspectives: social ideas, architectural philosophy, materials, methods, drainage and the use of space. Water does not only have its obvious purposes like irrigation and human consumption. It is essential for the industrial preparation of electricity, fuel, building materials and many other aspects of architecture. It affects almost every decision an architect makes. This is why it is important to assess how Lahore's modern urban architecture relates to the generation and control of urban heat, the provision of cooling and ventilation, and the use of light. This paper argues that the city's random expansion and excessive reliance on living styles alien to Lahore's climate and traditions are taxing its water resources extensively, often in indirect ways. It proposes that architects and the government explore new technologies and combine them with tested traditional methods of construction, styles of living and infrastructural investment as a model for future expansion in the cities of Pakistan.

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