Chapter 2
Climate Change and Living Cities: Global Problems with Local Solutions

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2.1 Introduction

In a report published in 2007, IPCC concluded that "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level" (IPCC 2007:2). Climate change has been one of the causes of increased incidences and/or intensity of extreme weather events such as floods and heat waves. These weather-related occurrences have had a major impact on cities, particularly those in developing countries and coastal regions.

Accompanying this change in climate patterns is the rapid urbanisation and growth of cities in the twentieth century. As centres of economic growth, urban centres play an important role in the economic development of a nation. Urbanisation is accompanied by change in lifestyles, increased energy demand, transportation, infrastructure, etc. It therefore exerts considerable pressure on the existing city resources. Rampant growth of cities has thus resulted in a number of governance, infrastructural and environmental issues. Further, changes in lifestyle have come at a considerable cost to the environment and human activities are often seen as major contributors to climate change. Given the increase in the number of people residing in cities, the effect that cities and human activities have on the climate, and the impact that climate change has on cities, the relationship between cities and climate change should be studied in depth. This chapter delves into this relationship.

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The chapter is divided into four main sections following the introduction. In Sect. 2.1, the trends of global climate change and urbanisation are discussed. Emphasis here is on understanding the implications of these trends on health, resource availability, infrastructure and governance. Section 2.2 discusses the inter-relationship between cities and climate change. The rapid growth of cities and accompanied changes in lifestyles and energy use has resulted in increased emissions of greenhouse gases and has ultimately altered the climate. Climate change has also had an impact on city life, competitiveness and growth. Section 2.3 focuses on the ability of cities and urban centres to mitigate and adapt to climate change. It discusses the important role played by cities in fighting climate change.

This chapter proposes that the solution to the global climate change challenge should be implemented at the local level. While cities may be the source of a considerable amount of GHG emissions, waste disposal and adverse land use changes, they also possess the potential to provide solutions to climate change and global warming through adoption of good policies and governance. Although global coordinated action is required, the important role that cities can play needs to be recognized and exploited. In keeping with the idea of centrality of cities in the fight against climate change, the concept of "Living Cities" has been introduced in Sect. 2.4. This concept serves to help cities address the problems of climate change while enabling them to retain or even strengthen their image as vibrant centres of economic prosperity.

2.2 Climate Change – Current Trends

The latest report by the IPCC (2007) concluded that climate change is a global phenomenon. In coming years, global temperatures, precipitation, droughts and floods are likely to be more extreme and intense. The earth's mean temperature has been rising steadily over the past 100 years by approximately 0.6°C (Walther et al. 2002). Sea levels are likely to continue to rise, causing major problems for coastal low lying areas. Figure 2.1 shows the increase in global mean temperatures over the past 150 years.

The human influence on this change in climate and temperature is substantial. It is a major contributor to the increasing emissions of greenhouse gases (GHGs) such as carbon dioxide (CO_2). CO_2 is the most important GHG. Between 1970 and 2004, its emissions have grown by 80% due to an increase in the use of fossil fuels, industrial activity, transportation and other human activities. The concentration of CO_2 in 2005 was approximately 379 ppm, which exceeds the natural range of 180–300 ppm over the past 650,000 years (IPCC 2007). The rate of human-induced climate change is much higher than that attributable to natural processes.

It is highly unlikely that climate change can be reversed or stopped in the near future. The effect of an increase or decrease in GHGs emission is not felt immediately. This implies that climate has not yet fully reacted to the current levels of emissions and this "unrealized" effect could be close to a warming of 0.5°C (Karl and Trenberth 2003). As a result, even if emissions are held constant at the year 2000 level, it is highly likely that the warming trend will continue into the near future.

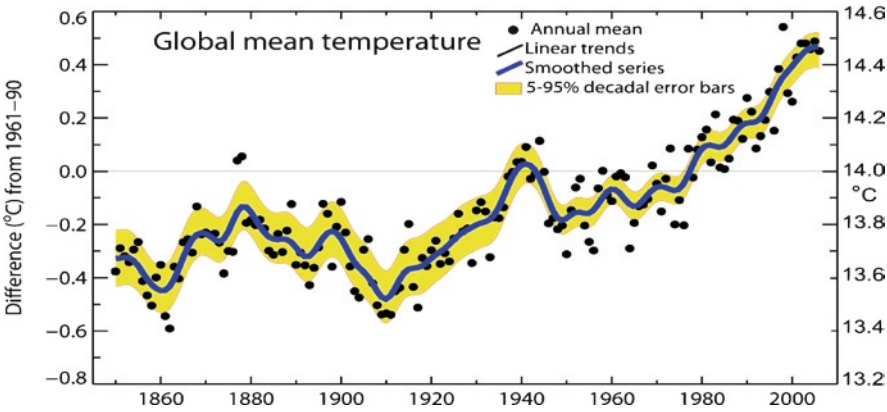

Fig. 2.1 Changes in global average surface temperature (IPCC 2007)

Since climate change trends will largely depend on population growth, changes in lifestyles, technology and innovation, future studies on climate change need to interrogate these attributes.

Rising global temperatures and heat waves, extreme precipitation and flooding in some parts of the world, and frequent droughts in others, rising sea levels precipitated by melting glaciers, are all telltales of climate change (IPCC 2007). Although floods, heat waves, and storms are all naturally-occurring phenomena, and mostly cannot be prevented, climate change results in the amplification of these phenomena and an increase in the frequency at which these extreme weather events occur. These changes have far-reaching impacts on human health, food and water resources.

2.2.1 Urbanisation and Growing Cities

In the last century, urbanisation, which is the process of migration of people from rural areas to urban areas, has been on the rise, with approximately 48% (three billion) of the world's population living in urban areas today (UN Department of Economic and Social Affairs, Population Division 2004). A further two billion people are expected to be added to this number by 2030, most of whom will be in developing countries (at approximately 2.3% per annum since 2000) (Cohen 2006). The growth rate of urban population in the period 2000–2030 is expected to be 1.8%. When this is compared to the expected total population growth rate of less than 1%, the high rate of urbanisation and subsequent growth of cities is put into perspective. As can be seen from Fig. 2.2, urban population growth is expected to be greater than rural population growth in the next few decades.

Due to urbanisation, there has been a rapid increase in the size of existing cities, in addition to the emergence of new ones. From only 80 cities with a population of one million or more people each in 1950, today there are more than 300 cities with a population of 1 million and above. Further, the average size of the largest 100 cities

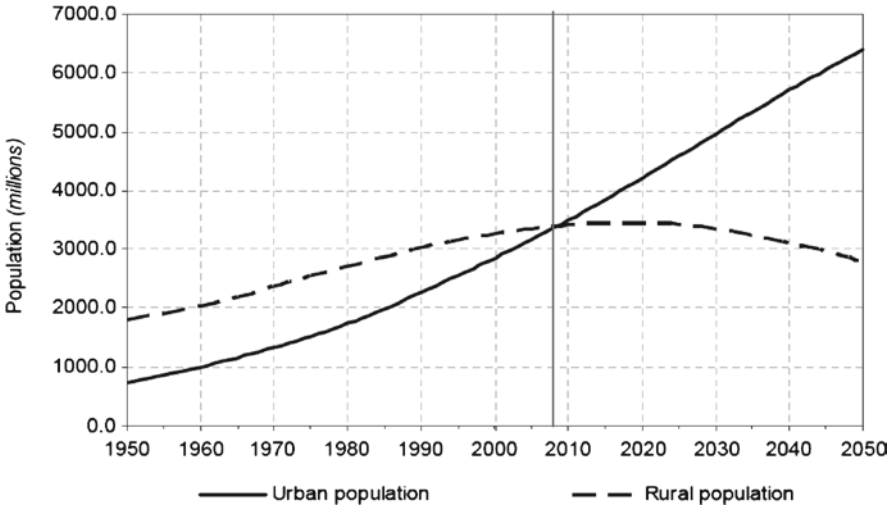

Fig. 2.2 Urban and rural populations of the world, 1950–2050 (United Nations 2004). World Urbanization Prospects, NY: United Nations

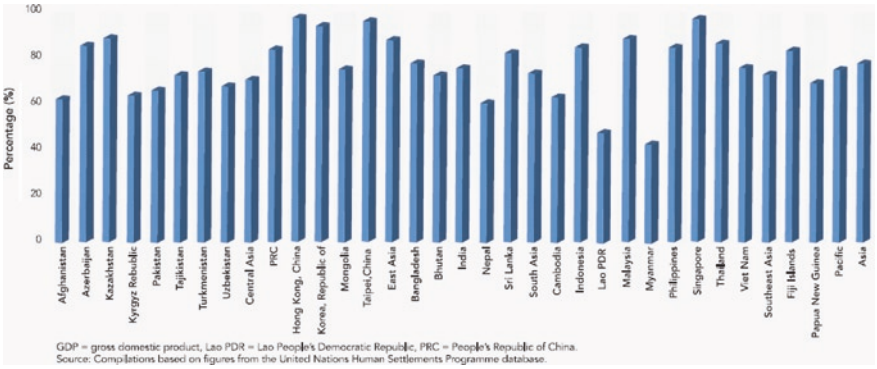

Fig. 2.3 Urban share of GDP, 2004 (Asian Development Bank 2008). *Managing Asian Cities*. Manila: ADB

around the world has also grown from 200,000 to nearly five million (Satterthwaite 2000). The increasing concentration of people in a city is both a cause of, and a result of, increasing economic opportunities and growth. Urban areas are typically more productive than rural areas since they are centres of innovation, development and growth. The growth of cities is therefore not an adverse trend since some of the largest economies in the world are from countries with the largest cities (Cohen 2006). Since cities tend to be the hub of economic growth, they often carry the burden of improving the economic performance of the entire country. The high degree of dependence of Asian countries on their cities for economic growth is reflected in Fig. 2.3. For Asia, the contribution of cities towards the continent's GDP is close to 80%.

While cities are engines of growth, they are also the most vulnerable. Due to the rapid and unplanned increase in urban populations, cities face increasing pressure on their resources, infrastructure and the environment. In terms of population, cities such as Lagos and Dhaka are nearly 40 times the size they were in 1950 (Davis 2006). One of the largest and most populous mega cities in the world, Mumbai, provides a perfect example of the challenges that face major cities. "Mumbai is bursting at the seams due to an influx of migrants from other parts of the country to this financial magnet. The result is an overpopulated city with an unbearable load on a crumbling infrastructure and pressure on every available open space. Awkward and incremental planning has compounded the problems" (Remaking of Mumbai Federation 2008).

An excellent example of the vulnerability of cities is the emergence of slums and the problems associated with them. Urbanisation and the growth of cities has been accompanied by the growth of slums, with nearly a third of the entire world population residing in slums (Sclar et al. 2005), and in some cities like Mumbai, nearly half of the population reside in slums (Stecko and Barber 2007). Slums are usually built on land that is dangerous and unsuitable for settlement. For example, shanty towns near Buenos Aires and slums in India (like the 'bustee' in Vijayawada) are built on flood prone land. The residents have to choose between safety and health, and their need for shelter (Davis 2006). The conditions faced by slum residents include poor housing, poor access to clean water and unsanitary conditions, overcrowding and insecure land tenure. Living in these conditions has a serious impact on the welfare of the city population (Sclar et al. 2005).

In summary, cities face a number of infrastructural and resource constraints. Ageing and insufficient infrastructure cannot cater for the demands of a growing population. Water stress, sanitation, growth of slums and shanty towns due to poor housing policies, inadequate health support, and environmental degradation are only a few of the growing concerns and problems that cities are plagued with.

As discussed earlier, climate change and the growth of cities affect each other. While cities contribute towards the changing climate, climate change and global warming seriously affect city life, health and the infrastructure.

2.3 How Cities Contribute Towards Climate Change

Urbanisation is often accompanied by a change in lifestyle, increased consumption, fossil fuel usage and inefficient energy uses, which contribute heavily towards global warming and climate change.

The use of fossil fuels to generate energy has been a major cause of GHG emissions. About 80% of the total global energy is supplied from fossil fuels. Dhakal (2008) has established that incomes and energy usage are positively correlated. Since cities are usually characterised by higher average incomes compared to rural areas, it would be logical to assume that cities' contribution to GHG emissions is higher than that of other areas. According to a UN-Habitat report (2006), cities

contribute up to 80% of the total CO_2 emissions globally, mainly through generation of energy, vehicular emissions, etc. Rapid urbanisation and increasing per capita incomes will continue to increase energy demand, and will therefore continue to contribute towards increasing CO_2 emissions. These GHG emissions may be directly generated within the cities, or indirectly in cases where energy is generated outside a city, but consumed within the city. However, regardless of the form of emission, the city is responsible and accountable for the same.

The impact of cities on the local environment is determined and affected by a number of characteristics such as urban structure, economic activities and development pattern, population growth and size, average household size, society, traditions and culture. Depending on these factors, either separately or as a combination, the level of emissions and the impact of the city on climate vary. Other factors that impact the level of emissions include a city's institutional and policy framework and the ability to implement and enforce policies, and a city's land use pattern among other natural factors.

2.3.1 Impact of Climate Change on Cities

Although cities contribute significantly towards climate change, they are also severely affected by it. The various hazards of climate change such as rapid population growth, housing and infrastructural constraints, poor water and sanitation have exacerbated the problems faced by cities. Although floods, heat waves, and droughts are not a recent phenomenon, the frequency and/or severity of these extreme weather events is likely to increase with the changing climate.

2.3.1.1 Impact on Health

Climate change is likely to have a serious (adverse) impact on human health in urban areas. Health risks vary from thermal stress to spread of infectious diseases, to injury and deaths. Intense summers, heat waves and drought can cause heat strokes, allergies, and in extreme cases, death. The experience of Chicago in July 1995 is a perfect example of the effect that heat waves can have on human health and mortality. During that incident, a severe heat wave hit the Midwestern United States, severely affecting Chicago, with temperatures hovering between the 90°F and 100°F for an entire week (The University of Chicago Press 2002). During this month, approximately 514 heat-related deaths were reported, which at that time was amongst the highest heat-related death toll in the history of the United States (Whitman et al. 1997). A rise in the incidence of heat waves and associated events, which is highly probable with climate change, is therefore likely to have a serious effect on people residing in heat-wave prone areas. Further, the impact of surface warming is likely to be more serious in city regions and, according to Whitman et al. (1997), urban centres are usually a "prime target for heat mortality". The 'Urban Heat Island'

effect precipitated by the high concentration of concrete structures in urban areas also plays a major role in amplifying the impact of rising temperatures, putting urban agglomerations at a higher risk (Patz and Kovats 2002).

Floods, extreme precipitation, and stagnant water also pose a major health problem since they provide an ideal environment for the spread of vector and water-borne diseases such as diarrhoea, cholera, malaria and dengue, which have been known to cause morbidity and even death. These diseases can reach epidemic proportions during periods of flooding. For example, more than 17,000 cases of cholera were reported in Mozambique during 2000 as floods ravaged the southern part of the country in February 2000 (Naidoo and Patric 2002). Health issues are already a major concern in cities, especially in slum areas where there is overcrowding, poor water and sanitation, poor drainage, poor housing and infrastructure. The spread of communicable diseases is therefore relatively easy in slums and cities (Sclar et al. 2005). These concerns are further compounded by frequent flooding caused by poor drainage.

These extreme weather events also lead to mental and physical stress, injury and even death. On 26 July 2005, Mumbai city centre experienced a heavy downpour (2.89 in.), which was among the heaviest recorded in India. The city's infrastructure and disaster mitigation strategy were unable to respond to the onslaught of the rains, and the resultant floods left approximately 410 people dead in Mumbai, and more than 1,000 dead in the state of Maharashtra. The existence of heavily populated slums in low-lying flood prone areas in the city exacerbated the situation (Stecko and Barber 2007).

Alarmingly, the health impact of climate change is not likely to be evenly distributed across the world. Developing countries and people in populated coastal areas will, in all likelihood, be more severely affected (WHO, n.d.) Cities that are located in developing countries are likely to be the worst affected by the changing climate and its manifestations.

2.3.1.2 Impact on Food Production

According to the FAO (2006), "Climate change will directly affect future food availability and compound the difficulties of feeding the world's rapidly growing population." By 2050, climate change will reduce the agricultural production by anywhere between 9% and 21% in the developing world (FAO 2009). Crop failure, loss of livestock (including marine livestock), reduced forest production, increase in weeds, new variety of pests and diseases are all side-effects of increasing temperatures, droughts and floods. Water stress is also likely to increase, and will therefore play a major role in the reduction of food production.

The effect of climate change is, once again, not likely to be uniform across regions, with crop yields expected to increase up to nearly 20% in East and Southeast Asia, whereas a decrease of 30% is expected in Central and South Asia by 2050 (Cruz et al. 2007). The poor and rural populations, which are already vulnerable, will be most effected by the changing environment and reduced food

production. Most of these people depend on agriculture to earn a living and will therefore be adversely affected. World hunger is expected to rise, and with it malnutrition will rise too.

However, since a large portion of the world's population will reside in cities in the future (Cohen 2006), cities will also likely be affected by food shortage. An increasing urban population implies more mouths to feed, and considering the reduction in food production, this may be a major challenge for city planners and citizens.

2.3.1.3 Impact on Coastal Areas

Between 1961 and 2003, sea levels have been rising at an average of 1.8 mm per year (IPCC 2007). Accompanying this rise in sea level is the risk of flooding, increase in the salinity of freshwater, land erosion, and a possibility of increased storm frequencies (Nicholls 1995). According to an estimate for India, a 1-m rise in sea level could result in the inundation of up to 5,763 km^2 (Chattopadhyay 2008). A direct result of this flooding and inundation is the loss of lives and homes of people living in coastal regions, which are often very heavily populated. Further, loss of coastal ecosystems affects the aquaculture industry and consequently the livelihoods of the people. As recorded in The Big Melt: Global Warming, "In a simple word: even with a small rise in sea level, nations and their civilizations could be destroyed." This statement provides a powerful indictment of the magnitude of the problem we face.

Many coastal cities across the globe are already facing the threat of subsiding and are slowly being "swallowed by the sea". According to Bohannon (2005), Venice, like New Orleans, is slowly being submerged due to the rising sea level, a problem that the city has faced since the Middle Ages. However, he claims that "an accelerating rise in sea levels linked to global warming has turned the sporadic flooding from a nuisance into a looming catastrophe" (Bohannon 2005:1978). Global warming and climate change are therefore likely to hasten and amplify the problems faced by many coastal cities. When we consider that currently 13 out of the largest 20 megacities in the world are coastal cities (Patz and Kovats 2002), the grave situation facing urban populations around the world becomes poignantly apparent.

2.3.1.4 Impact on Water Resources

By 2025, it is estimated that the proportion of the world's population living in countries facing water stress will increase to approximately five billion people; or two-thirds of the world population by then (Arnell 1999).

The hydrological cycle – quality, quantity and accessibility of water – will change with climate change. On the supply side of water, climate change alters precipitation patterns, snowfall, runoff, river flows and water recharge. As global

temperatures rise, the hydrological cycle will be intensified, leading to longer and more extreme periods of dry weather and intense precipitation, implying a higher risk of droughts and floods. By changing the precipitation and runoff, the water resource in some countries will rise, while it will diminish in others (Arnell 1999). In areas where melting snow is a major source of water flow, a change in the snowfall pattern will directly affect the availability of water. On the demand side, warming is likely to affect water resources by increasing the demand for irrigation, domestic and industrial use (Frederick and Major 1997).

2.3.1.5 Impact on Infrastructure, Economic Growth and Development

Floods, storms, heat waves, and other hazards linked to climate change will also have an adverse impact on the infrastructure and the economy of the affected areas. For example, the Mozambique floods in February 2000 resulted in a decline of nearly 7% in real annual growth rate of the country. Besides, 150,000 homes were destroyed along with the livelihoods of many (Department for International Development 2004). Given the high concentration of industry and economic activities in cities, their higher susceptibility towards flooding, proximity to the coast and the ageing infrastructure that characterises many cities around the world, and damage occasioned by extreme weather events is likely to be enormous. The 26 July 2005 floods in Mumbai which brought the city to its knees, grounded the transport network, cut off telecommunication and power, and disrupted financial services, cost the city approximately US$ 109 million in local businesses alone (Stecko and Barber 2007). The city of New Orleans met with a similar fate in August 2005 when Hurricane Katrina lashed her shores, causing immense damage. According to Comfort (2006:502) "…the destruction in New Orleans left the entire city uninhabitable, with no functional services – communications, water, electrical power, sewerage, transportation, gas distribution – for weeks. Mandatory evacuation was the only possible course of action." An entire city was lost to a single disaster! Given the prediction that climate change could increase the frequency of flooding and other extreme weather events, and the immense damage, including financial loss, accompanying these events, the future prospects are very grim.

Other areas that are likely to be affected include natural ecosystems, biodiversity and natural cycles (such as the water cycle). Many animal species such as polar bears and plants face extinction as their habitats are destroyed due to warming and rising sea levels.

According to O'Brien et al. (2006:68) "Climate change is a multifaceted (from drought to flood) and multidimensional (from local to global) hazard that has short-, medium- and long-term aspects and unknown outcomes." Therefore, it is highly likely that the effects of climate change will threaten long-term development activities. The world must brace for the immense challenges that lie ahead.

How can cities play a major role in controlling global climate change? This section attempts to answer this question by looking at the unique features that make cities ideal weapons for combating climate change. The idea proposed here is that

global changes in climate have been caused, to a large extent, by city-level activities. The argument here is that if they have city level causes, they must have city level solutions. This does not mean that national- and international-level policies and discussions are not important. However, action needs to be localised in order to directly target the sources of GHG emissions and climate change.

2.4 Global Issues, Local Solutions

The importance of cities in the fight against climate change is derived from the fact that cities have certain characteristics that make them unique. They also play a significant role in contributing towards GHG emissions. Cities and urban areas have historically been places of creativity and industry. They have played a major role in the industrial development of the world (Dhakal 2008; Grimm et al. 2008). They have therefore, in some ways, led the way for others to follow. Consequently, they can play a similar role in leading the world in the fight against climate change.

Besides, the disproportionally high emissions of GHGs from cities place on them a disproportionately higher responsibility for mitigating the effects of climate change. In addition, cities operate at sub-optimal levels with respect to emission optimisation and their impact on the climate (Dhakal 2008). Cities therefore possess a great potential for effective management of GHG emissions.

The impact on climate by different cities varies, just like the urban structure, economic make-up, cultural, traditional and social aspects of each city are different. A city's economic growth and development pattern, urban structure and existing infrastructure and technology determine the impact that the city will have on the climate. For example, Dhakal (2008) claims that emission levels deriving from economic growth differ across cities depending on the dominant economic activity in the city. Therefore, a city like Beijing or Ho Chi Minh will have a higher emission level due to their concentration of industries as opposed to a city like Tokyo which is dominated by service sector industries. Further, good urban infrastructure and the use of eco-friendly technology, as is the case in Tokyo, also affect a city's emission levels, and would explain the reason for the much lower per capita CO_2 emission in Tokyo compared to Shanghai and Beijing (Dhakal 2008). The interaction between a city and the local ecosystem is unique for each city, and policies need to be suited to local conditions, based on immense local knowledge and experience. As has been aptly put by Bohannon (2005:1978), "Determining a particular city's risk – and what to do about it – requires an understanding of how climate change plays out locally." Therefore, the case for local urban governance and policy making is crucial in the fight against climate change.

Economic considerations also give cities an upper hand in efforts to control climate change. Cities constitute a concentration of people, industry and commerce. According to McGranahan and Satterthwaite (2003), a result of this concentration

is that waste management is more effective, and environmental management is cheaper. They claim that checking emissions and waste disposal is more difficult in dispersed industries. Cities are therefore uniquely suited to control climate change.

Since cities play a very important role in combating climate change, they need to initiate both adaptation and mitigation policies. In response to the changing climate, cities must adapt, and as an acknowledgement of their role in contributing towards this climate change, they need to mitigate their impact.

2.4.1 Mitigation and Adaptation

> Cities have a considerable stake in both controlling emissions and lessening impacts and, therefore, have to play a leading role in mitigation and adaptation activities (Dhakal 2008:188).

2.4.1.1 Adaptation

Adapting to climate change involves adopting policies and practices that offset the adverse (long- and short-term) effects of climate change. Adaptation policies should be anticipatory and flexible, and their benefits must outweigh the costs (Smith and Lenhart 1996). Since most natural hazards cannot be prevented (O'Brien et al. 2006), the best defence against them is to be prepared and to have in place strong disaster management programs and policies. If and when extreme weather events strike a city, the structure or the city should be resilient enough to respond to the threat and adapt to the changes that result.

As a general rule, city planners must include adaptation policies in the overall long-term city plans, and must address the current as well as potential future impacts of climate change. Due to the slow reaction of oceans to agents causing climate change (IPCC 2007), many climate change impacts are yet to be felt. It is therefore prudent to include adaptation policies in the long-term plans so as to mitigate the long-term effects of climate change.

Adaptation polices need to be put through a rigorous cost-benefit analysis so as to ensure their long term viability. Since many of these policies are likely to be anticipatory in nature, they must be based on strong scientific assumptions, which must be tested against various scenarios.

Cities will need to involve everyone in the fight against climate change. To do this, they will have to spread awareness and educate the public on climate change issues. Education must focus on understanding the effects of climate change on water resources, land use, sea levels, health and the overall ecosystems, and must provide the people with the information they require to adapt to these policies. Water conservation, improved agriculture and irrigation techniques, the importance of increasing the green cover and understanding the ecological footprint of different human activities are some of the areas on which education can be focused.

2.4.1.2 Mitigation

While adaptation policies address the adverse effects of climate change, cities also need to reduce their impact on the environment. Policies for mitigation should be focused on emission abatement and increasing the green cover.

As previously discussed, emission of GHGs from cities is one of the major causes of global warming. Therefore, mitigation policies must focus on reducing these emissions, both direct and indirect. To cater for the demands of a growing city population, a lot of products and services are churned out. In the process, GHGs are emitted. For example, the demand for transportation may result in an increase in private car ownership (in the absence of a good public transport system), which would lead to more pollution and higher incidences of GHG emissions. Mitigation policies should therefore either focus on reducing demand for private cars, or on making the technology to make cars more environmental-friendly, or focus on both these aspects. For each source of GHGs and pollution-causing activities, policymakers need to identify the entire supply and demand chain, understand the relationship between them and then decide which one is the most appropriate for intervention. A detailed study of costs and benefits, and understanding the demand and supply linkage needs to be done before any policy decision can be made. However, it would not be wise to simply concentrate on either demand or supply. Instead, policymakers should adopt a layered approach, where initial focus is on demand or supply, and subsequently address the other side. For the transportation sector, Dhakal (2008) suggests that the supply (the side that directly contributes towards generation of GHGs) should be addressed first, followed later by the demand side.

The demand side of GHG emissions can be addressed by a number of policy initiatives that include educating people on the ecological impact of their habits, and formulating policies that encourage people to modify their lifestyles and consumption patterns. The supply side can be addressed by changing technology, improving efficiency and investing in research and development. The possibility of implementing emission abatement policies and taxes and developing carbon trading systems also need to be explored.

Both adaptation and mitigation policies should work towards fighting climate change; while adaptation policies address the impact of climate change, and enable a city to respond to the changing environment, mitigation policies should address the cause of climate change and help to reduce the effect that cities have on global warming.

In order to fully understand the causes of emissions as well as their impact, scientific knowledge is essential (Dhakal 2008). Therefore, for adaptation and mitigation policies to be effective, a considerable amount of scientific knowledge is required, accompanied by economic and technological expertise. Investment in research and development, and increasing the knowledge base plays a vital role in fighting climate change. Sound and realistic local policies that address products or activities that contribute towards GHG emissions should be designed and implemented.

In order for a city to manage climate change concerns and incorporate mitigation and adaptation policies at every stage of its development, it must be based on a

framework that addresses the various concerns in an integrated manner. These should include good governance, good infrastructure and an integrated urban management approach. Although this framework must be unique to the city, while designing plans and policies, urban architects and policymakers must ensure that the concept of "Living Cities" is upheld.

2.5 Living Cities – Better Governance and Better Infrastructure[1]

When the effects of climate change are considered alongside the unique challenges already facing cities, it becomes clear that cities need to be managed wisely if they are to continue being the centres of economic success. The concept of "Living Cities" is based on an integrated approach that addresses the main requirements of every city – to be competitive, to ensure good infrastructure, shelter and transportation systems, to ensure steady and timely flow of information and to protect the environment and sustain the growth of the city. In order to achieve a city that epitomises the "Living City" concept, good leaders, good governance and informed policy-making is essential. Policies that address all the main requirements of a city should be developed and must be based on the adaptation and mitigation guidelines already discussed.

On the infrastructure front, addressing water supply and sanitation, solid waste management and urban transport is essential for an environmentally responsible city. These areas provide good opportunities for implementing adaptation and mitigation policies. Since climate change impacts greatly on water resources, every city should prioritise it. Sound water management policies can help a city respond to these changes, while the provision of sanitation helps to check the spread of communicable diseases. Since solid waste and urban transport are major polluting agents, their adverse effects on climate change should be addressed as matter of priority. A marshal plan aimed at providing better housing, or upgrading existing slum dwellings should also be considered so as to serve a city's growing population better.

The urban environment needs to be managed well; a unique city-ecosystem relationship needs to be fostered in a sustainable manner; and an urban environmental management system, one of the most important pillars of "Living Cities", should be implemented.

Through such an integrated approach to urban management, a city can embark on a responsible development path that provides a high quality of life for its citizens where the environment is protected and the adverse impacts on the climate are minimised.

[1]This concept has been developed further in 'Developing Living Cities' (2010) edited by Seetharam Kallidaikurichi and Belinda Yuen.

2.6 Conclusion

This chapter has argued that global climate change has a local, city-level solution. As the climate change phenomenon unfolds, it is manifesting itself in many ways: intense heat waves, floods, droughts and rising sea levels. These hazards can spell disaster to city life, affecting the health of the people, destroying infrastructure and livelihoods. "The quintessential responsibility of government is to protect its citizens from danger" (Comfort 2006:503). This statement highlights the role of good governance and the importance of strong policies in protecting the cities against the manifestations of climate change. City planners need to embrace the climate change challenge by first recognising the important role played by cities. Although greater urbanisation has had a negative impact on the climate, primarily due to greater energy intensity and increased demand for transportation, cities are also immensely affected by climate change. They therefore have a huge stake in the fight against climate change.

The key message that this chapter propounds is that cities posses certain unique characteristics that make them excellent weapons in the fight against climate change. It is the responsibility of the local governments to recognise this and act accordingly; policymakers and urban planners must exploit these characteristics to the fullest. The aim should be to integrate adaptation and mitigation policies with overall urban planning – think locally, think long-term. Since cities are complex systems, climate change adaptation and mitigation policies should be designed in a way that suits the unique form of each city; and urban design should be based on an integrated framework where policies and decisions are aimed at improving the quality of life of a city's citizenry in an environmentally responsible manner.

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