

Greening Urban Areas

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Abstract

As cities and metropolises expand, it is vital to acknowledge the impact such growth has had on the environment and nature. Such changes have affected the climate and impacted humans and animals that live in these areas. Considering the pressing need for the development of urban areas as well as ecosystems that can support life and the wellbeing of communities and persons that work in such spaces, a healthy balance becomes inevitable. Green spaces are now becoming a common phenomenon in urban planning. Initially, urban greening meant nothing more than parks and streets that are lined with trees. However, today the concept has evolved to include more creative designs and placement of greens around these metropolises. There is limited research exploring the justification of adopting green spaces outside those of environmental concerns. Further, there is a need to leverage the cost implications against the benefits that green spaces bring to urban areas. This report gives a review of several pieces of literature and their support for urban greening. The central purpose of this study is to justify the implementation of greening projects in modern urban settlements in relation to their contribution in preserving the urban climate. The impact of urban greenery, as well as the limitations expected in the implementation of these strategies, provide a point for assessing whether greening of urban areas is a viable option in addressing challenges in those jurisdictions

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Greening Urban Areas

Chapter 1: Introduction

1.1 Background

As cities and metropolises expand, it is vital to acknowledge the impact such growth has had on the environment and nature. These spaces were once grasslands, forests, or even lush plains but have now become concrete jungles. The impacts of such changes have not gone unnoticed. It is now understood that the changes that man has made on the ecosystem can damage the planet. Such changes have affected the climate and impacted humans and animals that live in these areas. Considering the pressing need for the development of urban areas as well as ecosystems that can support life and the wellbeing of communities and persons that work in such spaces, a healthy balance becomes inevitable. The world is waking up to the fact that green cities are the way to go.

Green spaces are now becoming a common phenomenon in urban planning. Initially, urban greening meant nothing more than parks and streets that are lined with trees. However, today the concept has evolved to include more creative designs and placement of greens around these metropolises (Elmqvist *et al.* 2015, p.104). Urban areas now feature original and eye-catching installations. Models like as living walls and green rooftops are some of the most popular green designs that cover many new urban areas. The objectives of urban areas are numerous, but the primary ones are to improve the life (health) of people in urban areas and to support wildlife such as birds as well as function as a buffer to prevent the encroachment of bad climate in the regions (Raymond *et.al.*, 2017, p.18). Green urban areas are eco-friendly and more pleasing to the eye. Urban greening is central to the development and operation of modern urban places.

1.2 Problem Statement

The adoption of green approaches in designing and reformulating the ecosystems of metropolises is an expensive venture whose benefits may not be immediately realized. Considering that the development of metropolises are subject to local governments policies and political decision, adoption of greenery is often curtailed by politics as short-term (often the goal of such projects) (Raymond *et.al.*, 2017, p.16). The reconciliation between economic and environmental concerns forms the basis for which these decisions are made. Prioritizing of making urban spaces green is secondary compared to others in place of meeting other needs such as adequate housing, security, and waste management. Fundamentally, the return on investment, as well as the benefit of adopting green policies, must be sufficient enough to justify

their adoption. There is a lot of research exploring the justification of adopting green spaces outside those of environmental concerns. Further, there is a need to leverage the cost implications against the benefits that green spaces bring to urban areas (Chen & Jim 2008, p.301). Does the greening of the metropolitan regions provide more benefits besides from their aesthetic appeal and the innate need of man to exist in nature for which he struggled so much to leave?

1.4 Research Objectives

The study and literature review will be guided by a set of guiding objectives that will want to find the cost of implementation, the benefits as opposed to not implementing the greening of urban areas at all. The main purpose of this study and report is to formulate an actionable and comprehensive strategy that is operational in meeting the economic, social, and political challenges that arise when the need for urban greening is desired. The attainment of the primary objective will be attained through several research strategies that are highlighted as follows:

1. To justify the cost implications that arise from the adoption of urban greening projects.
2. To justify social implications as well as the environmental impacts that do arise from the adoption of urban greening approaches
3. To demonstrate the alternative implications of the non-adoption stance to the urban greenery strategy in urban improvement.
4. To assess the resources needed in urban planning and compare them to the benefits that may be accrued in the long and short term periods.

1.5 Purpose of the study

The central resolve of this report is to justify the implementation of greening projects in modern urban settlements. Cities such as London are growing, with their population increasing by millions in less than half a decade. When their functions are left as they are, they are likely to degenerate to major pollution centers. Other cities such as Beijing have become so polluted that the quality of air in recent years has become very undesirable (Li, Wang, Paulussen & Liu 2005, p.331). Additionally, major urban areas have become significant contributors to global warming. Tackling climate change manifested in increasingly hot and drier summers as well as high levels of precipitation requires the incorporation of efforts by urban areas as well in restoring habitats and enacting countermeasures to minimize their level of pollution (Madureira *et.al.*,2015, p.59). The study, therefore, proposes the greening of urban areas as a possible large scale measure to improve the wellbeing of the urban regions.

1.6 Significance of the Study

The report will be substantially crucial for the administration of small urban areas as well as institutions that are tasked with designing and maintaining urban areas. The information provided will include the considerations that are often made when finding the justification or opposition for adopting massive projects whose outcomes will transcend social and economic implications. Further, the study will also provide a reference point for activists who have sought to have urban areas become more responsible for how they impact the local ecosystems and environment at large. The report will provide an excellent literature resource that can be used in formulating the strategies. The reconciliation between economic and environmental concerns would form the basis for which these decisions are made. It would also justify lobbying for greener spaces in metropolitan areas and the inclusion of such strategies in future planning and design. The quality of life and wellbeing of urban dwellers will also form the basis for which a determination of the adoption of urban greenery approaches can be made.

1.7 Research Hypothesis

This report hypothesizes that the progression of greening urban areas approaches positively impact the wellbeing of people in those areas, the environment of those areas and substantially improves the aesthetic appeal of the concerned urban areas

Chapter 2: Literature Review

2.1 Introduction

This chapter analyses secondary sources that provide data and information on the adoption of greening in urban areas. Related data on alternatives is also explored with a view of finding what balance or metrics offer the best approach in the improvement of the metropolitan regions. The chapter will discuss the prevailing urban conditions and identify the challenges in these areas (that might be solved through greening. A current analysis will provide a platform for the argument of change or maintenance of present systems. The review of literature is meant to analyze all implications of sustaining current models or adopting newer ones, the justifications as well as opposition to the greening of urban areas. The review will also define and explain the major terms and concepts.

2.2 Urban Greening

According to Mees & Driessen (201, p.253), urban greening refers to the actions taken in public landscaping and urban forestry projects to create a relationship that is beneficial between city dwellers and their environments. Simply put, urban greening entails making urban spaces green. The most prominent forms of urban greening include the planting of trees, setting aside areas for parks, and incorporating greenery in the landscapes of newly constructed buildings. The main reasons given for the construction of urban greening have been to combat air and noise pollution, preventing flooding through the soaking of rainwater, provide a healthy habitat for the local wildlife as well as providing an aesthetic and calming effect for the residents. According to Lee, Jordan & Horsley (2015, p.131), the adoption of green spaces by urban planners can be viewed as a way of fulfilling diverse needs or wants for social spaces in the context of recreational and cultural purposes. Urban greenery projects may change the environmental decay in the rundown areas that affect the residents' sense of security and satisfaction. Therefore, urban greening is a strategy to improve many aspects of urban areas.

2.3 Justification for Urban Greening

Climate change concerns are some of the primary reasons for urban greening. According to Mees and Driessen (2011, p.13), cities such as London expect a growth increase of over 3 million people by around 2050. For such cities to remain healthy, green infrastructure will become significantly important. Climate shifts is, no doubt, one of the most significant problems facing the globe presently. According to Hamada and Ohta (2010, p.19), urban dwellers face a disproportionate level of contact to ecological risks. Other impacts of climate change are manifested in flooding, the emergence of heat islands and heatwaves. The adoption of greening approaches is consequently opted for under the realization that the plants and trees could significantly contribute to the lowering of these disadvantages.

2.3.1 Lowering of Urban Temperatures

A study by National Oceanic and Atmospheric Administration (2018) mapped out areas that recorded the highest heat within Washington DC and found out that the highest temperature was recorded in densest areas. The study also found out large parks could lower down temperatures by as much as 17 degrees Fahrenheit. Considering that there are more than 600 annual heat-related deaths, such drops could make substantial differences. The study found out that Asphalt and concrete, critical components in urban construction amplified the heat in urban areas. Some of the most affected areas, according to the study by the National Oceanic and

Atmospheric Administration (2018), were significant roadways and dense urban pockets. As expected, neighborhoods that were near large forested parks were among the most temperate places in Washington. Therefore, there is logic in creating green spaces in denser areas in the city.

Raymond *et.al* (2017) state that trees can provide cooling in two ways. First, they provide shade, and then they also reduce air temperature over evapotranspiration. Locally, the trees would provide a cooling impact through their shades. How warm one feels could depend on the surrounding air temperature. A tree canopy can prevent up to 90 percent of the sun's heat. Bowler *et.al.*, (2010, p149) notes that the ability of trees to reduce ground temperature also significantly lowers the surrounding temperature. They also advance that trees can reduce an individual's physiological temperature by about seven to fifteen degrees Celsius. Bowler *et.al.*, (2010, p150) also note that trees can lower the temperature of buildings as their shadow inhibits solar radiations from getting through windows or warming exterior walls of buildings. Raymond *et.al* (2017) mention that experiments in the United States have shown that tree shade can decrease the fee of air conditioning by close to 30%.

Zhang, Gao and Yang, (2014, p.38) argue that the use of green roofs is the most effective strategic approach in limiting the creation of heat islands in urban areas. A green roof or a rooftop garden is a vegetation layer that is grown on roofs of buildings. Green rooftops are known to limit the heat island effect by 30 to 40 degrees Fahrenheit as compared to those of conventional roofs. Green roofs also minimize the need of energy required for air regulations in buildings. Watts (2017) notes that the cooling impact increased the popularity of green rooftops in the USA and it is estimated that implementation has grown by over 10% from 2015. In 2016 a sample of contractors reported over 900 massive construction green roof projects, which totals about four million square feet of organic rooftops. Green roofs can be adopted in a broad range of buildings, such as industrial facilities, to private residences. Green roofs not only provide cooling benefits, but they also absorb pollutants and provide habitats. Their alternatives are cool roofs made of highly reflective material.

2.3.2 Urban Flooding

Increased precipitation and torrential rainstorms across the world have intensified the problem of flooding in urban areas. Unmitigated flooding could cause injuries, damage to homes, fatalities, destruction, and closure of businesses as well as urban infrastructures. Elmqvist *et.al.*, (2015, p.104) mentions that given the reality of climate change, it is likely that the flooding disasters would continue increasing unless some proactive measures are taken. During

rainstorms, stormwater can overload the combined sewer system resulting in polluted water stagnating or flowing through areas they are not meant to. The runoff may contain polluted runoff from sewage or chemicals from industries within urban areas. Containing urban flooding is, therefore, a crucial exercise of urban management. Many urban areas presently focus on having parks, urban forests, and green rooftops as a means of limiting runoff and preventing flooding.

According to a bulletin by the US Federal Forest Service authored by James Razio (2010, p.1), one tree could store about 100 gallons or more depending on its size or species. Urban forests, therefore, have a high capacity to minimize extensive flooding. When such factors are multiplied over a sizeable tree population, the water redistribution will likely be very significant. Razio (2010, p.1), estimates that a healthy medium-sized forest could reduce annual runoff by about 7%. Such reductions have a high dollar value considering that they prevent property destruction or the need to construct retention infrastructures such as dam or massive storm drains. Paved or tarmacked surfaces that characteristically the predominant feature in urban landscapes do not help the case of mitigating flooding. Elmqvist *et.al.* (2015, p.105) argue that when plants grow in specific areas, their roots get deep in the soil and make spaces in the soil particles. When it precipitation occurs, water seeps in to occupy such spaces. The mechanics between such happenings and the alternative of runoff in the pavement is very apparent.

Apart from taking in the water directly through absorption, there are other mechanisms through which urban greener limits flooding. Perini and Rosasco (2013, p. 116), for instance, demonstrate how green rooftops can minimize runoffs. Roofs that are covered by vegetation absorb a lot of water, which helps to mitigate flooding that may occur when such water finds its way to the ground surface. Green rooftops reduce runoffs and prevent an overflow of sewers. Vegetation also reduces the speed of flows, and since it does prevent the erosion of soil, the flow is less likely to cause damage to infrastructure. Ideally, trees prevent vast volumes of runoff from destroying urban infrastructure. Elmqvist *et.al.*, (2015, p.109) argues that the cost implications of flooding in urban areas, particularly those with insufficient infrastructure makes urban greenery on of the most infrastructural decision in jurisdictions that are prone to flooding.

2.3.3 Improved Air Quality

Garvin (2008, p.62) advances that urban pollution is a significant problem that many urban areas face today. Several toxic substances advance the pollution present in these areas. The most considerable polluters include particulate matter, nitrogen, and volatile organic compounds. The polluting agents are partially caused by local activities such as transportation. Some of the common pollutants include Sulphur dioxide (SO₂) that is produced from burning fuels, Nitrogen

Oxides (NO_x), Carbon monoxides and Carbon Monoxides. These particles not only impact the quality of air, but also act as green houses that trap heat in urban areas. External pollutants, such as industry and agriculture, also contribute to pollution. Garvin (2008, p.64) notes that human activities cause the majority of pollution in metropolitan areas. Considering that the population density in urban areas is very high, pollution in these areas is significantly higher than say rural areas. Air pollution is a health risk for humans, existing habitat, and in some cases, also damages construction materials. The improvement of the quality of air depends on several factors. These factors may include the type of vegetation, location of the vegetation, proximity to the source of pollution, and the impact of weather.

Nowak, Crane, and Stevens (2006) carried out a modeling study using meteorological and concentration data from several United States urban areas, which found out that trees that grow in urban areas remove massive amounts of air pollution, which consequently improves the quality of urban air. The study found out that removal of O₃, PM₁₀, NO₂, SO₂, and CO in cities varied according to the size of their greenery. It was estimated that the removal of pollution in US air by trees and other urban greenery stood at about 710 metric tons. A mature tree can take out over 1.5 kilograms of particulate matter annually. This value translated to about 3.8 billion dollars in other measures. The study concluded that the controlling of metropolitan tree canopy is a viable approach to progress the quality of air and in attaining excellent air quality.

Akimoto (2003) explains the mechanism through which plants remove pollutants in the air. He explains that there are different ways through which removal occurs. Small particulate matter like gases is taken into the plant stomata and stored. Particulate matter whose origin is anthropogenic like PM₁₀ and PM_{2.5} are more extensive and cannot be fitted into the stomata. Such particulate matter is precipitated into the surfaces of leaves and are washed off onto the soil when on the leaves. Once in the leaf structure, the gases move into intercellular regions and could be fascinated by moisture films to formulate acids. Trees absorb these pollutants and release them to the soil in less toxic forms, thus reducing the volume of suspended matter in the air. However, it is essential to note that different types of greenery impact air quality differently. Akimoto, (2003) notes that it is only trees and shrubs that contribute to the improvement of air quality. There is no data to suggest that grass helps in improving the quality of air.

2.3.4. Improvement of the Aesthetic Appeal of Urban Areas

The use of plants to improve the aesthetic appeal of homes, for instance, is a well know practice world over. Flower gardens, orchards, and indoor plants have all been used to improve the aesthetic value of living spaces. A similar mentality is used in the planning of urban areas.

Madureira *et.al.*, (2015, p.58) states that urban greenery is a form of living art that makes a living and working experience in urban areas more tolerable. Trees, for instance, provides privacy and beauty, which contributes to community aesthetics. Planting of trees provides for recreational or relaxing areas away from the hustle and bustle of central districts in metropolises. A report by the Office for National Statistics (ONS) (2019) found out that the aesthetic value of these green spaces can be monetized or understood in monetary value. The study found out that houses and flats that were within 100 metres of community green areas were averagely 2,500 pounds costlier than those that were 500 metres further. The study found out that the closer a house was to greenery, the higher the premium it attracted. This phenomenon indicates that a majority of urban population found the green areas attractive.

The aesthetic appeal and calming effect of greenery in urban areas have found therapeutic use. Lee, Jordan, and Horsley, (2015, p.131) notes that there have been several works of research in the past that have indicated a connection between urban greenery and wellbeing benefits at a personal and community level. Some of the benefits that are noted in the study include better outcomes for cardiovascular and respiratory mortality. The report argues that these benefits are likely to have arisen from the availability of spaces for exercise activities, to recover from tension, and attention exhaustion. Urban areas also facilitate social services. Green spaces promote active lifestyles in urban areas. Lee, Jordan and Horsley, (2015, p.132) advances that the physical activity levels in urban green spaces are advanced than in other regions. They could be utilized as rehabilitative opportunities for persons with diseases such as cardiovascular conditions.

Lee, Jordan, and Horsley (2015, p.134) also advance that urban green spaces provide openings for interaction with the therapeutic environment, which may be therapeutic. Contacts with the natural environment have are known to have a constructive therapeutic influence on the mental health and wellbeing of those that interact with them. Green spaces provide a buffer against stressful events. Such benefits are postulated to arise from the participation of activities that often take place in green spaces. The impact on the wellbeing of individuals could also have resulted from the social contact opportunities provided by the green spaces in urban areas. Chen and Jim (2008, p.306) support this assertion, and they progress that the social platforms provided by urban greenery could advance the wellbeing and welfare of urban dwellers via the reduction of social isolation. Additionally, they mention that green urban spaces create social wealth, lead to an increased personal vibrancy, and the general wellbeing of individuals utilizing these facilities.

2.3.5 Broad environmental concerns

Urban greening initiatives do not just mitigate the damage that has already been done to the environment; they also maintain urban areas ecosystems and biodiversity. The built environments in cities significantly impact elements such as solar heat, wind speed, air temperature, rainfall pattern, humidity and temperatures. According to Haq, (2011, p.602), the green spaces in metropolitan areas are the most critical areas that supply cities with vital ecosystem maintenance structures through the maintenance of biodiversity and regulation of the urban climate. Additionally, its ability to mitigate and limit the impact of pollution enables the greening of urban areas, some of the most ecology conscious practice in urban planning. Air and noise pollution are some of the most substantial sources of creating weak and unhealthy habitats. Plants such as trees are known to limit air pollution significantly. Haq (2011, p.602) also raises another crucial point when he asserts that urban greenery also minimizes noise pollution. He mentions that urban green spaces located in crowded urban centers can reduce noise pollution based on their size and distance from the source of contamination. The minimization of noise enables ecosystems in urban habitats to thrive with minimum interruptions.

According to Haq (2011, p.602), green spaces act as safeguard sites for the continued propagation and survival of species. All urban areas were initially naturally inhabited spaces occupied by different plant and animal species. Human development and concretization of most spaces certainly affected these species as the natural foliage, food chains, and conditions suitable for reproduction were irreparably changed. Green spaces protect some of those initial habitats or bring back the original conditions that were suitable for habitation by native species. Li *et.al.*,(2005, p149) suggests that green spaces provide corridors and greenways to link habitats. These locales that are full of foliage and shrubs sustain desirable habitats for a variety of bird species, fish, small animals and even insects. Trees provide protection from the elements and food for the species that reside in these green spaces. These spaces are some of the desirable properties, and business owners, as well as homeowners, pay premium prices to be located close to them.

2.4 The Economic Impacts of Urban Greening

Heckert and Mennis (2012) point out that the economic impact of urban greening undoubtedly makes them one of the most desirable accessories for urban developers. The first significant economic impact of the implementation of greening efforts is drawn from its perceived protection of urban and municipal infrastructures. Urbanization dramatically impacts natural ecosystems that had evolved over hundreds of years to cope with forces of nature. For instance,

previously permeable ground surfaces are presently impervious, bringing about the issue of flooding. The destruction of property and infrastructure through flooding has an immense economic impact in urban areas. Impassable roads and location limit the movement of people and goods while also adversely affecting the transport sector, cumulatively, these occurrences lead to the loss of millions of pounds or dollars. When flooding is left unmitigated, the drainage and sewer systems are likely to be overwhelmed and may fail. According to the Southern Group of State Foresters. (2020) the city of Atlanta, for instance, had to spend close to 250 million dollars to upgrade its sewer system after losing its forest cover. The stormwater retention capacity of the urban forest in Atlanta is close to 2.5 billion dollars. Heckert and Mennis (2012), therefore, advance that greening is an economical way to protect urban infrastructure.

Perini and Rosasco (2013, 116) evaluate the cost and benefits of the implementation of greenery projects. The cost of treating pollution-related diseases such as asthma, allergies, skin diseases, and respiratory diseases in a large population may have substantial implications on healthcare costs. In the US alone, over 300 people die of heat-related conditions annually. The American Lung Association has reported that ozone healthcare-related costs America about 50 billion dollars annually. Urban greenery seeks to minimize the impact of forces of nature that would otherwise contribute to poor health to individuals. Flooding may also affect an individual's health indirectly, such as altering the access to clean water, destruction of homes, and businesses. Perini and Rosasco (2013, 118) argue that the initiation of greenery project has long term economic benefits for urban areas that seek to sustain a healthy population and minimize a massive need for medical services or facilities.

Heckert and Mennis (2012) state that urban greening dramatically impacts local and small businesses in urban areas. Trees, for instance, attract businesses and tourists in specific areas. Schilling and Logan (2008, p.457) conducted a survey that found out that customers were willing to pay 10% extra for specific commodities and services if their businesses were positioned in areas lined by trees. The study also found out that consumers were likely to test products in shopping areas where there were a large number of trees compared to shopping locations that did not have trees. Areas with trees or aesthetically pleasing greenery encouraged consumers to linger in those areas a little bit longer. Such areas also attracted more businesses increasing the revenue that comes there. A similar sentiment is shared in the real estate sector. A study by Office for National Statistics (ONS) (2019) found out that apartments and homes that were inside 100 metres of green urban locations were averagely costlier than those that were 500 metres away. According to the Southern Group of State Foresters (2020), well maintained trees could raise up to 15% to the value of suburban areas. Strategically planted trees could also reduce the cooling

costs that are taken in by air conditioning by about 30%, making them very useful in energy conservation and economically viable.

2.5 Limitations in the Adoption of Greening

Lee, Jordan, and Horsley (2015, p. 133) mention that while many urban administrators are fully aware of the numerous benefits that could be accrued from greening approaches, they are limited by the challenges that come with large scale urban projects. The most immediate problem Lee, Jordan, and Horsley identify is the availability of space. The size of land available for public use may limit or dictate the available resources for the initiation of greenery approaches. Cities that do not have large spaces for infrastructural development may find it challenging to initiate projects that would have any meaningful impacts. The acquisition of land from private owners could dramatically increase the cost of putting up green spaces. Troy *et.al.*, (2007, p.406) argues that land limitation or space limitation is the single most crucial determiner in the expansion or initiation of urban greenery project on a large scale. However, opportunities such as sidewalk greening and planting trees along the street and boulevards, as well as encouraging the planting of hedges and trees in urban settlement areas, could provide some respite.

Budget constraints are also central in initiating urban greenery initiatives. Sassen (2000, p.144) argues that social challenges arising from rural to urban migration as well as population explosion have led to the many difficulties witnessed in urban areas. Considering the challenges faced by many urban areas, the pursuit of green regions may not be highly prioritized. Sassen (2000, p.145) mentions the problem of housing as one most prominent problem that urban areas have to contend with. The population explosion has stretched public facilities such as sewerage systems, public transport, and health facilities.

Additionally, unemployment is another emerging challenge that faces the residents of major urban areas. As a result of low-income household's informal settlements have become features of many major metropolitan areas, particularly in developing nations (Perini & Rosasco 2013, 118). Consequently, many urban administrators find it challenging to invest in urban greenery projects when there are challenges seen to be of high priority.

Public and political support in the initiation of greening projects in urban areas is another obstacle that must be overcome by proponents of the approach in improving metropolises. According to Ginn, Francis and Campus, (2014, p.287) mention that the lack of public support for urban projects could limit the political goodwill to carry out such projects. Recently, political leaders have shown skepticism towards the science that explains climate change and, therefore, projects such as urban greenery whose primary objective is to tackle pollution and climate change

may not receive very much support. Mell (2009) supports that proposition by arguing that public knowledge on the essential infrastructural decision may determine whether such projects receive public assistance or if they are shelved for much more urgent priorities. Political goodwill is critical for justifying the adoption of specific projects and the continued public support for them. The support of the public is central in advocacy, implementation as well as enforcement of urban greening project. Therefore, implementation must be reinforced by mass sensitization and lobbying for political goodwill.

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