

# **"Urban Planning Framework Towards Sustainable Environment in Hot-Dry Climate"**

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# Urban Planning Framework Towards Sustainable Environment In Hot-Dry Climate

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## Abstract

Over one-half of the human population residing in cities, this ratio of the world urban population is expected to increase by nearly double in the next 30 years (*U.N. 2018*). When designing urban areas, it is essential to balance between environment, economy, and society's needs.

Urbanization refers to the movement from rural to urban areas; it also can apply to the extent and density of these areas. Uncontrolled urbanization can damage the environment and cause air pollution, waste disposal, noise, visual pollutions, and mental health.

It is impossible to stop new urban settlements, although we can prevent the harm caused by these settlements by applying control measures to guide urbanization towards minimum environmental impact.

This study aims to formulate an urban planning strategy for a "Hot Dry Climate Region" to propose an interactive planning framework. It will provide planners with methods and tools to challenge the complexity of the relationship between urbanization and sustainability. City council and other bodies related to the city planning board need to contribute their effort towards defining their city master plan without compromising economic, social, and environmental concerns. As urbanization is a continuous process that the environment suffers from; thus, tangible regulations and rules should present to protect the environment in urban areas. Urban planning frameworks and strategies will be discussed and evaluated to develop and introduce a customized framework that can fit specific regions.

**Keywords:** *Urban Planning, Sustainable, Environment, Urbanization. Green Infrastructure,*

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## 1. Introduction

In 1987, the United Nations General Assembly defined sustainability as “development that meets the present’s needs, without compromising future generations’ ability to meet their own needs” (*Brundtland Report 2015*). This statement is a solid motivation to support redesigning the urban plan’s framework and to deliver the best sustainable urban development. Moreover, the world needs a different type of framework that can communicate more effectively with our society. Various kinds of methodology will be presented, aiming to enforce development to maintain a high-quality, sustainable environment. Environmental issues require engineers, architects, and researchers to work together to solve these issues. Following, conceptional frameworks and methodologies that approach the problem from different angles:

## 2. Urban planning framework-methodologies

Following, proposed three methodologies as urban plan frameworks for a hot-dry climate region:

**2.1. Planetary boundary (P.B.)** is a science-based analysis framework introduced in 2009 (*Stockholm University 2009*). Aimed to define the environmental limits within which humanity can safely operate. This approach has proved effective policy, in global sustainable development, through its new paradigm that integrates development with Earth’s System. The planetary boundary framework provides a risk analysis that human perturbations will destabilize.

This urban plan framework has several crucial boundaries, which represent the most affected areas in the environment. Researchers suggest some limitations that civilization can develop in its perimeters. The framework’s concept is to warn about the risk of creating permanent damage to the planet Earth. It has established global awareness and impulse some constraints and protocols. This framework considered Earth a single combined system; it operates as an interdependent set (*The planetary boundaries: Stockholm resilience 2009*). Researchers push this concept on top of recommended policies. Planners, and decision-makers, can benefit from this framework, especially at global levels. Planetary boundary works on large scales. This framework’s weak point is that it does not consider that small societies act differently and affect the environment unevenly.



Planetary-Boundaries-2015: Different control variables for nine planetary boundaries. The green shaded polygon represents a safe operating space.

Source: Steffen et al. 2015 Ref.  
<https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html>

### 2.1.1. Loss of biosphere integrity

The Millennium Ecosystem Assessment of 2005 concluded that changes to ecosystems due to human activities were more rapid in the past 50 years than in human history. That would increase the risks of irreversible changes, while the main drivers of change are the demand for food, water, and natural resources. As a result, this will cause severe biodiversity loss and leading to changes in ecosystem services.

### 2.1.2. Climate Change

Recent evidence suggests that the Earth, now passing 390 PPMV CO<sub>2</sub> (parts per million volume) in the atmosphere, has already transgressed the planetary boundary and is approaching several Earth system thresholds. The world has reached a point at which the loss of summer polar sea-ice is almost certainly irreversible.

### 2.1.3. Freshwater consumption and the global hydrological cycle

The freshwater cycle is strongly affected by climate change. Add the consequences of human modification of water bodies. Water is becoming increasingly scarce - by 2050, about half a billion people are likely to be subject to water-stress.

### 2.1.4. Land system change

Human-converted land uses one driving force behind the severe biodiversity reductions; it impacted its essential elements and affected Earth system processes globally. A boundary for human changes to land systems needs to reflect the absolute quantity of land and its function, quality, and spatial distribution.

### 2.1.5. Atmospheric aerosol loading

Earth's climate system influence Atmospheric aerosol planetary boundary.

They directly affect climate by changing how much solar radiation is reflected or absorbed in the atmosphere. Inhaling highly polluted air causes roughly 800,000 people to die prematurely each year. The toxicological and ecological effects of aerosols may thus relate to other Earth system thresholds.

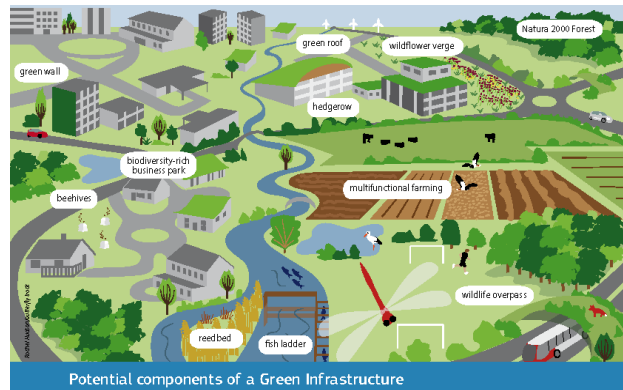
## 2.2. Urban green infrastructure (U.G.I.)

Greenery urban plan framework attempts to solve problems related to urban development in hot climates. This concept approaches a solution by implementing green infrastructure and focusing on green spaces, including facades and green roofs (Saaroni *et al.* 2018). This strategy encourages developers to adopt this method to reach sustainability. The long-run achievement can solve additional issues with no added efforts, such as pollution reduction and biodiversity habitat evolution. This framework focuses on implementing green infrastructure, maintaining ecological balance, and enhance environmental

quality. It imposes policies and regulations in the planning process. Green infrastructure can bring economic, social, and environmental benefits to improve the ecosystem. It links greenery development together, as most of them are separated. Governments, municipalities, and regulatory boards could be encouraged to focus on the city green master plan. It also offers significant control over the design. Urban green infrastructure introduces a long-term solution to confront global warming. These frameworks approach environmental issues in different areas, as follows:

### 2.2.1. Urban heat island:

It is a phenomenon that happens when a city gets warmer than nearby rural areas. Urban and rural surfaces absorb heat and retain it. The difference



<https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment/urban-green-infrastructure/what-is-green-infrastructure>



Aerial view of Chicago City Hall green roof, City Hall-County Building.  
<https://www.nps.gov/tps/sustainability/new-technology/green-roofs/chicago-case-study.htm>

between the two bodies determines the urban heat island level.

**2.2.2. High-density human habitation:** High-density city is an urban area where there are a high number of residents. While theory indicates that cities operate more efficiently when residents live in denser urban surroundings; as a result, green belt development will decrease. As a solution, planners should integrate green assets in high economic potential fields. In this way, planners and developers will benefit from a strong coalition between economic and green infrastructure, positively affecting life quality (Zölch et al. 2016).

**2.2.3. Multifunctional green spaces:** This framework considers the productiveness of green areas, such as parks, side streets, waterfronts, and nature reserves. City authorities are encouraged to create a living city-environment and play multiple roles to enable the economy to grow. Proper planning is the merge of green spaces with the community's needs (Stocco et al., 2015). This tool could be the primary achievement tool, with several benefits towards the environment, social and economic.

**2.2.4. Building absorbed Solar radiation:** Urban areas affect more than rural, as building structures absorb more solar radiation than the Earth's surface. With further construction developments, sunlight strikes the building's materials, absorbing or reflecting solar heating. This daily natural event forces urban planning to deal more deeply with sunlight. Some approaches attempt to use solar radiation to produce heating and cooling effects in buildings. City planners should approach intercept solar radiation using solar panels to convert sunlight to electricity.

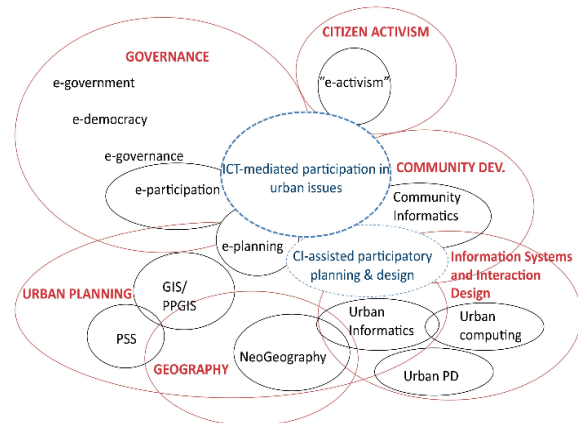
### 2.3. Participatory design (P.D.)

The interactive urban planning framework provides various forms of information and knowledge. It allows us to evolve, access, and combine cross-disciplinary information. The framework aims to increase stakeholder participation in the planning process and support decision-making (Antje, 2020).

Sustainable urban planning needs to consider stakeholder and community feedback besides expert knowledge, especially when the goal is environmental protection and social life. Participatory urban planning provides a public information base suitable for integrating urban patterns and processes. In comparison, the workshop offers an advanced tool to collaborate, simulate, and design. This tool enables continuous brainstorming, modification, and correction of the city plan, through participatory meetings that address critical issues and city priorities, such as:

- Sustainable development guidelines.
- Form urban design patterns.
- Identify focus areas and local potentials.
- Evaluate and Simulate different scenarios.

This method enables stakeholders to participate efficiently through disciplinary groups. It supports the design process and local awareness of future sustainable developments. Through this method, products get more support from stakeholders, city planners, and investors.

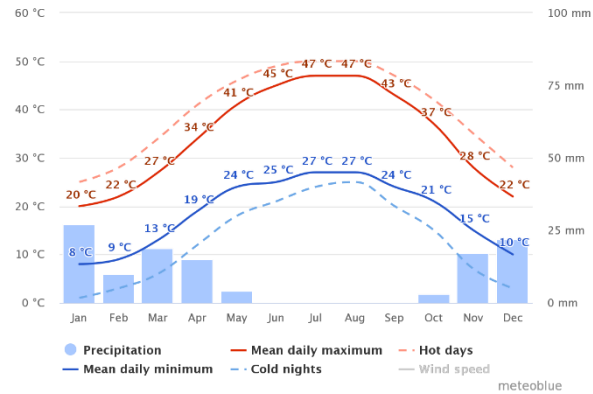


ICT-mediated citizen participation in urban issues  
<http://ci-journal.net/index.php/ciej/article/download/579/603?inline=1>

### 3. Discussion

This study presents three urban planning frameworks: Planetary boundary, Urban green infrastructure, and Conceptual participatory design; each has its characteristics and focus area. These frameworks offer a discussion system, as city developers and representative often has interconnected and contradicted issues. Cities should adopt a framework that reflects city needs, plans, and environmental vision. I aimed to adapt a framework that suits a hot, dry city. I focused on Kuwait. It has a subtropical desert climate. The main character is a high temperature, almost half the year; the average temperature is 35+ °C. The sun shines all year round, with an average of 9.17 hours per day. The yearly average precipitation is 140 mm in 32 days. Kuwait falls in a subtropical desert climate; it needs a suitable framework that considers these characteristics (*The meteoblue 2020*). Choosing an appropriate framework requires a revised action and compatibility check with city nature. It is the question of which of the frameworks will be more beneficial and most efficient.

City planners' responsibilities are designing buildings, streets, and landscapes, solving problems, and making places convenient and attractive. City planners must balance industrial development, housing demands, agriculture, and a sustainable environment.



Average temperatures and precipitation – Kuwait City

<https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/kuwai>

t-city\_kuwait\_285787

Following, issues that most impact the environment in a hot dray city:

- **Water scarcity**
  - Reduce water consumption
  - Reuse water
  - Encourage harvesting rainwater
- **Reduce energy consume**
  - Efficient design
  - Passive energy design techniques
- **Create more green areas**
  - Plant more trees to Create shades
  - Absorb sun radiation
  - Reduce B.T.U. needed to cool building
- **Sustainable building materials**
  - Use material with less impact.
  - Use lighter colored
  - Reuse building materials
- **Use less parking surface are**
  - Plan more underground parking
  - Shade car parking
- **Green buildings**
  - Roof garden
  - Reflective surface
  - Vegetated walls
  - Create ventilation
- **Interactive system**
  - Continues data collection
  - Remote and active sensors
  - Smart interactive systems
- **Unconnected architecture**
  - Adapt related local design guide
  - Establish a control architect board
  - Establish an environmental, social value
  - Thrive environment practices
  - Providing efficiency advice
  - Implement local improvement projects
  - Establish stakeholder's community

## **4. Advantages and challenges of the frameworks**

### **4.1. Planetary boundary**

Planetary boundary offers a global platform and includes constraints and regulations. It approaches the problems through a set of solutions and limitations it suggests a multi-connected safe operating space that needs a clear interconnection definition. Depending on international bodies, the framework offers a safe space designed for large-scale globally broad boundaries. However, small societies act; differently that's why this framework is not suitable for small communities.

### **4.2. Conceptual participatory design**

This framework method aims to establish stakeholders' decision-making control through city control committee planning. These meetings involve logical arguing in a different context, social, economic, and environment. The benefit of this method is to enhance city planning. Theoretically, the stakeholder has enthusiasm about the city development plan. Nevertheless, in some cases, this is not the case; they may lack the knowledge and motivation. For various reasons, participatory concepts can lose their direction in city plan meetings. Usually, developers, architects, and economists dominate the discussions as professional players in the city master plan. This framework appears emotionally accepted. However, it has a thought-provoking challenge, like; what type and level are required to qualify the participator. This framework is not the best choice for most developing and under-developing countries region.

### **4.3.**

This urban framework highlights the vital role of the greenery concept. It influences more spaces for vegetation in urban areas. As the population grows, density in suburbs increases, and green spaces become less, which affects the urban heat island effect. A green infrastructure is a cost-effective approach; it improves social health and life quality (Wang *et al.*, 2015). This method enables a strong coalition between city systems and the environment. This framework challenges city conflicts, and environmental concerns, by optimizing practical solutions and creative modeling. In a hot and dry climate, urban development is very advisable to adapt to urban green infrastructure.

## **5. Conclusion**

City characteristics are the main element for comparing different types of sustainable urban plan frameworks; the chosen framework should reflect city needs, focused areas, and local boundaries. Local governments carry the responsibility to achieve sustainable cities and an excellent urban plan to balance economy, environment, and social life. City planners should consider the city's previous experience to solve weak points and deficiencies.

As discussed, Urban Green Infrastructure is the most suitable framework for a hot-dry climate. This framework has a significant favorable influence on this environment, and it can confront the irreversible impacts of climate change. According to the previous study, adopting this framework benefits vegetation and water consumption and helps combat urban heat islands. Each city needs a customized planning framework. Accordingly, planning a new metropolitan area in a hot-dry climate (*Example: Kuwait City*) should be constructed on its characteristics and elements. Thus, it is necessary to adopt a framework that focuses on greenery strategy and respects the region's climate.

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