Integrating Climate Change Adaptation and Mitigation with Urban planning for a Livable City in Tehran

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Abstract

Climate change impacts are seen within growing numbers of cities in low- and middle-income countries, so there is growing interest in the adaptation and mitigation plans and programs put forward by city authorities. This paper aims to provide a better understanding of the constraints which cities face them in this subject by analyzing the case of Tehran. City has a commitment to decentralization, transparency, accountability and participation. There are some new programs and plans in urban planning which has evolved to include a broad vision of urban challenges and responses, a commitment to environmental sustainability and a strategic plan that has involved multiple stakeholders. This paper describes the principles for integrating climate change adaptation and mitigation with urban planning which can be useful for urban authorities. Then it analyses the many measures implemented in Tehran over the last years, which provide a solid foundation for more systematically addressing adaptation. It also describes the significant challenges faced by the city's administration, especially around funding, data and the challenge of responding to pressing and competing interests. Tehran city is still struggling to complete greenhouse gas inventories and it has, however, implemented several specific mitigation measures and tries continuously to place this issue on the government's agenda. However, Tehran's particular way of responding to current development challenges has put in place the flexibility, creativity and commitment needed for adaptation, regardless of whether this is made explicit or not. The results of this study reveal that Tehran's policies have had continuity and consistency, despite being frequently revised over years, because each administration has built upon the progress of its predecessor. This is quite unusual; it is more common for there to be a revision of all that has been accomplished and for the need to point out the negative aspects of the previous administration and to differentiate from it. But according to policies that developed and leading countries in field of climate change adaptation and mitigation, Tehran can create a basis for including adaptation measures in local environmental and development plans. Some solutions in this area are: effective governance; institutional capacity; innovative planning and legal frameworks; holistic approaches to urban environmental problems and local development issues; a capacity to work with the urban poor; and an engaged civil society.

***Keywords**:* Climate Change Adaptation, Urban Development Plans, Livable City, Urban Planning, Tehran.

1. Introduction

Direct and indirect impacts of climate change risk urban dwellers in low- and middle-income nations, most of whom have consumption patterns and lifestyles that have contributed very little to global warming and climate change. Distribution of the impacts is uneven between and within countries, regions and urban center, but there is little doubt that many of those at highest risk are low-income groups, and climate change will probably worsen the constraints and deprivations they already face in their daily lives. Some urban locations are more at risk than others to such hazards as, or are more vulnerable to high temperatures, water stress, sea level rise and changing patterns of precipitation. But critical city infrastructure and services – water networks, sewerage, drainage systems, solid waste collection, transportation, health centers, schools, emergency services, etc. – are also unevenly provided across urban areas. Even when they are in place, they are often poorly maintained. Storm and surface drains, for instance, which are keys to limiting disaster, are often clogged with solid waste. Practice has shown that installing infrastructure is often not enough; for one thing, this can transmit a false sense of security. Furthermore, complex urban environmental problems need sound social and institutional systems to support structural and non-structural interventions.

Mitigation to reduce greenhouse gas emissions is, of course, an essential response to climate change. But in urban areas in low-income and many middle-income nations, adaptation to cope with the effects of climate change is and will continue to be of particular importance (Sharma et al., 2010). This makes urban planning and local development more challenging, as city operations

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have to adapt both; to current climate variability and to future climate change. The quality and capacity of city and municipal governments have considerable influence over the distribution and level of risk within a city. Much has to do with government's capacity to understand risks and plan accordingly and its ability to work together with different stakeholders, including those most at risk (Un−Habitat, 2011). Growing numbers of cities and municipal governments around the globe are putting forward plans and programs on climate change adaptation, but in most of these, only very preliminary steps have been taken (Hardoy et al., 2011). There are several reasons for this:

- Climate change issues are often perceived as global and in the distant future. (Hardoy et al., 2011; Roberts, 2010).
- There is little certainty around the potential impact in specific cities. There has been no translation of global risks to the local level, and practical, accessible information to guide local action is scarce (Sharma et al., 2010).
- There is not city government which has been recognized for the disasters it has prevented, and risk reduction investments have to compete for scarce resources with what are judged to be more pressing needs − such as backlogs in infrastructure and service provision, poor quality housing and social emergencies (including high levels of unemployment).
- Solutions to these immediate, pressing issues are usually narrowly focused, managed by a single government sector, and seldom envisioned as responding to broader local development issues (Hardoy et al., 2011).
- There is a lack of understanding of the co-benefits of adaptation planning, urban planning and environmental sustainability (Sharma et al., 2010).
- There is a shortage of skills and financial resources. Municipal and city governments are understaffed, with little access to external sources of financing (Roberts, 2010).
- Sectors in charge of managing risk and adaptation to climate change often have limited budgets and lack political influence within the government structure (Dodman et al., 2009; Carmin et al., 2009),
  on more powerful departments for action. The cross cutting, cross-departmental, cross-sector nature of climate change adaptation also makes it difficult to address issues that fall within different departments. Climate change Adaptation requires coordination between departments with different powers, resource availabilities and priorities.
- Horizontal relationships are important, but so also is the vertical autonomy of municipal and city governments. Relations between local, regional and national levels are critical, as are those between sectors and between private and public spheres. Local governments often lack the autonomy and decision-making powers over key policy issues such as transportation, land use planning, energy and infrastructure provision. There is often a "problem of fit" between the problem to be addressed and local possibilities (Bulkeley, 2010).Our aims in this paper is to provide a better understanding of these constraints faced by city and municipal governments in Iran in developing adaptation plans, by analyzing the case of the city of Tehran.

2. Research method

For access to desirable results in this essay, research method is descriptive-analytic and they were based on written and library information such as books, scientific articles, essays and sites.

3. Theoretical basis

As the world enters the second decade in the new millennium, humanity faces a very dangerous threat. Fueled by two powerful human-induced forces that have been unleashed by development and manipulation of the environment in the industrial age, the effects of urbanization and climate change are converging in dangerous ways which threaten to have unprecedented negative impacts upon quality of life, and economic and social stability. Alongside the threats posed by the convergence of the effects of urbanization and climate change, however, is an equally compelling set of opportunities. Urban areas, with their high concentration of population, industries and infrastructure, are likely to face the most severe impacts of climate change. The same concentration of people, industrial and cultural activities, however, will make them crucibles of innovation, where strategies can be catalyzed to promote reductions in greenhouse gas (GHG) emissions (mitigation) and to improve coping mechanisms, disaster warning systems, and social and economic equity, to reduce vulnerability to climate change impacts (adaptation).

The main factors that affect the sectors generating GHGs –namely, geographic situation, demographic variation, urban form and the types of economic activities. None of these factors operate in isolation, and it is perhaps more appropriate to conceptualize the urban system as a whole – recognizing that any urban area is intricately linked with rural areas, urban areas within the same country, and has international linkages. With a more complete expression, there are a variety of factors influencing the total and per capita emissions of a city, including geographic situation (which influences the amount of energy required for heating and lighting), demographic situation (related to both total population and household size), urban form and density (sprawling cities tend to have higher per capita emissions than more compact ones), and the urban economy (the types of activities that take place, and whether these emit large quantities of GHGs).

Urban governance and planning

The ability of urban centers to prepare for and respond to climate change is linked in large part to the quality of local governance and the strength of the institutional networks available to provide assistance to residents. Urban governance and planning can improve resilience to climate change impacts through targeted financing of adaptation, broad institutional strengthening and minimizing the drivers of vulnerability. Urban areas with weak governance systems – as a result of political instability, exclusion of climate change from the political agenda or lack of governmental resources – are highly vulnerable to climate change impacts.

Urban governance for climate change mitigation

Municipal authorities and other actors have developed a range of strategies and measures for mitigating climate change in different policy sectors. The mechanisms which urban actors use to develop and implement these initiatives can be grouped into distinct 'modes of governing'.
Four modes of governing that have been identified within municipal governance – self-governing, provision, regulation and enabling – the growing importance of corporate, donor and civil society actors means that (quasi) private modes of governing – voluntary, private provision and mobilizing – are also becoming important.

Modes of governing climate change mitigation

The term governance can be broadly understood in two different ways. First, in a 'descriptive sense, it refers to the proliferation of institutions, agencies, interests and regulatory systems' involved in managing societies.
Second, in a 'normative sense, it refers to an alternative model' for organizing collective affairs, frequently assumed to be based on horizontal coordination between mutually dependent actors where governments may be one among many agencies involved.
Understanding the nature, potential and limitations for urban climate change governance involves considering the different ways in which urban governments operate, as well as recognizing the important roles played by a variety of other public and private actors.
Small number of distinct '*modes of governing*' is being employed to address climate change in the urban arena. In terms of the modes of governing deployed by municipal authorities, four approaches appear to be important:
1. *Self-governing:* the capacity of municipalities to govern their own operations, estate and activities;
2. *Provision:* the shaping of practice through the delivery of particular forms of services and resources;
3. *regulation:* the use of traditional forms of authority such as mandates and planning law, and the oversight and implementation of regulation created at other levels of Government: and
4. *Enabling:* the role of municipalities in facilitating, coordinating and encouraging action through partnership with regional or national governments, private- and voluntary-sector agencies, and through various forms of community engagement (UN-Habitat, 2011).

While municipal modes of governing climate change were dominant during the 1990s, more recently, new modes of urban climate governance are emerging in which private actors (such as foundations, development banks, NGOs and corporations) and public agencies outside the local authorities (donor agencies, international institutions) are initiating schemes and mechanisms to address climate change mitigation activities in the city. Three approaches appear to be gaining ground, which in some ways mirror those being deployed by municipal authorities:
1. *Voluntary:* the use of 'soft' forms of regulation to promote action either within an organization or amongst a group of public and private actors, combining features of the self-governing and regulation modes detailed above;
2. *Public–private provision* of low-carbon infrastructures and services, either in place of or in parallel to government schemes, including initiatives developed through the auspices of the CDM; and
3. *Mobilization*, where private actors seek to engage other organizations in taking action, such as through education campaigns (UN-Habitat, 2011).

Each mode of governing relies on a different combination of policy instruments and mechanisms, and may be more or less effective in mitigating climate change in the urban arena. The following sections review municipal and public–private modes of governing in turn, assessing their use in different policy sectors as well as their strengths and limitations for achieving reductions in GHG emissions.

Municipal governance

These four approaches of municipal governance- self-governing, provision, regulation and enabling – are not mutually exclusive; rather, municipalities tend to deploy a combination of these modes at any one time. This is indicative of the impact of state restructuring, where – rather than governing in a direct, hierarchical, manner – the task for state authorities is one of 'meta-governance': of articulating and combining different modes of governance. However, research suggests that the self-governing mode remains the dominant approach adopted by municipal authorities in response to climate change. While the self-governing mode has significant limitations in terms of the proportion of urban GHG emissions that can be addressed. it offers a visible and often short-term means through which municipal authorities can demonstrate their commitment to climate change (Martinot et al, 2009).
In developed countries, self-governing and enabling modes have been dominant, while initiatives in developing countries are often based on the provision of low-carbon infrastructures and services. While regulation

is the least frequently used mode of governing, it is most common in the transport and urban development sectors, reflecting the roles of local authorities in controlling air pollution and land-use planning (UN-Habitat, 2011).

The development of climate change initiatives in the urban infrastructure sector has primarily relied on the provision mode of governing, while the enabling mode dominates in the built environment and carbon sequestration policy sectors.

This analysis suggests that municipal governments are making use of a wide range of policy instruments and mechanisms in seeking to address climate change. Given the cross-cutting nature of climate change as a policy issue, it is perhaps not surprising to find that there is no single 'recipe for success' – with the demands of different policy sectors, as well as different national and local contexts, leading to a 'patchwork' of approaches being adopted (Bulkeley and Kern, 2006). However, the dominance of the self-governing and enabling modes and the limited role played by regulation point to the underlying challenges that municipal government face in seeking to address climate change. On the one hand, accounting for the impact of regulation, provision and enabling measures – in terms of GHG emissions saved, and the financial and additional benefits accrued – is a complex task. In an era where municipal governments are required to audit their achievements, such measures may be deemed economically and politically unfeasible. At the same time, moving this complex policy issue into concrete actions beyond the areas within which they exercise direct control involves municipalities challenging the deeply ingrained relationship between the use of fossil fuels and economic development, and the political and social interests that this sustains (UN-Habitat, 2011).

Table 1.

Municipal modes of governing climate change

Mode of governing	**Policies and mechanisms**	**Examples**	**Advantages**	**Limitations**
Self-governing	- Management of local - authority estate - Procurement - Leading by example	- Investment in energy-efficient street-lighting - Purchasing renewable energy for municipal buildings - Behavioral change programs for local	Self-governing measures are under the direct control of the municipality and can provide quick, verifiable and cost-effective means of reducing GHG emissions. They provide a means for municipalities to demonstrate leadership and commitment to addressing climate change.	Self-governing measures can only address a small proportion of urban GHG emissions. They may be limited to those that can provide a financial return within the (short) time horizons of local governments.
Provision	- Operation of municipal infrastructure systems - Green consumer services	- Investment in low-carbon transport systems such as BRT - Household energy surveys and subsidized renovation programs provided by municipal authority	The provision of low-carbon infrastructure and services has potential for significant reductions in GHG emissions by changing the carbon intensity of utility provision and altering the choices available to households and businesses across the city. The development of new low-carbon infrastructure networks could improve access to basic services and improve livelihoods.	Municipal capacity for providing low-carbon infrastructure and services is hampered by a lack of finances, dependency on the terms and conditions of capital loans, and a limited remit for providing energy, water, waste and transport. In contexts where there is a lack of basic services, developing low-carbon networks is unlikely to be a priority. In addition, the provision of infrastructure and services is only one factor shaping their use and may not lead to an overall

				reduction in GHG emissions without additional measures.
Regulation	- Taxation - Land-use planning - Codes, standards, etc.	- Congestion charging schemes - Requirement for renewable energy technologies in new development - Energy and water efficiency standards for buildings	Regulative measures can provide transparent and effective means for reducing GHG emissions from a variety of policy sectors. They provide a level playing field for the business community. They may also yield additional revenue, which can be invested in additional low-carbon measures.	Regulative measures can be difficult to implement because of concerns about their impact upon businesses or particular sections of the community. Regulations are difficult to apply retrospectively (e.g. to existing buildings) and governments are often reluctant to regulate individual behavior, meaning that the application of such measures may be confined to a small proportion of total urban GHG emissions. In a context of limited municipal capacity, regulations can be difficult to monitor and enforce.
Enabling	- Information and awareness-raising - Incentives - partnerships	- Education campaigns for walking and cycling - Grants/loans for low-carbon technologies for households/businesses - Development of voluntary GHG emissions reduction schemes for local businesses	Enabling measures can require relatively little or political investment. They enable municipal governments to benefit from the resources and capacities of a range of other urban actors in reducing GHG emissions. Through involving a range of different partners, they may increase the democratic mandate for acting on climate change.	Enabling measures are dependent on the goodwill and voluntary actions of businesses and communities who may not be forthcoming. Assessing and verifying the impact of GHG emissions and it may be difficult to evaluate their cost effectiveness.

(Source:Bulkeley and Kern, 2006; Bulkeley et al, 2009; Hammer, 2009; Martinot et al, 2009; ICLEI, 2010)

There are five key sectors in which urban responses to mitigating climate change have been concentrated: urban form and structure; built environment; urban infrastructures; transport; and carbon sequestration.

Urban development and design

The use of energy within a city, and the associated production of GHG emissions, is dependent on both the form of urban development (i.e. its location and density) and its design. As urbanization continues apace, one of the critical challenges is managing the process of urban development and, in particular, the twin challenges of urban sprawl and the growth of informal urban settlements.

Urban sprawl is an increasing challenge for cities in developed and developing countries. As the distances between home, work, education and leisure activities increase, so often does the reliance on private motorized transport. In some cities sprawl has meant the development of middleclass urban fringe districts where dwelling sizes tend to increase, leading to an increase in per capita GHG emissions. In other cities, sprawl is fueled by the growth of informal settlements.

In seeking to address these challenges, various strategies of land-use planning, including land-use zoning, master-planning, urban densification, mixed-use development and urban design standards, have been used in order to limit urban expansion, reduce the need to travel and increase the energy efficiency of the urban built form. Such approaches can be deployed at a range of locations within the city and at different scales.

Most often, these projects are led by municipal authorities through the use of planning regulations and planning guidance.

Table 2.

Climate change mitigation through urban development and design

Type of scheme	Description
Urban expansion, informal settlements or suburban development:	Application of land-use planning and design policies to limit energy use in the expanding areas of existing cities.
New urban development:	Application of land-use planning and design policies to limit energy use in new urban areas.
Reuse of brownfield land:	Urban development on old industrial or other derelict areas of the city to encourage densification, mixed-use development and reduce energy use in the city.
Neighborhood and small-scale urban renewal:	Schemes which seek to renew existing housing stock and redevelop urban layout and design at a neighborhood or street scale in order to reduce energy use in the city.

(Source: UN-Habitat, 2011: 95)

Built environment

The design and use of the built environment is a critical arena for climate change mitigation because 'the building sector consumes roughly one-third of the final energy used in most countries, and it absorbs an even more significant share of electricity'.

Table 3.

Climate change mitigation in the built environment

Type of scheme	Description
Energy-efficient materials:	The use of energy-efficient materials in the construction of the built environment.
Energy-efficient design:	The use of energy- and water-efficient design principles, such as 'passive' heating and cooling.
Building-integrated alternative energy supply:	The use of renewable and low-carbon energy technologies to provide energy to individual buildings.
Building-integrated alternative water supply:	The use of off-grid water supply and processing techniques which reduce energy use in the production and heating of clean water.
New-build energy and The use of energy- and water-efficient technologies:	The use of energy- and water-efficient devices in the construction and development of new buildings.
Retrofitting energy- and water-efficient technologies:	The use of energy- and water-efficient devices in the renovation of existing buildings.
Energy- and water-efficient appliances:	The use of efficient appliances within the built environment.
Demand-reduction Measures:	Measures aimed at reducing the demand for energy and water within the built environment.

(Source:UN-Habitat, 2011: 96)

Urban infrastructure

Urban infrastructure – in particular, energy (electricity and gas) networks, and water and sanitation systems – is critical in shaping the current and future trajectories of GHG emissions. The type of energy supply, the carbon intensity of providing water, sanitation and waste services, and the release of methane from landfill sites are important, though often hidden, components of GHG emissions at the local level.

Table 4.

Climate change mitigation and urban infrastructures

Type of scheme	Description
Alternative energy supply:	Development of renewable energy or low-carbon energy supply systems at the city scale.
Landfill gas capture:	Use of gas produced by landfill sites for energy provision.
Alternative water supply:	Use of alternative forms of water supply, storage and processing to reduce energy use at city scale.
Collection of waste for recycling or reuse:	Development of alternative collection systems and ways of using waste to reduce methane produced at landfill sites.
Energy and water efficiency/conservation:	Enhancing the efficiency of existing infrastructure systems or development of new efficient systems.
Demand reduction:	Schemes to reduce demand for energy and water use, and for the collection of waste.

(Source:UN-Habitat, 2011: 98)

Transport

The transport sector is a significant contributor to GHG emissions, representing 23 per cent (worldwide) and 30 per cent (OECD) of CO2 emissions from fossil fuel combustion in 2005. In developing countries, especially China, India and other Asian countries, although transport's share of GHG emissions is low, it is growing much faster than other sectors.

Table 5.

Climate change mitigation and transportation

Type of scheme	Description
New low-carbon transport infrastructure:	The development of new transport infrastructure to encourage low-carbon modes of transportation.
Low-carbon infrastructure renewal:	The renewal or upgrading of transport infrastructure to reduce GHG emissions
Fleet replacement:	Replacement of vehicle fleet with energy-efficient or low-carbon vehicles.
Fuel switching:	Switch from the use of fossil fuels for powering fleet to alternative low carbon or renewable fuels.
Enhancing energy efficiency:	Measures to enhance the energy efficiency of existing vehicles and their use.
Demand-reduction measures:	Measures aimed at reducing the demand for individual motorized transport.
Demand-enhancement measures:	Measures aimed at enhancing the demand for alternative forms of travel (e.g. public transport, walking and cycling).

(Source:UN-Habitat, 2011: 101)

Climate change adaptation and urban development

Adaptation-related issues for urban development across the world include two dimensions: first, the implications of climate change impacts for urban development projects that are likely to call for adaptations; and, second, the relationships between adaptation action to reduce the impacts of climate change, on the one hand, and urban development, on the other.

Climate change poses particularly severe threats for urban development in those areas that are most vulnerable to climate change impacts. For example, many cities are located in coastal areas and river valleys, as well as areas where the economic base is rooted in climate-sensitive sectors, such as agriculture, forestry or tourism, and areas

where these regional climate-related activities face increased competition with population and economic growth. If climate change is relatively severe in local contexts rather than moderate, some cities will find that incremental adaptations that protect current activities and ways of life may no longer be adequate.

A current example of what future climate change could mean for urban development can be found in the polar regions of the world, where temperature increases (and emerging sea-level rise) are not only affecting urban infrastructure as the permafrost melts, but are irreversibly destroying polar ecosystems and indigenous ways of life that are closely linked to them. In these and similar cases, adaptations that are 'transformational' may be required, such as changes in land uses and movement of investment away from vulnerable areas, or shifts in directions of urban development to different economic sectors or land uses. Climate change impacts are therefore a critically important challenge for urban development, and if climate change is severe (rather than moderate), the number of cities at risk will be multiplied many times over (Hardoy, 2013).

Experience suggests that, given human resources and access to knowledge, urban dwellers often have impressive capabilities to adapt in ways that are good for their development, even with limited financial resources.

This is not to say that decisive action is not needed at all levels; but it is important to note the many actions are already being undertaken by households and communities – frequently in the absence of actions by local government and other stakeholders.

One of the most fundamental challenges in relating climate change adaptation with urban development in many regions, however, is a limited capacity to identify vulnerabilities and adaptation pathways, along with a limited capacity to make adaptation happen. Many small- and medium-sized cities, especially in sub-Saharan Africa, South Asia and Central America, currently show low levels of capacity to adapt to the current range of climate variability, let alone any future climate change impacts. Problems in many such cities include a lack of provision for infrastructure (including all weather roads, piped water supplies, sewers, drains, electricity, etc.), urban social services (such as health and education) and institutional capacity.

Yet, many cities have shown an ability to adapt to local climate conditions, whether related to climate change or not; and where climate change adaptation is being considered seriously (in urban areas from Bangkok, Thailand, to Melbourne, Australia), in nearly every case adaptation options are being identified that are relatively low cost and have broad constituency support. Some developing country cities have moved beyond option identification to adaptation planning (such as Durban and Cape Town, South Africa), Furthermore, most of the adaptation options offer considerable co-benefits – that is, benefits for urban development and/or environmental stress reduction in the near term, as well as added resilience to impacts of climate change in the longer term, which is often critically important in sustaining attention to adaptation while impacts are gradually emerging.

There are positive examples of cities that are taking steps to promote development and reduce vulnerability at the same time. These cities have implemented actions to prevent rapidly growing low-income populations from settling on dangerous sites. Although these actions have not been driven by climate change concerns, they illustrate how predevelopment and pro-poor policies can enhance adaptive capacity. Conflicts and trade-offs between development policies and adaptations are also possible, as in the development of infrastructure whose design and construction have the potential to displace informal settlements (UN-Habitat, 2011).

As climate change impacts are felt locally, there is increasing, and often urgent, interest in the adaptation plans and programs being put forward by city authorities. There is some understanding of what such plans should include, but much less on how they should be implemented and what the implications might be.

It is important to assess the extent to which an adaptation strategy is actually guiding and influencing the largest and most powerful departments within city and municipal governments, and whether these departments are putting in place the needed regulatory frameworks to guide urban expansion and infrastructure development. An effective city climate change adaptation strategy needs support from most if not all departments and sectors. It needs specialist staff to organize it and high level support to encourage the engagement of all relevant departments. It needs the knowledge and capacity to build resilience and set in motion the procedures to reduce risks – including disaster preparedness for extreme weather events (Bernard, Susan M. et al, 2004). For any large city with different local governments, it also depends on the coherence in adaptation across different jurisdictions. It is a challenging task to identify cities that are actually implementing climate change adaptation plans and programs with more than nice-looking statements of intent. Several cities have plans and program, but not many can show them in advanced stages of implementation.

The Government of Iran is currently incorporating National Adaptation Program of Action to fulfill adaptation to climate change and mitigate its impact on the health system in Iran which includes:

- International programs such as the Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS)
- National action Plan on Drought & Dust Storm to reduce the risks of trans-boundary air pollution
- Comprehensive plan for clean and healthy air

- Adoption of Health Impact Assessment in national development plans, of climate change and issues such as floods, landslides and other natural disasters
- Protecting the environment in rural areas by improving drinking water supply and implementation of Healthy City Healthy Village Community Based Initiatives (CBI)
- Tehran is prone to some paralyzing climate challenges, namely drought, dust and sand storms, and infectious diseases and the associated vectors.

4. Characteristics of Tehran

Socioeconomic context

Tehran metropolitan area is about 250 km from east to west, and 50 km from north to south, located between mountain and desert. Tehran city locates in the eastern part of this region. It's the largest city in Iran with a population of over 12.5 million.

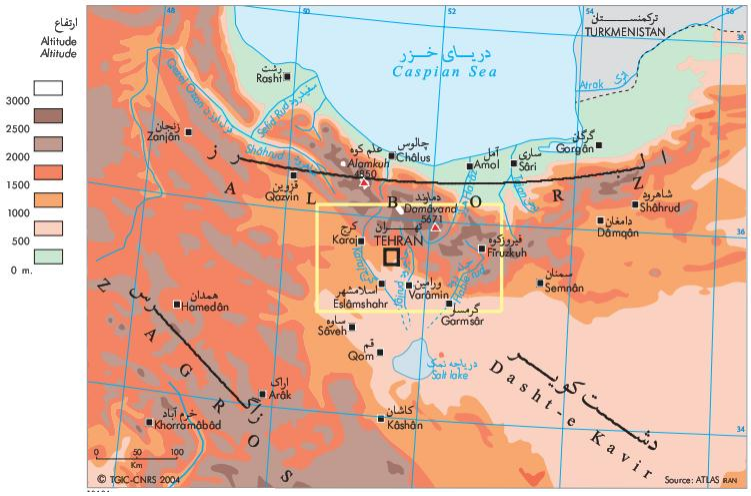

Fig. 1. Tehran's location between Desert and Mountain

(Source:Atlas of Tehran Metropolis)

Administrative structure of Iran was concentrated in Tehran. Tehran is also the political center of the country; it is also an important economic hub. While only 11 percent of the population living in Tehran, about 25 percent of the GDP of the city, Tehran hosts nearly half of the country's industrial activities.

Rapid population growth in Tehran started in the middle 1900s and continues today, although at a reduced pace. Since the early stages of its growth there has been economic and social inequality between Tehran and its surrounding hinterland. Similar inequalities could be seen within the city of Tehran: the wealthy live in North Tehran, while the south of the city is home to relatively poor inhabitants and the center contains the rapidly growing middle class. Informal settlements in small towns and villages located around the city are of an even lower economic level. This contrast between center-periphery and north-south is a key characteristic of the metropolitan area. Tehran is the most developed province in the country. It has the highest position in most development indexes and is the economic and political center of the country. Both income and living costs are higher in Tehran than in other provinces of the country (Statistical Center of Iran, 2011).

Tehran continually threatened by floods. The main reason for this may be the differences in altitude, climatic conditions, particularly the existence of large rivers such as Karaj River, *Jajrood* River, Kan River and multiple issues and the placement of Tehran, at the foot of the mountain range.

Political and administrative context

Tehran's unique location has affected its growth and development. It is on the southern slopes of the Alborz Mountain and is surrounded by mountains to both the north and east. This creates a natural barrier for Tehran's growth. The Dasht-e-Kavir desert on its southern edge also limits growth. The city's expansion has concentrated on its western side and partly to the south (Habibi and Hourcade 2005).

Tehran Municipality to meet the requirements and better management divided the city to 22 districts. Tehran

Municipality is a non-governmental organization which was founded on 1907 and managing Tehran city.
Tehran's City Council is composed of 31 representatives on the board responsible for administering the Tehran law). The main tasks of the council elected mayor for four years, overseeing the operation of the municipality and, if necessary, dismissal of the Mayor, the approval of plans for the welfare of citizens and monitoring their implementation, approval the annual budget of the municipality, the municipality adopted the Statute of the institutions and affiliates.

Urban Planning and Governance

The local government is responsible for urban management and the implementation of rules, regulations, and planning documents - great tasks for which municipalities have limited resources. Comprehensive and detailed plans are the main legal documents for controlling land-use planning and development of urban areas. However, Iranian municipalities have limited control over the content of those plans, as they were prepared and approved by the "Ministry of Road and Urban Development". Their top-down, rigid approach, based on a time consuming preparation and approval processes, and a lack of flexibility in dealing with changing situations drew criticism, causing a long debate among academics and professional urban planners of Iran. The result was the substitution of strategic plans as a more flexible method (Fahrhoodi et al., 2009). This change in planning process is still in its preliminary stages and more experience is needed to ensure its development and progress. City authorities must also deal with land speculation and unplanned development as well as the huge challenges of infrastructure improvement and maintenance. These hurdles significantly influence the implementation of sustainable solutions in Iran's urban development and urban form.
Tehran municipality is a very strong organization with big responsibilities: dealing with the complicated and increasing problems of a metropolis is a difficult task. Air pollution, insufficient public transportation and urban infrastructure, traffic congestion, environmental degradation, low green space coverage, and vulnerability to natural hazards are among the major issues to be tackled.
Lack of integrated urban management and limited financial resources are among main challenges of urban administration in Tehran. Since early 90s, Tehran started to allow higher densities through bonus zoning: "developers could build taller buildings by paying fees to the municipality, in a policy popularly known as selling density." (Madanipour, 2006). This was a route for the Municipality to gain financial autonomy, but the policy caused disorder and chaos in Tehran's urban form. Although this policy is restricted in newer planning documents, the municipality still needs this source of income to fund civil projects.
According to Roshan (2010), Tehran is characterized by disintegrated and sprawl-like growth during recent decades. Comparing the population growth rate with the city's physical expansion shows that in the last 85 years, the population of the city multiplied by 37, while in the same period, its area increased by 100. Beyond rapid growth, the city's expansion has been unplanned, desultory, and dispersed - the typical characteristics of sprawl. High land prices, which many people can't afford, and speculation impinge on any attempt to create a compact urban form. Moreover, with housing development in Tehran so profitable, there is less willingness to develop green spaces and parks in the city. In fact, this profit-making trend has led to many of the city's old gardens being replaced by high rise buildings. The low and decreasing supply of open and green spaces has a significant negative affect on the local city climate (Pahl-Weber et al., 2013).

Tehran urban development plans

Responsibility of preparing Urban Development plans is with the Ministry of Road and Urban Development, of course, their implementation is with municipality. Some of Tehran urban development plans are comprehensive plans, master plans, urban strategic plans and some short-term plans. Partitioning the plan has been a strategy not only to adapt to specific local needs, but also to guarantee the progressive continuity of Tehran urban development plans implementation. Discussing and reaching consensus over general plan for the city is different from the same process applied to plans at a smaller scale.
As specific plans progress, former obstacles and conflicts are solved, developers and landowners, as well as the general public, see the positive results of the interventions and start to support the process. For example, below, we describe parts of a strategic plan in Tehran.

Table 6.

Tehran's strategic plan strategies

Principle	Actions
Protect the environment and secure the city from disaster	- Lack of development on water resources or in close proximity to the watercourse - Reduce air pollution in urban and residential areas - No damage to protected areas - Ban horticultural and agricultural land use change - Transfer annoying industries to industrial towns
Social and economic development	- Using accumulated and massive social capitals for job development - Regularization of informal settlements and marginalization in urban areas - Access to public transport systems - Alternative sustainable sources of revenue to fund city government
Sustainability of Resources	- Ensuring the sustainability of protected areas and biodiversity of ecosystems within the city and surrounding metropolitan Tehran - Reduce the level of informal settlements in the region - Organizing activities in the city of Tehran in order to ensure the sustainable development - Use of unused land in the area - Prevention of pollution of water resources as part of Tehran's underground water supplies

(Source:Tehran Strategic Plan, 2010)

The strategic plan establishes guidelines for land use, the transport system and mobility, public spaces, historical, natural and built heritage, housing, infrastructure and services.

The cross cutting environmental approach

There is a strong environmental component to the planning reforms. Some of the main goals of the urban plan are to reduce density in the central area and redistribute population to other areas of the city; also control the heights of the buildings and establish some distance between them. Issues such as mobility, transportation and access to services and infrastructure (such as water, sanitation and drainage networks, public spaces, health centers and community centers) are taken into account, but also wind patterns and flood risks. New urban norms incorporate energy efficiency criteria and safety measures in the use of certain construction materials, such as glass in high-rise buildings. Environmental measures undertaken with different sectors include the delimitation of flood risk areas that guide land use; the development of parks in flood risk zones; early warning and emergency systems and educational campaigns for risk prevention; dengue campaigns, including control of mosquito breeding grounds and strong community awareness campaigns; and the creation of a green belt around the city, used for urban agriculture.

One issue that still needs regulation is the use of tin roofs, which is common but these are easily damaged during hailstorms. Funds should be allocated to research and development into materials that are more resistant.

Representatives of civil society believed that the local administration could have done more. During public discussions around modifications to the urban code, experts and local NGOs argued that insufficient attention was being given to such environmental issues as the impacts of population densities, heat island effect, air circulation, air quality etc., and that the influence of construction companies, professional schools was too strong.

Aside from this, as in any city, the application of new norms is slow and the controls needed to cover all new construction take time and resources. There are always ways around the regulations so these need to be constantly revised. The environment has not necessarily been a cross-cutting issue in different public policies, and the sub-secretariat is always underfunded and depends on other areas to implement actions.

General Climate Change Challenges of Tehran

There is extensive literature on Tehran's vulnerability to climate change impacts. The city's dry climate, scarce water resources, limited forest cover, periodic droughts, and floods have already caused shortages and limitations for many Iranians in the past. The situation will only be exacerbated by rising temperatures and climate change effects such as an increasing number of hot or dry days, extreme events of heavy rainfall, and floods.

Tehran city is both accelerators and victims of climate change. The extensive energy consumption and CO2 emissions of Iran's residential and transportation sectors makes the role of the city in climate change obvious. Continued urbanization will further increase this role in the future. The impacts of climate change on city and urban areas include but are not limited to (UNDP and DoE 2010):

- Increasing droughts will reduce agricultural production, raise unemployment, and increase migration from rural to urban areas.
- Floods may affect water resources, aggravating city's water supply problems. Sea level rise will affect cities and villages located in the coastal areas and may cause damage to coastal infrastructures.
- The effects of changes in temperature, namely an increase in minimum temperatures, the reduction of daily temperature variability, and general warming, will be magnified in large cities and metropolitan areas. Urban heat islands will amplify the need for cooling in summer. As the use of cooling technology increases, so in turn will the energy demand, and often the water demand (for adiabatic evaporative cooling systems).
- Water pollution, combined with increasing temperatures and heavy rainfall will increase the risk for vector borne diseases such as malaria, leis manias is, cholera, and diarrhea − constituting one of the main health related consequences of climate change.
- Air pollution, especially in metropolitan areas like Tehran, will increase the rate of strokes, as well as cardiovascular and respiratory diseases.
- Dust storms will further worsen the situation in Tehran. (Pahl-Weber et al, 2013).

5. Discussion and Conclusion

Tehran is not a recognized international leader in addressing climate change. It has not prepared an official mitigation plan, much less an adaptation plan, nor presented its climate change action plan at international forums. The city is still struggling to complete greenhouse gas inventories. It has, however, implemented several specific mitigation measures and tries continuously to place this issue on the government's agenda. For local authorities, adaptation to climate change has been a much more diffuse issue than mitigation, and their initial response is to think that they aren't doing much and that mitigation is the first serious step in a climate change agenda. The connection between climate change adaptation and good urban planning, risk reduction and management, good governance mechanisms and environmental concerns is not established quickly.

However, Tehran's particular way of responding to current development challenges has put in place the flexibility, creativity and commitment needed for adaptation, regardless of whether this is made explicit or not. Tehran's policies have had continuity and consistency, despite being frequently revised over years, because each administration has built upon the progress of its predecessor. This is quite unusual; it is more common for there to be a revision of all that has been accomplished and for the need to point out the negative aspects of the previous administration and to differentiate from it.
Policies are strongly underpinned by urban planning reforms. These, together with environmental sustainability as a key component of habitat improvement, cross all policies and actions. Urban planning is the physical support of social transformations, and environmental sustainability is a measure of the city's future viability.

Efforts are being made to find new ways of working across different secretariats. The city's GIS, for instance, is produced and shared between administrative areas. Public administration leans naturally towards sectoral division, and cross-cutting policies take great effort to produce.
The local administration is clear about its constraints, and creative in searching for ways around these to achieve its objectives. Examples are the strategy used to get parts of the city plan approved, or the mechanisms used to engage public−private sectors in different urban interventions.

Representatives of the construction sector mentioned the city's flexibility in conveying competing interests, creatively searching for solutions and integrating social housing within the land market to get financial resources and land to start solving housing needs. A concern of the local administration is that they have still not obtained sufficient land for much-needed social housing programs. The program allowed for the improvement of housing and services in informal settlements, relocation from flood areas and legal tenure for many families. The focus on employment and social cohesion also improved community resilience. The city barely keeps up with the growth of informal settlements, which results from both natural growth and the continuous inflow of immigrants.

Improved contact with residents through decentralization and participatory budgeting has cost money but is in line with the political commitment to democratic inclusion.

An important percentage of the city budget goes to health. Also a political decision, especially has given this is a provincial responsibility.

Active citizen participation also provides continuity and can act as a safeguard for the processes implemented. Citizen participation, however, is not an easy process for any city. The typical citizen probably lacked the information for knowledgeable, confident involvement. Participation also carries risks – not everything proposed by stakeholders is necessarily in line with what government expects or needs, and local governments should be prepared for this. There have to be instances where stakeholders can influence local policies. There has to be a clear commitment to the process and continued support.

Some of the present and future challenges which the city faces are listed below:

One of the main challenges for the city is access to funds. There have been creative efforts, but every action needs financial resources, whether it be running the decentralized districts, managing the health service or maintaining green areas and the solid waste collection. The former Sub-secretary for the Environment recognized that funds were needed to develop a greenhouse gas inventory, but more pressing was the need for mosquito control, urban forestry, solid waste management, etc. Most of the environmental budget goes to finance these routine activities.

Key to many of the programs and actions encouraged by the city is support from higher levels of government. Conflict on this front, especially at the national level, has hindered the city's capacity to embark on projects, although it has also made the administration more resourceful and independent. International funds usually go to national governments and are centrally managed, but city level adaptation projects are not a priority for the national climate change agenda. The mechanisms for local governments to access international funding are complex, and usually they have to adapt to the priorities of funding agencies, not necessarily what they most need.

Data is also a challenge. Climate change adaptation actions require specific local knowledge about vulnerability and impacts, and call for an updated, comprehensive database.

Where the city has relevant information, it is complicated to share it between city offices. Without this type of information, it is difficult for city administrations to buy into climate change adaptation or to demonstrate clearly the relationship between climate change and other local planning processes.

A related challenge is the documentation and evaluation of current efforts, which can in theory provide good learning opportunities. (Sharma, D. et al, 2010)

But external consultants often undertake evaluations of programs with little participation of local government staff and these results in long reports of little practical use.

So according to policies that developed, and leading countries in field of climate change adaptation and mitigation have applied, Tehran can create a basis for including adaptation measures in local environmental and development plans. Some solutions in this area are: effective governance; institutional capacity; innovative planning and legal frameworks; holistic approaches to urban environmental problems and local development issues; a capacity to work with the urban poor; and an engaged civil society.

6. Suggested solutions

Several principles are fundamental to an integrated, multi partner approach towards climate change action at the urban level:

• No single mitigation or adaptation policy is equally well-suited to all cities;

• It would be beneficial to take an opportunity/risk management approach in a sustainable development perspective, considering not only emissions, but also risks that are present in a range of possible climate and socioeconomic futures;

• Policies should emphasize, encourage, and reward 'synergies' and 'co-benefits' (i.e. what policies can do to achieve both developmental and climate change response goals);

• Climate change policies should address both short-term and longer-term issues and needs; and

• Policies should include new approaches that support multiscale and multisector action, rooted in the different expectations of a wide range of partners.

For the local level, the Report suggests, broadly, that urban policy-makers should begin from an awareness of local development aspirations and preferences, local knowledge of needs and options, local realities that shape choices, and local potential for innovation. In this context, urban local authorities should:

• Develop a vision of where they want their future development to go and find ways to relate climate change responses to urban development aspirations;

• Expand the scope of community participation and action by representatives of the private sector, neighborhoods (especially the poor) and grassroots groups, as well as opinion leaders of all kinds, in order to ensure a broad-based collection of perspectives; and

• Using an inclusive, participatory process, cities should conduct vulnerability assessments to identify common and differentiated risks to their urban development plans and their different demographic sectors, and decide on objectives and ways to reduce those risks.

To achieve more effective policies, local governments need to expand the scope, accountability and effectiveness of participation and engagement with non-governmental organizations (NGOs), such as community and grassroots groups, the academic sector, the private sector and opinion leaders. Effective engagement with NGOs will serve multiple purposes:

• It will become a source of innovative options, as well as both scientific and locally relevant knowledge;
• It will allow participants to understand and mediate the diverse perspectives and interests at play; and
• It will provide broad-based support for decisions and promote knowledge on the causes of emissions and vulnerabilities, as well as mitigation and adaptation options thus achieved.

Partnerships with the private sector and NGOs are of special relevance in this context. For example:

• Resources from international, national and local private organizations can be mobilized to invest in the development of new technologies, housing projects and climate-proof infrastructures, and to assist in the development of climate change risk assessments; and
• The widespread involvement of NGOs in climate arenas as diverse as climate awareness and education and disaster relief should be welcomed – the inputs and perspectives of these organizations can be harnessed to help develop a more integrated urban development planning.

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