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URBAN PLANNING FOR CLIMATE CHANGE

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Abstract

The effects of climate change pose a substantial challenge for the world's metropolitan infrastructure. It is expected that its consequences will become more severe during the next several decades. The scientific data suggests that some of these consequences are now occurring and will continue to occur regardless of any continuing mitigation efforts. This is the case despite the fact that humanity may be able to take collective action to decrease the severity of these effects. There is a high probability that the consequences of climate change, such as increasing rainfall intensity, storm surges, floods, and urban heat island effects, will have an influence on many metropolitan systems around the globe. These will have a severe impact on urban systems as well as the populations and services that are supported by those systems. In order to make it through these impacts, adaptation is very probably going to be necessary. It is encouraging to highlight, in this respect, that urban planning has the potential to become a crucial role in the process of designing and implementing adaptive solutions in urban systems. One of the benefits of urban planning is that the profession and the tools accessible to it are applicable to a wide variety of settings. Tools for urban planning regimes all over the globe include plan-making, stakeholder engagement, development management, and design standards. These tools are accessible to urban planning regimes and are utilized by them.

keywords*: Urban, Climate, Change*

INTRODUCTION

The effects of climate change represent a significant challenge to the practice of sustainable urban development, putting a number of cities in jeopardy. According to UNISDR (2012a), the number of so-called natural disasters that occur on a global scale has almost doubled in the last 30 years, which has resulted to an increase in the number of lives lost and the amount of money lost. Climate change will definitely increase the vulnerability of urban populations if adequate adaptation measures are not taken (IPCC, 2007; UNHABITAT, 2011). This will occur despite the fact that there are numerous unknowns about the size and frequency of hazards, as well as their particular implications. Throughout history, cities have been and often currently are seen as places that provide protection from natural calamities and act as buffers against the effects of environmental change. However, in modern times, risk and catastrophe hotspots are a more accurate way to represent these areas (Pelling, 2003; UNDP, 2004). The environmental changes that mankind is now experiencing are intricately linked to the intricate processes of urbanization and are occurring at a pace and scale that have never been witnessed before (EEA, 2012; O'Brien and Leichenko, 2008). As a direct result of this, the municipal authorities are faced with the issue of figuring out how to include adaptation tactics into their job. However, due to the fact that adaptation to climate change is still a relatively new field of endeavor, the knowledge and expertise associated with it is still limited and dispersed (UNISDR, 2010a). Although urban planners are usually seen as being accountable and capable of responding to natural disasters and climate risk (Stern, 2006; IPCC, 2007), their role, the steps that should be done, and the duties of municipal authorities are often unclear (Greiving and Fleischhauer, 2012). The purpose of this paper is to critically review and compare current theoretical and practical approaches to adaptation planning in cities, and to discuss the implications of these approaches for achieving sustainable urban transformation. This review and comparison will be done with the goal of contributing to the development of knowledge and organizational learning for local adaptation planning.

Literature review

According to Gosling et al. (2011), urban systems are defined as "the constantly evolving spatial product of the flow of social, economic, infrastructural, and ecological systems which grow and develop around an urban area." The creation of a model often requires a significant amount of resources, and it also makes a significant contribution to rising levels of greenhouse gas emissions and, as a consequence, to climate change. In a quantitative sense, the influence of urban systems on climate change may be highlighted by the fact that 75% of all greenhouse gas emissions are created in the world's metropolitan regions (UN, 2007). This is the case despite the fact that only around half of the world's population lives in closer settlements. Urban systems are a major contributor to climate change. To put it another way, urban systems are the primary contributor to newly developing climate hazards (ESPACE, 2008). Because the functions of urban systems require the burning of fossil fuels, the very nature of urban systems is a contributor to climate change. Building buildings inside urban systems to house people and businesses as well as providing space for people to engage socially and economically are examples of the spatial functions that are performed by urban systems. Movement of people, products, and materials into, out of, and within cities are all considered part of the function of transport. According to Rosenzweig, Solecki, Hammer, and Mehrotra (2011), the provision of supply functions includes the provision of food, sanitation, and clean water in addition to the provision of energy, light, and heat. These roles, together with a number of others, guarantee that urban systems make a significant contribution to the demand for fossil fuels, which in turn contributes to climate change. As a result, there is an indirect yet directly causative link between the operation of urban systems and the changing climate.

The specific effects of climate change on urban systems will vary depending on location, but they may include reductions in potable water, more frequent and severe weather events such as heavy rain-falls and cyclones, increased incidences of flooding, inland storm surges, and an increase in the frequency of extremely hot events. Because of the nature and extent of these possible effects of climate change, the majority of urban systems and the people who live in them are susceptible to some degree. According to Condon, Cavens, and Miller (2009), the concentration of people and economic activity in confined areas, as well as the demands that this creates on urban functions and infrastructure, may enhance the severity of urban vulnerability. As a result, even very slight impacts of climate change may have a significant impact on vast populations of people and can have severe repercussions for larger metropolitan systems. Every urban system will experience some degree of vulnerability as a result of the consequences of climate change. These consequences may cause a broad range of urban functions to become inoperable or perhaps be destroyed. These immediate repercussions are only the tip of the iceberg when it comes to the potential implications that climate change may have on urban systems. It is plausible, and in fact likely, that urban characteristics may increase the severity of these consequences as well as the susceptibility of urban places. These characteristics include the following: (1) Hard surfacing such as asphalt, tarmac, concrete, and other similar materials absorb heat from the sun, resulting in a "urban heat island" effect, which contributes to higher urban temperatures; (2) Hard surfacing reduces the absorption of rain water, which overcomes storm water systems and increases the risk of flooding; (3) Population densities in urban areas can reduce or put pressure on green spaces, which could reduce heat, water runoff, and air pollution, and it can also put pressure on water It has been hypothesized that urban systems are now caught in a vicious cycle of negative feedback since they both play a substantial role in causing climate change and stand to be severely impacted by its impacts. As a consequence of this, adaptation in urban systems is required in order to mitigate and effectively manage the repercussions of these effects. It may be possible to lessen the vulnerability of urban areas and to increase their resilience via the implementation of adaptive measures. (Condon, Cavens, & Miller, 2009)

Research methodology

This is the current status of the study technique, which is attempting to identify the methods that are crucial for designing and implementing urban adaptation at a range of different sizes. To begin, let's take a cursory look at the role that urban planning plays in the adaptation process. Second, urban strategies for preventing and adapting to the effects of climate change. In conclusion, it is important to provide several examples in order to identify successful methods and implementation projects.

Findings and discussion

Urban Planning as an Agent of Adaptation

The process of developing adaption techniques in urban systems is one that is very difficult and complicated. It is necessary for a large number of performers to collaborate with one another in addition to working separately. Urban planning regimes are well equipped to meet the problems created by the adaptation process (Condon, Cavens, & Miller, 2009), (Hunt & Watkiss, 2010). In many aspects, urban planning regimes are well adapted to meet the obstacles caused by the adaptation process. Urban planning regimes are social instruments that are tasked with the responsibility of establishing order among the activities that take place in urban areas and limiting the number of conflicts that arise as a result. According to Davoudi et al. (2012), urban planners play a crucial part in directing and influencing the function and structure of urban systems as a result of their fulfillment of this responsibility. In addition, the instruments that are used by planning regimes, such as plan-making, development management, urban design, and so on, are often applicable in all contexts. Additionally, planning regimes often operate mostly at the municipal level. Therefore, it is hypothesized that urban planning regimes are in a good position to positively contribute to urban adaptation efforts, particularly when adaptation actions are directed locally. This is because urban planning regimes are well positioned to do so. Furthermore, despite the fact that there may be monetary costs associated with incorporating climate change concerns into planning processes and systems, the cost of taking early action should be far less than the cost of responding to the consequences of climate change as they occur or reacting to them in hindsight. The effects of climate change need to be included into planning immediately. The preponderance of the data suggests that this will have an effect on the way that we design cities. The process of adaptation could need for extensive preparation and activity. (Bulkeley, 2006).

Adaptation through Plan-making

As will be shown in the next section, partnerships between community groups and local governments are one of the most successful forms of pro-poor action that can be taken in order to minimize vulnerabilities. The majority of facets of "development" boost adaptive capacity since they also increase local knowledge and local ability to act. This is because of the relationship between the three. In order for development to be successful, it is necessary to raise the incomes and asset bases of lower-income groups, as well as to improve their health; this, in turn, will boost the capability of these groups to take action to minimize their vulnerability. In addition, development should strengthen the ability of economically disadvantaged groups to exert influence on local governments, therefore encouraging such governments to take appropriate action. It is common practice to differentiate between unplanned or "policy-driven" adaptation and "autonomous" or "natural" adaptation (Table 1.), as well as between short-term and long-term responses. (in talks of development and of disaster preparation, they may be referred to as "coping" and "adaptation" - while in other contexts, the ability to cope is regarded to be the same as the capacity to adapt). There is also a difference to be made between reactive adaptation and anticipatory adaptation, with the former occurring as a result of an extreme occurrence and the latter being carried out in advance of a danger that is anticipated to emerge. (Adger, Arnell, & Tompkins, 2005)

Table 1.: Examples of adaptation in practice (Stern, 2007).

Type of response to climate change	Autonomous (by households, communities and firms)	Policy-driven
Short-run	Making short-run adjustments, e.g. reducing water use, spreading the risk of loss through insurance	- Developing greater understanding of climate risks and vulnerabilities - Improving emergency response
Long-run	Investing in climate resilience is strongly urged if the potential consequences on the future can be predicted with a reasonable amount of accuracy and the advantages can be easily realized by households, community organizations, or businesses.	- Investing in the creation or modification of key infrastructure, such as expanding the storage capacity of reservoirs, increasing the drainage capacity, or erecting higher sea walls - Preventing unfavorable effects by, for example, limiting construction in floodplains and other vulnerable coastal areas via careful land-use planning

Adaptation through Infrastructure and Design

Planning is of utmost importance in the process of defining and putting into practice standards for infrastructure and design. According to the Intergovernmental Panel on Climate Change (IPCC, 2007) and Davoudi et al. (2012), urban infrastructure and design may play an essential part in adapting urban systems and strengthening their resilience to the impacts of climate change. Consequently, planning regimes may have a helpful and strategic function in the development of urban resilience with relation to the consequences of climate change by supporting particular infrastructure and design standards that have adaptable properties. It places a primary emphasis on the role that planning plays in advancing adaptive design solutions such as porous surfaces and green roofs. These technologies provide a significant amount of opportunity for urban systems to adapt, including the management of surplus surface water and the consequences of urban heat islands. As a result, they provide a sizable opportunity for urban planning regimes that aim to increase resilience via adaptation. (Sanchez-Robriguez, 2009)

Porous Surfacing

Concrete, asphalt, and paving slabs are examples of conventional hard surfaces that may be found in metropolitan settings. Because these materials are impermeable, they prevent surface water from being absorbed into the ground. The quick removal of surplus surface water in many metropolitan systems is instead accomplished via the use of piped systems. When water accumulates on impermeable surfaces, it has a tendency to flow laterally until it reaches a sewage system where it may be disposed of. Piped systems often concentrate the peak surface water flow into compact places, which leaves the system susceptible to vulnerability. These systems are intended to collect and "bottle" the surface water runoff that occurs in impacted regions so that it may be transported via a network of pipes and away from those areas. When they reach their maximum capacity, there is a potential for issues. The most serious of these is a rise in the frequency and severity of floods in metropolitan areas caused by the accumulation of surface water in traditional piped systems. This may cause the system to become overwhelmed, which can increase the likelihood of flooding as well as its frequency (DEFRA, 2008). The frequency of severe weather events that produce rainfall that is greater than the capacity of conventional piped systems is growing, which means that conventional piped systems are becoming more susceptible. More frequent storm surges and heavy rainfalls may be particularly troublesome, particularly when heavy rainstorm patterns are defined by short, powerful bursts or come from increased storm activity. This is especially the case when heavy rainfall patterns are characterized by short, intense bursts. These occurrences are occurring with greater frequency, and it seems that they will be a nearly universal result of climate change (IPCC, 2007; Condon, Cavens, & Miller, 2009).

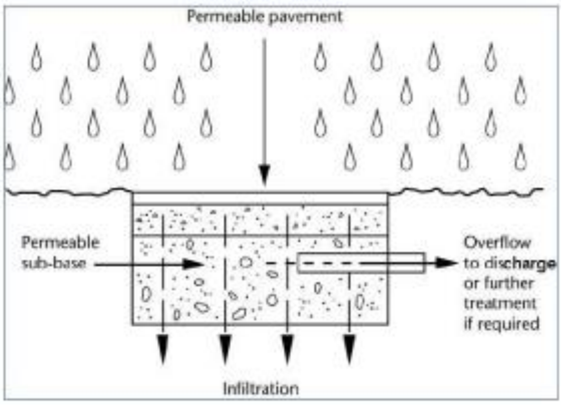

Figure 1: Porous surfacing technical design

The term "porous surfacing" refers to pavement and other types of surfacing materials that are permeable and hence enable water to flow through the surfacing material and into the earth below. Porous surfacing may also be used interchangeably with "permeable surfacing." Porous asphalt, pervious concrete, porous grass, and open-jointed blocks are some examples of the many kinds of materials that are accessible. These technologies allow for a more gradual transport of surplus surface water and a decrease in the amount of water that must be transported. This has the potential to contribute to improved flood risk management as well as greater conservation of groundwater resources, in addition to having positive effects on biodiversity and promoting urban amenity. According to DEFRA (2008), porous surfacing has the potential to boost groundwater supply. The fact that porous surfacing has the ability to be employed in a wide variety of urban systems is just another one of its many benefits. In point of fact, a number of cities all over the globe are in the process of initiating projects to improve adaptability by instituting porous surfacing as an infrastructure and architectural standard. Consultations conducted during the pre-planning stage may be used to ascertain in advance the potential logistical and financial challenges that porous surfacing may provide for a development. When it comes to innovations of a medium to big scale, this approach may be beneficial since it makes it possible to guarantee that adaptability becomes an early priority. When it comes to porous pavement, development control may be able to enforce applicable criteria in smaller projects, such as in driveways and parking lots. This is because porous paving allows water to drain through it more easily. (DEFRA , 2008)

Green Roofs

Green roofs are a kind of roofing system that has been carefully planned and constructed so that it may support the growth of plants and flora on its surface. They have application possibilities across a wide range of building types, including residential, commercial, and even industrial structures. The architecture of traditional roofing materials like slate, tile, and lead makes it possible for rainfall to easily drain down the roof and into the sewage system below. This tends to put more stress to the systems that manage water, especially during times of high rainfall or storms. The flow of rainfall is slowed down and part of it is absorbed by the roof itself when green roofing is used. As a result, there is a reduction in the amount of storm water runoff and pollutants that enters drainage systems (Buckwalter Berkooz, 2007). This is because vegetated surfaces offer some degree of retention, attenuation, and treatment of precipitation. Despite the fact that enhanced water management is one of the most important benefits of green roofing. They can also contribute to the local biodiversity by providing habitats and food sources for insects and birds. Urban cooling and a reduction of the effects of urban heat islands are two other benefits that they provide. Roof-based vegetation lowers the absorption and release of solar radiation, while water trapped in foliage increases local humidity and allows cooling via evapotranspiration. Additionally, green roofs can contribute to a building's overall aesthetic. (Buckwalter Berkooz, 2007) Several municipalities have recognized the adaptable benefits of green roofs and have instituted rules that enable local planning regimes to guarantee that urban development incorporates this technology. These standards allow green roofs to be included in urban development. For instance, as a result of recently implemented revised development standards in Toronto (Sanchez-Robriguez, 2009), the city's planning system may now make use of the development control process to guarantee that newly constructed buildings have between 25 and 50 percent of their roofs covered with greenery, depending on the building's type and intended purpose. According to Buckwalter Berkooz's research (2007), the planning regimes of Chicago, Boston, and Minneapolis have likewise enacted comparable requirements. These examples show that urban planning regimes may play a key role in providing urban adaptation via the implementation of infrastructure and design standards connected to green roofs. These standards can be applied to buildings that have green roofs. Similar to the situation with permeable pavement, it is probable that these standards will function most effectively if they are included into the goals and strategies that are contained within development plans and adaptation plans.

Urban Climate Change Mitigation Strategies

The area of mitigation methods encompasses a wide variety of "sectors responsible for greenhouse gas (GHG) emissions" and is characterized by a high degree of diversity overall. These are (Energy supply, Transport, infrastructure, Residential and commercial buildings, Industry, Agriculture, Forestry, Waste management), as stated in the fourth assessment report of the Intergovernmental Panel on Climate Change (Gosling et al., 2011). In addition, climate change mitigation measures may be broken down into short-term, medium-term, and long-term categories, with short-term plans spanning the next 20 years and medium-term strategies covering the period following 2030 (IPCC, 2007), Mueller & Rynne, 2009. These four activities for mitigating climate change are usually referred to as "energy-efficient urban planning" or tasks that are important to climate change, and they involve a lot more than just the energy sector alone. In light of this, the paragraphs that follow will take a look, by way of illustration, at the architecture of settlements, the extension of settlements, and new energy systems. They will be explained in a moment but collectively make up the most important aspects of climate change adaptation and urban planning.

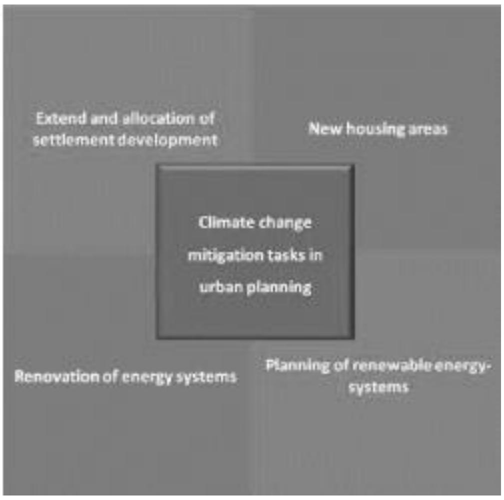

Figure 2.: Climate change mitigation tasks in urban planning

The geographic dispersion of settlements is something that has been a topic of study ever since (Mueller & Rynne, 2009). The extent of the growth of settlements and how they are distributed. In contrast, in the face of challenges such as climate change, the aspect of restricting sprawl and trends towards increasing congestion and spatial bundling of communities takes on a new level of significance. The targets include mixed use settlement structures as well as compact and energy-efficient settlement structures (www.mbv.nrw.de) (Friesecke, Schetke, & Kotter, 2012). These goals go hand in hand with decreased demands for traffic and transportation (Friesecke, Schetke, & Kotter, 2012). The German sustainability plan aims to decrease land consumption from its present level of about 100 ha per day to 30 ha per day by the year 2020 (www.umweltbundesamt.de/rup/flaechen/index.htm). One illustration of these objectives is the encouragement of infill development. However, it is unarguable that these more or less general goals need to be supplemented with additional mitigation measures in the areas of housing, energy, and transportation.

CONCLUSIONS

The effects of climate change provide a significant challenge to the practice of sustainable urban development and put the safety of a great number of cities in jeopardy. The problem of discovering methods to incorporate adaptation tactics into the work that city authorities do is becoming more and more pressing. However, as of yet, only a small number of cities have produced complete models for the adaptation to climate change. By conducting an analytical analysis and making a direct comparison of theoretical and practical methods, this article makes a significant contribution to the expansion of current understanding of local adaptation planning.

The role of urban planning as a strategy for mitigating the effects of climate change and adapting to its effects is becoming more essential. Floods, droughts, landslides, and other severe weather occurrences are expected to become more dangerous as a result of climate change, according to the assumptions of experts. The increase in global temperature is also expected to play a role in this. In order to be ready for these kinds of calamities in the future, we need multidisciplinary and preventative actions pertaining to the management of land.

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