Livelihoods and Living Conditions in Urban and Coastal Areas

Background paper for World Bank Report:

Adaptation to a Changing Climate in the Arab Countries

Authorship

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A working outline of this paper can be found in Annex 2

Disclaimer

This text is not for citation. The statements, views, interpretations and findings expressed in this draft and in all contents herein are entirely those of the authors. They do not necessarily represent the view of the World Bank, its Executive Directors, or the countries they represent.
Notice of Invitation for Contributions:

We are interested to hear from researchers/practitioners in the MENA region who are in a position to contribute to the chapter. In particular, we are interested in contributions and suggestion for case studies or examples from the Maghreb and Mashreq regions. This draft is written on the basis of a desk review of research already conducted on this topic. Incomplete areas are demarcated by [highlighting].

If you are a researcher or practitioner from the Maghreb, the Central region, the Gulf region, or the Mashreq with interest and expertise in climate change and adaptation in urban and/or coastal areas in any of these sub-regions, or if you are familiar with the related literature in Arabic and French and can help contribute to the full elaboration of a case study, then we invite you to send contributions to us.

The best contributors will be invited to participate in a five-day Writers' Workshop in Marseille in June 2011 and will feature as contributing authors of the paper. See website for more information.
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1. Introduction

It is well recognized that Arab states are located in a region characterized by a harsh environment. The region already suffers from hot weather conditions, shortage of water and food resources, low biodiversity, excessive coastal unplanned urbanization, low education attainment and high unemployment rates. In addition, the region suffers from impacts of severe extreme events of dust storms, flash floods, heat waves and marine storms. These problems and variabilities are expected to be enhanced with climate changes. As a result, life is expected to be even harder for 18.2 percent living under national poverty lines in the region, possibly forcing many of them to emigrate both internally and outside of the region.

It is well known that the Arab region is and will continue to be one of the fastest urbanized regions in the world. Most of the urbanization occurs along coastal areas which makes the urban sector in the Arab region highly vulnerable to potential impacts of climate change. The Arab countries have 34,000 km of coastal lines, nearly fifty percent of which is already inhabited. Urbanization rate reaches as high as 90 percent in some Arab countries especially in the Gulf region. Moreover, the past few decades have witnessed large-scale developments and massive urban sprawl such as what is happening in Dubai and in many other Gulf Cooperation Council cities (Gelil, 2010). Adaptation to climate change is therefore expected to be a priority for development in the region.

With increasing population, population densities and activities in the Arab region, and the need for high rates of urbanization, it is well realized that urban areas especially in coastal zone are the most vulnerable to impacts of climate change. City location in the coastal zone, population densities, governance and extension of the surrounding land use and the efficiency of energy utilization dictate the performance and efficiency of the city in the climate changing era.

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As climate change intensifies, urban centers will face growing risks from storms, floods, heat waves and water shortages. Nations and cities most at risk are the poorest nations and cities that have contributed least to the creation of the problem (e.g. Stern, 2007). Climate change will certainly exacerbate the problems associated with voluntary or involuntary eco-migration to large and intermediate cities, away from flood-prone localities, as well as potentially large-scale internal and cross-border mobility away from agricultural zones undermined by changing climatic conditions or declining water availability and droughts. Coastal urban centers have already experienced ecology-related immigration from both the interior and adjacent regions. This has exacerbated urban poverty and unemployment, while contributing to the flows of migrants seeking to reach the Canary Islands, of the southern areas of Spain and Italy on board unseaworthy boats in a desperate hope of gaining access to the European Union (The State of African Cities, 2010).

In a region faced by rapid urbanization and population growth, the struggle against climate change impacts in the Middle East and North Africa is increasingly urban. Over the past 40 years, the population of Arab countries has grown nearly threefold, and half of the region’s 359 million inhabitants live in urban areas (UNDP, 2010).” It is anticipated that over 70 percent of the total population will live in urban areas by 2015 (World Bank, 2008). While they may contribute significantly to GHG emissions, urban areas also concentrate population and the infrastructure investments and economic activities which sustain them. Always susceptible to floods, heat waves, droughts and other natural hazards, it is anticipated that climate change will exacerbate the vulnerability of cities to natural phenomena (Satterthwaite et al., 2007). The exposure and vulnerabilities of urban areas to climate change is significant in the Arab region; with nearly 34,000 km of coastline, much of the region’s population is focused in low-lying coastal zones. In North Africa alone, the coastal flooding associated with an increase of

---

2 What is the number that reach Europe annually through the region?
3 Percentage of pop near coast – source suggestions?
1°C-3°C will threaten the wellbeing of between 6 and 25 million urban residents, including Alexandria, Algiers, Tunis, and Casablanca (Osman Elasha, 2010). In the case of small island developing states (SIDS) such as Comoros and Bahrain, their entire population is under threat of sea level rise. Recognizing the heavy urbanization of low-lying coastal areas, this chapter will explore the effects of climate change on both urban and coastal areas in the Arab Countries.

A large amount of climate change research, both globally and within the region, fails to account for urbanization in climate models. In fact, the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) recognizes that urbanization is missing from climate model projections (Christensen et al., 2007). While it is referenced in AR4, urban planning strategies for adaptation and mitigation are not comprehensively reviewed; AR5 is expected to cover more adaptation and mitigation strategies in relation to human settlements and infrastructure. Globally, there are many urban initiatives underway to share information on climate change actions; however cities in the Arab countries are largely absent. Cairo is the only city in the region active in C40 Cities Climate Leadership Group; there are no regional members of the World Mayors Council on Climate Change (WMCCC). At the local scale, many city managers have yet to take into account how changes in temperature and rainfall will affect service provision and livelihoods within urban areas.

In this chapter, we address the impacts of climate change on livelihoods in urban and coastal areas, with particular interest for the wellbeing of the urban poor. First, we will discuss overlying factors which affect the ability of cities and residents to adapt to climate change impacts. These include native vulnerabilities of urban and coastal areas, issues of governance and intergovernmental management, as well as the lack of climate funds available specifically for municipal-level adaptation planning. Next, we outline

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sector-specific vulnerabilities and adaptation strategies seen in the Arab region to date. Sectors include traditional architecture, building codes, green building, urban flooding (coastal protection and drainage), urban water supply, solid waste and sanitation, transport, energy, tourism and cultural heritage, and disaster risk reduction. Finally, we conclude with key messages relevant for policy makers.

2. Climate adaptation in the urban setting

In the case of the Arab countries, rapid population growth and urbanization are contributing to local climate change vulnerability. Urbanization in the region is happening for a number of reasons, including high fertility rates, substantial rural-urban migration, international emigration, and the concentration of economic activity in urban areas. Urbanization is not only occurring in large metropolises, but also small and medium-sized towns.\(^5\) Table 1 illustrates that in 19 out of 22 Arab countries, the annual urbanization rate exceeds the rate of population growth, with the exceptions of Djibouti, Bahrain, and United Arab Emirates (three countries with over 75 percent urban populations). Three least developed countries are the most rapidly urbanizing in the Arab world: Yemen (4.6 percent), Somalia (4.1 percent), and Sudan (3.7 percent).

Table 1: National population and urbanization rates

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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Maghreb</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algeria</td>
<td>34,994,937</td>
<td>66</td>
<td>1.173</td>
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</tr>
<tr>
<td>Libya</td>
<td>6,597,960</td>
<td>78</td>
<td>2.064</td>
<td>2.1</td>
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<td>Mauritania</td>
<td>3,281,634</td>
<td>41</td>
<td>2.349</td>
<td>2.9</td>
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<tr>
<td>Morocco</td>
<td>31,968,361</td>
<td>58</td>
<td>1.067</td>
<td>2.1</td>
</tr>
<tr>
<td>Tunisia</td>
<td>10,629,186</td>
<td>67</td>
<td>0.978</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Central</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comoros</td>
<td>794,683</td>
<td>28</td>
<td>2.696</td>
<td>2.8</td>
</tr>
<tr>
<td>Djibouti</td>
<td>757,074</td>
<td>76</td>
<td>2.237</td>
<td>1.8</td>
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<tr>
<td>Egypt</td>
<td>82,079,636</td>
<td>43.4</td>
<td>1.96</td>
<td>2.1</td>
</tr>
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### Livelihoods and Living Conditions in Urban and Coastal Areas

#### Somalia

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Somalia</td>
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<td>37</td>
<td>1.603</td>
<td>4.1</td>
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#### Sudan

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<tbody>
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<td>Sudan</td>
<td>45,047,502</td>
<td>40</td>
<td>2.484</td>
<td>3.7</td>
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</table>

#### Mashreq

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</thead>
<tbody>
<tr>
<td>Iraq</td>
<td>30,399,572</td>
<td>66</td>
<td>2.399</td>
<td>2.6</td>
</tr>
<tr>
<td>Jordan</td>
<td>6,508,271</td>
<td>79</td>
<td>0.984</td>
<td>1.6</td>
</tr>
<tr>
<td>Lebanon</td>
<td>4,143,101</td>
<td>87</td>
<td>0.244</td>
<td>0.9</td>
</tr>
<tr>
<td>Palestine (Gaza Strip)</td>
<td>1,657,155</td>
<td>72</td>
<td>3.201</td>
<td>3.3</td>
</tr>
<tr>
<td>Syria</td>
<td>22,517,750</td>
<td>56</td>
<td>0.913</td>
<td>2.5</td>
</tr>
</tbody>
</table>

#### Gulf

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>1,214,705</td>
<td>89</td>
<td>2.814</td>
<td>1.8</td>
</tr>
<tr>
<td>Kuwait</td>
<td>2,595,628</td>
<td>98</td>
<td>1.986</td>
<td>2.1</td>
</tr>
<tr>
<td>Oman</td>
<td>3,027,959</td>
<td>73</td>
<td>2.023</td>
<td>2.3</td>
</tr>
<tr>
<td>Qatar</td>
<td>848,016</td>
<td>96</td>
<td>0.81</td>
<td>1.6</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>5,148,664</td>
<td>84</td>
<td>3.282</td>
<td>2.3</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>26,131,703</td>
<td>82</td>
<td>1.563</td>
<td>2.2</td>
</tr>
<tr>
<td>Yemen</td>
<td>24,133,492</td>
<td>32</td>
<td>2.647</td>
<td>4.6</td>
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</table>


While rural to urban migration is not the only cause of rapid urbanization or the growth of informal settlements, it does contribute to the growth of many cities in the region; prolonged droughts and changing precipitation patterns are driving rural farmers into cities in search of work (Tacoli, 2009). Droughts are a major disaster risk in the Arab region, affecting over 38 million people between the years of 1970 and 2009. Arid zones are prone to drought; normal conditions depend on so few rainfall events that even a small deviation can negatively affect local livelihoods. In Syria alone, the UN estimates that a recent 4-year drought drove nearly 800,000 rural villagers to makeshift camps around cities such as Aleppo, Damascus, and Homs.\(^6\)

In many cities, rapid urbanization reflects a lack of oversight and planning, as new migrants move to any areas that they can afford regardless of risk. The urban poor often

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settle in hazard prone areas, have substandard housing, and lack access to basic services and infrastructure. While the impacts of climate change will affect all urban residents, it is well documented that the urban poor are the most vulnerable. In fact, the poor are likely to continue suffering indirect losses after a disaster, such as the disruption of livelihoods, social networks, and displacement (Hardoy, and Pandiella, 2009). Vulnerable populations such as the urban poor, children, women, the elderly, and minority groups generally have a lower capacity to adapt to the impacts of climate change due to limited financial, political, social, and information resources. Social networks are critical to the adaptive capacity of environmental degradation; the dependence of poor women on livelihood activities which depend on the natural environment makes them incredibly vulnerable to climate change impacts in both rural and urban areas (Denton, 2002). In many countries, anti-migrant policies merely contribute to the vulnerability and hardships of migrants, viewing them as contributors to poverty, crime, and environmental degradation. There are however, positive effects of migration that are rarely recognized, such as an increase in local labor pool and remittances sent to rural areas (Tacoli, 2009).

Despite the significant impacts forecasted, many Arab countries are not taking climate concerns into account when building new infrastructure; an estimated 75 percent of built structures in the region are at risk of sea level rise, storm surge, and heat impacts. In urban settings, this will have negative effects on systems of transport, energy generation, water supply, and wastewater conveyance (Tolba and Saab, 2009). Urban planning, building codes, risk mapping, and zoning are all tools that governments can use to improve the safety of communities. Sadly, informal settlements lack these interventions, which ultimately make them more vulnerable to natural hazards such as climate-induce flooding.

**Overview of Urban Issues by Sub-region**

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7 See Adger et al., 2003; Moser, 1998; Satterthwaite et al., 2007
Rapid urbanization create a number of social and economic challenges such as high unemployment rates, slum proliferation, social polarization, and crime rate increase, which all result from unequal distribution of urban or national resources. Despite this, rapidly growing cities can be major assets for political, social, and economic development of a nation or region, provided that this growth is properly managed. Curitiba, Brazil is an example of this, where the city managed environmental and economic resources and concerns to improve the quality of life for all levels of society (REF). In the Arab countries, urbanization rates, economic climates, and development varies across and within sub-regions. Below, primary concerns for each sub-region are identified.

**Maghreb Countries:** This region is the only sub-region in the developing world where both the number and the proportion of slum dwellers have been steadily declining since the year 2000. Despite an urban growth rate of 2.4 percent (or an additional 2.2 million urban dwellers every year) over the past decade, the share of slum dwellers in the sub-region fell from 20 percent to an estimated 13.3 percent over the same period, or about 2.9 million in absolute numbers. This substantial reduction in the urban divide can be attributed to effective government policies for slum upgrading and prevention.

**Central countries:** This region includes Egypt, Sudan, Somalia, Djibouti, and Comoros. In these countries, the rate population growth is relatively high, the urbanization is increasing rapidly and slum areas are also increasing. Immigration from rural to urban areas has been increasing. Urbanization with infrastructure has been decreasing from north to south. In this region is exposed to varying flood conditions.

**Mashreq Countries:** The proportion of slum dwellers should be relatively low by 2010, at an estimated 24.6 percent of the urban population. In terms of slum reduction, however, the sub-region has made little progress, owing to deteriorating living conditions in Iraq, Lebanon and Jordan. The slum population in the sub-region has grown by more than half since the year 2000 (from 23 million to 36 million), as a consequence of
ongoing political turmoil, a related increase in the refugee population, and disruptions in the delivery of basic services and housing. The implications of the region’s instability are also evident in other Millennium Development Goal indicators, such as the high proportion of underweight children under 5 and the high maternal mortality rate – two indicators on which Western Asia has made little progress compared with other developing regions.

Gulf Countries: Over-urbanization, whereby populations grow much faster than urban economies, is becoming visible across the Arab Gulf sub-region (ref.). {To be completed}

Vulnerability Assessment of Urban Sector in the Arab Region

The Fourth Assessment of the Intergovernmental Panel on Climate Change (IPCC) of 2007 noted the following, all with high confidence:

- “The most vulnerable industries, settlements and societies are generally those in coastal and river flood plains, those whose economies are closely linked with climate-sensitive resources, and those in areas prone to extreme weather events, especially where rapid urbanization is occurring.
- “Poor communities can be especially vulnerable, in particular those concentrated in high-risk areas. They tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies.
- “Where extreme weather events become more intense and/or more frequent, the economic and social costs of those events will increase, and these increases will be substantial in the areas most directly affected. Climate change impacts spread from directly impacted areas and sectors to other areas and sectors through extensive and complex linkages.”

Cities by their very nature concentrate people and their homes, activities, physical capital, industries and wastes. This can make them very dangerous places to live and work and
make their populations highly vulnerable to extreme weather events or other physical
events that have the potential to be disasters. This is best seen not as inherent to cities but
as the product of unplanned development, mismanagement of resources and inadequate
governance. High population densities produce high risk through, for instance, the
dangerous conjunction of residential and industrial land uses, the lack of space for
evacuation and emergency vehicle access and potential for the spread of communicable
disease. A high proportion of lower-income groups may even exacerbate the situation by
settling on hazardous sites (for instance sites at risk from floods or landslides). They do
so because of lack of awareness and because no other (safer) land is available to them –
while also lacking access to the means to reduce their vulnerability.

Regionally, anticipated climate change impacts include, but are not limited to: (i)
Changes in precipitation patterns: decreased precipitation in the eastern Mediterranean,
and, possibly increased precipitation in equatorial Africa but the possibility of more
frequent, intense flash floods elsewhere; (ii) increased duration and intensity of droughts;
(iii) sea level rise; (iv) accelerated desertification; (v) long term salinization of both
inland and coastal aquifers; (vi) increased frequency and intensity of sand and dust
storms; (vii) increased summer temperature and decreased winter temperatures; (viii) and
lowered levels in water storage catchments (Sowers and Weinthal, 2010). In urban
areas, these climate change impacts will manifest in a variety of ways, affecting many
sectors. Increased temperature is not only expected to increase the risk of heat waves, but
also accentuate urban heat island effects, negatively affecting local health, building
systems, and livelihoods. Heat islands are urban areas of high density where the diurnal
cycles of absorption and re-radiation of solar energy from built/paved physical structures
leads to higher temperatures than in surrounding areas. Localized heating effects are
significant in the Middle East and North Africa; nocturnal temperatures have been shown
at times to be five times the median temperature and the addition of urban surfaces to the
HadAM3 global climate model demonstrated a total warming of 6.2°C (McCarthy, et al,
2010). In addition to this, higher air temperatures are often associated with decreased air
quality, and can increase demand for mechanical cooling, and thus energy. Flooding,
storm surge, and sea level rise are expected to compromise land, buildings, and infrastructure at the cost of assets and lives.

For the urban poor and those working in the informal economy, climate change challenges the security of their physical, financial, human, and social assets. Physical assets, such as land and houses, are critical to the urban poor, as 50 percent of income in poor households is generated in the home. In the context of climate change and extreme events, security of tenure increases the amount that a dweller may invest in better construction methods. In urban areas, financial assets are critical to livelihood security, as most work is wage based and most resource access results from cash exchanges (Sanderson, 2000). Even before urban areas are impacted by climate change, the urban poor tend to pay higher prices for water and food expenditures⁸. Human and social assets are also at risk, as climate change could impact the health and force migration, reducing the ability of children to seek an education, and for communities to maintain social networks. Table (2) lists how anticipated climate changes could affect urban systems and residents.

Table 2: Climate Change and Impacts in Urban Areas

<table>
<thead>
<tr>
<th>Natural Hazards and Extreme Events</th>
<th>Incremental Impacts on Urban Systems</th>
<th>Impacts on Urban Residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Increased Temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Heat waves</td>
<td>• Increased heat island effect</td>
<td>• Asthma</td>
</tr>
<tr>
<td>• Fires</td>
<td>• Increased outdoor pollution</td>
<td>• Heat stress and stroke</td>
</tr>
<tr>
<td></td>
<td>• Reduced interior air quality</td>
<td>• Thirst</td>
</tr>
<tr>
<td></td>
<td>• Increased interior temperatures</td>
<td>• Illness</td>
</tr>
<tr>
<td></td>
<td>• Reduced groundwater</td>
<td>• Property losses</td>
</tr>
<tr>
<td></td>
<td>• Changing disease vectors</td>
<td>• Housing instability</td>
</tr>
<tr>
<td></td>
<td>• Stress on storm water system</td>
<td>• Disruptions in access to</td>
</tr>
<tr>
<td></td>
<td>• Increased energy demand</td>
<td>power, transport systems,</td>
</tr>
<tr>
<td></td>
<td>• Increased road surface damage</td>
<td>and supplies</td>
</tr>
<tr>
<td></td>
<td>• Increased demand for water</td>
<td></td>
</tr>
<tr>
<td>II. Decreased Precipitation</td>
<td>• Groundwater depletion</td>
<td>• Water shortages</td>
</tr>
<tr>
<td>• Drought</td>
<td>• Subsidence</td>
<td>• Food shortages</td>
</tr>
<tr>
<td>• Fires</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Livelihoods and Living Conditions in Urban and Coastal Areas

**III. Increased Precipitation**
- Flooding
- Mudslides
- Epidemics
- Stress on storm water and sewage systems
- Stress on building foundations
- Stress on building envelope
- Slope instability
- Road washouts
- Changing disease vectors
- Exposure to new disease vectors
- Illness
- Exposure to elements from substandard construction
- Disruption of basic service provision and access to supplies
- Housing instability
- Property loss and relocation
- Community fragmentation

| Source: Adapted from World Bank, forthcoming; Carmin and Zhang, 2009; Dickson, et al., 2010; Dodman and Satterthwaite, 2008; Wilbanks, et al., 2007 |

### IV. Sea Level Rise
- Storm surges
- Flooding
- Coastal erosion
- Alters coastal ecosystems
- Impacts on wetlands
- Salinization of water sources
- Stress on water treatment systems
- Stress on storm water systems
- Disruptions to shipping and ports
- Exposure to flood-related toxins and wastes
- Disruption in availability of potable water, food, and other supplies
- Property loss and relocation
- Community fragmentation

The urban sector in the Arab region is therefore, particularly vulnerable to various impacts of the climatic changes. In particular, cities such as Nouakchott, Casablanca, Benghazi, Alexandria, Rosetta, Port Said (e.g. Senousi, 2008, El Raey et al, 1995, El Raey, 1997 and El Raey 2010), Port Sudan, Aden, Djibouti, Jeddah (SANC ), Kuwait ( ), Abu Dhabi, Dubai, Basra are all vulnerable due to direct potential impacts of sea level rise and salt water intrusion. In addition, extensive vertical and horizontal urbanization in the coastal zone in the Gulf region has extended over large areas, which makes it vulnerable to problems of land subsidence and landslides. Unfortunately, land subsidence on the coastal zone of the high rate oil extracting Gulf States has not been monitored carefully. Adaptation measures have been worked out through national communications of various countries including land subsidence in the Nile delta region (e.g. El Raey et al, 2000; Second National Communication of Egypt, 2010; Emirates second national communication, 2010). Figures 1 through 5 present maps of a variety of urban sites.
Livelihoods and Living Conditions in Urban and Coastal Areas

Chapter 5

considered vulnerable to climate change in the Arab region. The vulnerability and adaptation actions of Alexandria are highlighted in Box X.X.

Figure 1: Land Use in the western Mediterranean, highlighting a vulnerable area in Morocco

Source: Snoussi et Al, 2008

Figure 2: Digital Elevation Model (DEM) of the western Mediterranean coast of Morocco, indicating vulnerable coastal areas

Source: Snoussi et al, 2008

Figure 3: Extensive landfilling for coastal urbanization near Dubai
Figure 4: Extensive landfilling and high rising buildings in Dubai

Source: XXXXXX
Governance and Management

By nature, urban climate adaptation spans sectors and requires cooperation between multiple layers of governance. It also involves multidisciplinary criteria such as legislation, economic costs, engineering aspects and socioeconomic considerations. Implementation of adaptation measures and activities again requires integration and coordination of cross-sectoral and multidisciplinary activities.

For example, effective adaptation to sea level rise might use legislation for setback distance, engineering codes for building on the coastal area and multidisciplinary defense measures based on awareness, and socioeconomic conditions in the region. The overall implementation requires the availability of an effective monitoring and assessment system.

The word 'governance' refers to the exercise of authority on both the political and administrative levels to ensure moral, behavioral, and ethical conduct in the task of governing. Urban Governance is underpinned by seven interrelated norms: sustainability, decentralization, equity, efficiency, transparency and accountability, civic engagement.
Livelihoods and Living Conditions in Urban and Coastal Areas

Chapter 5

and citizenship, and security (e.g. Hamza, 2008). Urban planning is an essential prerequisite to attain proper adaptation to climate change in the Arab cities.

Governments in many of the Arab countries tend to be centralized. In other words, the authority responsible for taking action and implementing urban activities is concentrated at a central authority in the capital city. This means that it can often be difficult to change decisions based on particular environmental needs at the site. In addition, the coordination and/or integration among both vertical (national, regional, and local) decisions and horizontal (sectoral or across agencies) decisions among interacting sectors are, in reality, not well practiced in any of the Arab countries. Cities and national governments must work together to effectively tackle climate change; this can be facilitated by a framework for understanding the linkages across multiple levels of government with the private sector and non-governmental stakeholders.

The decentralization of authority and resources has been demonstrated to be an important means of improving stakeholder participation. Local authorities are closest to their citizens, enabling them to understand their needs, and hence are in the best position to involve them in the decision-making process and in consultation. At the same time, struggles concerning resources at the local level may exclude some citizens rather than to encourage them to participate. Equity in the city implies proper representation as well as equal access to resources. Equity of access to decision-making and the basic necessities of urban life are necessary for proper urban governance.

An effective framework of governance in Arab cities should be based on multilevel governance that makes use of linkages between national, regional and local policies as well as coordination among vulnerable sectors. Such a framework integrates vertical governance between various levels of government, with horizontal governance across multiple sectors at the same level of government, including engagement with non-governmental actors. It also lays out a framework to explore good practices in the area of
multi-level governance and climate change, laying out a number of sub-themes and questions for investigation.

Multi-level governance is a critical issue for national governments. A key issue for national policy makers is what they can do to empower cities to become more effective in the design and implementation of policies for mitigation and adaptation to climate change. These include policies driven from the top by national or regional governments as well as activities and measures taken by local policy approaches and innovations that may subsequently be scaled up to regional or national responses. A hybrid of the two frameworks provides top-down incentives and guidance while leaving room for city-level leadership and innovation may be most effective. Partnerships with civil society are important feature in the hybrid framework. Climate priorities also call on national governments to integrate adaptation goals into national and regional development policy frameworks.

Particular attention needs to be paid to coastal urbanization in the Arab region due to its sensitivity and increasing pressures on the coastal region. Many of the coastal cities of high population density in the Arab region are located on a low elevation area that makes them highly vulnerable to sea level rise and salt water intrusion. In addition, the expected increasing frequencies and severities of extreme events with climate changes, such as flash floods and storm surges are expected to exacerbate coastal problems. To date there are few examples of actual enforcement or practice of Integrated Coastal Zone management (ICZM), including participation of stakeholders, in the Arab region as a whole.

The Worldwide Governance Indicators (WGI) measure six components of governance, including the Voice and Democratic Accountability (V&A) indicator. According to Daniel Kaufman of the Brookings Institute, “the V&A indicator measures not only whether countries hold elections, but also whether these are truly contested, legitimate, free and fair, whether the government is accountable to its citizens, and whether there are
basic freedoms of expression and association, including protection of media freedoms, of
civil society, and against human rights abuses” (2011). As a region, the Middle East and
North Africa rate very poorly in V&A, relative to the rest of the world, with very few
exceptions.\textsuperscript{9} Figure 6 compares the V&A indicators for 2000 and 2009 in the Middle
East and North Africa region, showing that V&A in most of these countries have
dropped over the last decade.

\textbf{Figure 6: Voice and Accountability}

\begin{center}
\includegraphics[width=\textwidth]{voice_and_accountability.png}
\end{center}

\begin{footnotesize}
\begin{itemize}
\item For each country, the top bar (in blue) displays 2009 data, while the bottom bar (orange) displays 2000 data. Margins of error are not shown here (they can be found in the WGI website); yet they remain relevant, thus on occasion differences in ratings are not statistically significant.
\end{itemize}
\end{footnotesize}

In addition to the challenge of accountability, corruption within government is another
challenge faced in environmental management and climate adaptation. In the Arab
region, corruption in city management is manifested in a variety of ways, including non-

\textsuperscript{9} http://www.brookings.edu/opinions/2011/0202_egypt_development_kaufmann.aspx
compliance with adopted and approved plans of development in land use, site selection of projects and heights of buildings, and many other regulations. The shortage of a strong institutional capability for urban monitoring and assessment, in addition to administrative national and local corruption, are major problems. For proper adaptation to a changing climate, governing institutions and authorities need to be transparent, active, and responsible. Policy and climate change awareness among citizens and community can help enforce accountability at the local level.

For example, Figure 7 presents illegal landflling of the River Nile near Rosetta City. The original channel is shown in blue, while illegal landfill areas are shown in red, and illegal fish cages are shown in pink. Driven by urban property values, the illegal landfill areas created new government-owned land which was subsequently sold to build slum communities along the River. These unregulated slum communities place their residents at risk for low-level flooding, and demonstrate how lack of accountability in governance increases both exposure and vulnerability to climate hazards. In the case of Rosetta City, this type of illegal development has continued for over 20 years. Urban development in the Arab world will need to take into account serious considerations of proactive urban planning, transparency, and risk preparedness. All require the capacity of strong institutional monitoring, assessment, and feedback.

**Figure 7:** A change detection analysis of the River Nile.
Funding Urban Climate Adaptation

It is very difficult to estimate the cost of adapting urban infrastructure to climate change if there is no infrastructure there to start with. If adaptation action is applied now, there will be large cumulative benefits and large cost savings, including avoidance of premature death, injury and property loss.

Several recent studies have estimated adaptation costs for climate change for developing countries. While the studies are valuable preliminary efforts, uncertainties and the exclusion of key sectors has likely led them to under-estimate adaptation costs. Examples include: (i) some sectors have not been included in an assessment of cost (e.g. ecosystems, energy, manufacturing, retailing, and tourism); (ii) some of those sectors which have been included have been only partially covered; and (iii) the additional costs of adaptation have sometimes been calculated as ‘climate mark-ups’ against low levels of assumed investment. In many parts of the Arab region shortage of investment have led to a huge adaptation deficit, this deficit will need to be made good by full funding of development, without which additional funding for adaptation will be insufficient.

Residual damages also need to be evaluated and reported because not all damages can be avoided due to technical and economic constraints (Martin Parry et al, 2009). Estimates
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of the urban adaptation cost include adaptation of various serving sectors such as energy, water, food, waste, industry and tourism

Measures to reduce greenhouse gas emissions, improve air quality, and adapt to expected climate change impacts will put additional pressure on city budgets and increase the need for additional public resources. Opportunities to reform existing sub-national and national revenue sources as well as new forms of financing for urban climate change initiatives are necessary. A number of existing fiscal instruments and incentives are already at cities’ disposal, including taxes, fees and grants. These could be considered as soft instruments for achieving adaptation to climate change and urban sustainability. Carbon markets and access to financial capital may emerge as promising new funding sources, particularly if national and international policy makers decide to adapt them to better accommodate the multi-sectoral nature of many urban adaptation projects.

3. Making resilient cities: Sectoral approaches

Cities face many challenges in relation to climate change, including the broad range of possible impacts and uncertainty, location and socioeconomic vulnerability, and the governance and institutional organization issues discussed in the previous section. As the effects of climate change are cross-sectoral in nature, different institutions will have varying degrees of responsibility to adapt to climate change. The following section discussing vulnerabilities and adaptation options by sector, including urban planning, building construction, urban and coastal drainage, water supply management, solid waste and sanitation, transport, energy, tourism, and disaster risk management.

Urban planning

The Arab city has been transformed from a humane fabric which is pedestrian in scale, harmonious and integrated in terms of urban space, into a new and inhumane fabric that can be defined as vehicular and monumental in scale and spatially fragmented as a result
of global urbanization processes. The effect of this on transportation options (walking versus cars)...

**Figure 8:** Changing urban fabric of Damascus

19th century: about 500 inhabitants per hectare, mostly one and two story structures
1880-1910: about 300 inhabitants per hectare; mostly two story structures
1920-1940: about 200 inhabitants per hectare; mostly three story structures
1950-1960: about 200 inhabitants per hectare; mostly four and five story structures

Source: Adapted from Abdulac 1983.

In cities throughout the Arab region, unsustainable land use occurs due to a high demand for limited land and resources. The expansion of cities into flood plains, wadis, wetlands, and water catchments endangers not only local residents, but also the city as a whole as; these areas are the natural safeguards against flooding. Hillside deforestation and development increases the amount of water runoff and can lead to landslides, a secondary hazard. The urban poor, priced out of more desirable areas, frequently create informal settlements in marginal lands such as these, making them the first to suffer the consequences of a disaster event (Huq, et al., 2007). In developing countries, poor urban planning policies and administration can exacerbate these problems. Without the resources to settle in desirable and secure locations, and with ill-regulated land use, poor migrants make their homes along waterways and in lowland areas previously used to absorb excess rainfall.

Unregulated development in Arab countries is a trend which is continuing. Large cities in Tunisia, Algeria, and Morocco are surrounded by unplanned, shantytowns known as
bidonvilles. In Aleppo, Syria, rapid urbanization has led to an increase in informal settlements....

Major reductions in the vulnerability of cities can be made through informed infrastructure improvements and good urban governance. Poor land governance, such as unsustainable land use, poor urban planning, and weak land administration can be used to predict land system vulnerability (United Nations Human Settlements Programme, 2010).

An ongoing World Bank study, begun in September 2008, is currently investigating the affects of climate change on the coastal urban areas of Alexandria, Tunis, Casablanca, and the Bouregreg Valley urban expansion area between the cities of Rabat and Salé. Representative of other coastal cities in the region, ...

Land use is "the total of arrangements, activities, and inputs that people undertake in a certain land cover type" (FAO, 1997a; FAO/UNEP, 1999)....

Table 3 contains a number of land use classifications used in vulnerability assessments...

<table>
<thead>
<tr>
<th>S. No</th>
<th>Class</th>
<th>Class Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Agriculture</td>
<td>Covered with cropland, fields with definite boundary and pattern.</td>
</tr>
<tr>
<td>2.</td>
<td>Airport</td>
<td>Includes airstrips or helipads</td>
</tr>
<tr>
<td>3.</td>
<td>World Heritage Site</td>
<td>World Heritage sites recognized by UNESCO</td>
</tr>
<tr>
<td>4.</td>
<td>Commercial</td>
<td>Multi storied commercial buildings, retailing shops etc.</td>
</tr>
<tr>
<td>5.</td>
<td>Dense Urban</td>
<td>Includes developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial complexes. Impervious surfaces account for 80 to 100 percent of the total cover.</td>
</tr>
<tr>
<td>6.</td>
<td>Dense Vegetation</td>
<td>Areas characterized by dense tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25-100 percent of the cover.</td>
</tr>
<tr>
<td>7.</td>
<td>Industrial</td>
<td>Covered mainly with factories and industries manufacturing goods. Covering large</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>8.</strong></td>
<td>Low Urban</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td>Open Land</td>
</tr>
<tr>
<td><strong>10.</strong></td>
<td>Parking</td>
</tr>
<tr>
<td><strong>11.</strong></td>
<td>Public Parks</td>
</tr>
<tr>
<td><strong>12.</strong></td>
<td>Residential</td>
</tr>
<tr>
<td><strong>13.</strong></td>
<td>River</td>
</tr>
<tr>
<td><strong>14.</strong></td>
<td>Roads</td>
</tr>
<tr>
<td><strong>15.</strong></td>
<td>Skyscraper</td>
</tr>
<tr>
<td><strong>16.</strong></td>
<td>Sparse Vegetation</td>
</tr>
<tr>
<td><strong>17.</strong></td>
<td>Squatters</td>
</tr>
<tr>
<td><strong>18.</strong></td>
<td>Sub Urban</td>
</tr>
<tr>
<td><strong>19.</strong></td>
<td>Urban</td>
</tr>
<tr>
<td><strong>20.</strong></td>
<td>Water bodies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spatial Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Urban</td>
<td>Low density of buildings with some vegetation within the yards; vegetation is also seen along the roads, more open areas are lying in-between the houses.</td>
</tr>
<tr>
<td>Open Land</td>
<td>Vacant or un used areas in built up or agricultural areas.</td>
</tr>
<tr>
<td>Parking</td>
<td>Facilities for stopping vehicles for brief time</td>
</tr>
<tr>
<td>Public Parks</td>
<td>Open spaces provided for recreational use, usually owned and maintained by a local government</td>
</tr>
<tr>
<td>Residential</td>
<td>Includes areas covered with residential houses; may vary from apartments to single owned. Well defined pattern of house, surrounded with trees and grass cover.</td>
</tr>
<tr>
<td>River</td>
<td>Linear water features like streams and rivers.</td>
</tr>
<tr>
<td>Roads</td>
<td>All types of motorable roads and streets.</td>
</tr>
<tr>
<td>Skyscraper</td>
<td>High Rise buildings (&gt;40m), specially apartments or buildings with facilities like parking, swimming pools etc.</td>
</tr>
<tr>
<td>Sparse Vegetation</td>
<td>Low and scattered vegetation, thin density of forest, bushes, scrubs with low tree density.</td>
</tr>
<tr>
<td>Squatters</td>
<td>Informal Settlements in and around Urban Areas (irregular pattern in appearance)</td>
</tr>
<tr>
<td>Sub Urban</td>
<td>Mostly singly owned residential areas on the outskirts of the city having low population density. Impervious surfaces account for 40 to 50 percent of the total cover.</td>
</tr>
<tr>
<td>Urban</td>
<td>Includes developed areas of medium density where people reside or work. Impervious surface account for 60 to 70 percent of total cover.</td>
</tr>
<tr>
<td>Water bodies</td>
<td>This class consists of confined water bodies (smaller scale), lakes, reservoir and dams.</td>
</tr>
</tbody>
</table>


National and city governments have several choices to increase the resilience of urban settlements. First, national and city governments can discourage the placing of dwellings in hazardous locations through zoning, and enforce building regulations. Site selection concerns include not only limiting residential expansion in hazardous areas, but also limiting critical public infrastructure such as schools and hospitals. Second, governments could incentivize the adoption of better building practices through free training or the provision of financial resources. Third, in the case of areas too hazardous for inhabitation, the assisted relocation of households may be necessary. Resettlement is the least desirable option in this case, as relocation can do great harm to a social and community networks. [Include example of relocation challenge]

Table ( ) includes a list of public and environmental assets that should be considered during site selection.
Table 4: Sensitive assets to consider during site selection

<table>
<thead>
<tr>
<th>Major Infrastructure</th>
<th>Roads, water supply, sanitation, sewerage, bridge, docks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Infrastructure</td>
<td>Hospitals, fire stations, police stations, government offices, schools</td>
</tr>
<tr>
<td>Major community structures</td>
<td>Religious, markets, historic structures</td>
</tr>
<tr>
<td>Major environmental</td>
<td>Coastline, wetlands, water bodies, conservation areas, brownfields</td>
</tr>
</tbody>
</table>

Building Construction

Traditional Architecture

Due to the prevailing high temperatures common the North African and Middle East region, many forms of adaptation of building structures are common for hundreds of years.

For example, in the hot-arid regions of North Africa, Kasbahs in southern Morocco are fortified dwellings built out of adobe mainly located. The climate in these regions is harsh, with an average daily maximum of 104°F and reaches 109°F in the summer.

Minimum temperatures reach 44°F in Cold months such as January. Humidity varies from 10 percent in the hot months to 50 percent in other months.

Typically, these Kasbahs have small size windows and are built usually high and very close to each other. The town that counts several of these dwellings is called a kasr (pl. ksours), a type of fortified village. These Kasbahs are a skillful adaptation to the harsh climate in the hot-arid region. Indeed, the primary purpose of these constructions was to protect the inhabitants and the animals from the extreme sunny days of the summer.

Figure 9: Vernacular Architecture in the region was well designed to deal with hot and arid conditions.
In addition to Kasbahs, the takhtabush, another type of North African and Middle Eastern houses make extensive use of shading devices and privacy screen, which also help regulate the climate inside the house. The *mashrabiya* for instance is also widely used wooden lattice screen composed of very small wooden balusters round in section. The name mashrabiya is derived from the word “drink” in Arabic. The mashrabiya was originally a “drinking place” where jars of water were placed to be cooled by the evaporation effect when air moves through the space.

**Figure 10:** Example of a Mashrabiya
The mashrabiya has many different functions among which: controlling the passage of light, controlling air flow, reducing the temperature of the air current, increasing humidity of the air current and assuring a great amount of privacy (Naciri, 2007).

According to Hassan Fathy, a renowned Egyptian architect, the south sunlight entering a room has two components: the direct high-intensity sunlight and the lower intensity reflected glare. The mashrabiya’s interstices both intercept the direct solar radiation and soften the uncomfortable glare. In addition, considering that the mashrabiya is made of out wood, it helps regulate the humidity inside the space.

It is known that wood absorbs, retains and releases water. When air passes through the interstices of the porous wooden mashrabiya it vaporizes some of the moisture gathered in the wood and carries it towards the interior. Other widely used screening devices are the clastra. The *claustrum* is a multitude of small vents made out of plaster. These allow a uniform distribution of air flow, provide security and have a good aesthetic value. They are typically used on the higher section of the wall in order to allow the dissipation of hot air. Box X.X further explores the regional appropriateness of Fathy’s work.

[More discussion on the difficulties of achieving “ideals” described above – i.e. proper planning, effective design, stakeholder engagement etc]
Building codes
Current trends in the Construction and Building Sector in the Arab Region (El-mallah, 2008):
The Construction and Building Sector is considered as one of the important sectors of the Arab economy. In 2005, this sector achieved about 8 percent of the Arab GDP and employed about 7 percent of Arab manpower. Most building materials are available in the Arab Region in different quantities, types, degrees and abundance and quality levels.
The Arab Cement industry is one of the industries that have largely evolved during the last two decades. Huge amounts of cement are being exported to different Arab and international markets and the production of a large number of cement factories is directed wholly to exportation. This goes in line with the developed countries' tendency to localize polluting industries in developing countries, including Arab countries where foreign investments in the cement industry are growing.
The Ceramic industry is relatively new in the Arab Region. It has also greatly developed during the last two decades. This industry is also supported by foreign investments aiming at locating polluting industries in the Arab countries. In spite of the spread of the building materials industry in the Arab Region, yet some building materials do not cover the needs of the Building and Construction Sector, such as iron and steel, other metallic products and glass.

Some Arab countries have adopted a number of encouraging policies that aim at improving and developing the Construction and Building industry and linking the industry and its needs with the research plans of specialized scientific centers and institutes. Some Arab countries pay special attention to training good professional and technical labor in order to sustain the quality of the industry and profession in a way that goes in line with the development in technologies. Some Arab countries have taken positive steps towards optimal use of resources and the achievement of sustainable construction and sustainable urban development through transforming the unilateral thought into a comprehensive perspective that takes into consideration all sectors that affect Construction and Building. Some Arab countries increasingly tend to encourage the concept of decentralization in the sustainable planning and management of land uses.
Some Arab countries, such as XX and XX, have achieved a tangible success in developing policies for limiting the spread of slums starting from their removal, to their integration into urban development projects.

**Heat waves, urban heat islands and the possible role of “green buildings” in combating them.**

Heat waves in cities are exacerbated by the so-called “urban heat-island” effect. Heat islands result from lowered evaporative cooling; increased heat storage and sensible heat flux caused by lowered vegetation cover, increased impervious cover and complex surfaces, and possibly from heat trapping by elevated levels of locally produced CO₂. Individual cities show a large heat-island effect, measuring up to 5–11°C warmer than the surrounding rural areas. Wider urban sprawl further exacerbates the effect which can cause dramatic impacts on urban health. The most striking example was the extended period of record of high temperatures experienced in Europe in summer 2003, which was made significantly more likely by human induced climate change. This caused excess mortality of over 35,000 people within a 1- to 2-week period. Global trends toward higher and increasingly variable temperatures are expected to further increase the frequency of heat waves. While the effects in temperate developed regions may be partly compensated by lower winter mortality and adaptation, poor populations in tropical developing cities do not show such compensation.

Analysis of long time series of meteorological data of some cities (e.g. Alexandria) has revealed a general increase of the trend of heat waves with time. In addition, due to extension of urbanization and population growth, extensive energy consumption and needs for air conditioning due to temperature increase, it is expected that an increase of heat islands effect will continue, with its potential impacts causing damage of urban infrastructure of roads, buildings and facilities.

**Figure 11:** Diagram illustrating the concept of urban heat island effect
Urban flooding: Coastal and drainage concerns

Exponential urban growth and increased climactic shocks have contributed to an increased vulnerability to flooding in the developing world, even in arid regions. Urbanization processes decrease the natural ability of ecosystems to manage heavy precipitation. The removal of ground cover, deforestation, the excessive drying of soil, and paving decreases the permeability of the soil. In turn, the rate of offsite flow increases, decreasing aquifer recharge and increasing sediments in nearby waterways.

There are four major sources of flooding in the urban areas: (i) coastal flooding, (ii) major rivers, (iii) small streams, and (iv) inadequate drainage (Douglas et al 2008). Coastal flooding is any type of flooding from the sea, including high tides, storm surge,

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and high level flows from rivers while sea level is high due to tides and storm surge affecting deltas and estuaries. Frequently, coastal areas are of a low elevation and prone to subsidence, thus making them more susceptible to sea level rise. As mentioned, the majority of population in the Arab region is located in coastal zones. Cities such as Tunis, Alexandria, Beirut, Nouakchott, and Dubai will be vulnerable to coastal flooding. While inland communities may be spared sea level rise, the flooding from major rivers can impact them. Khartoum, Cairo, Sana’a, Damascus, and Baghdad (1954) are all cities with a history of riparian flooding.

Small streams, as well as dry wadis, whose catchment areas lie entirely within built-up areas, are of particular concern; they have a tendency to rise quickly after a heavy rain and are typically clogged with debris and urban waste. Land use changes and culverting of urban waterways further decreases the absorption capacity of these streams. Finally, localized flooding occurs in urban areas where there are too few drains, or too limited capacity to deal with heavy precipitation. Like small streams, solid waste and sediments can block storm water drains, impeding the flow of water from the impacted area and increasing area pollution. Inadequate drainage contributed significantly to the 2009 flooding in Jeddah [more info?].

Figure 12: Flooding in Jeddah

Urban flooding is a complicated issue, and in a changing climate, policy-makers may not be aware of how development can impact future flooding. Urban flooding can destroy livelihoods, as [ ]. There are structural, social, and institutional measures that can minimize the impact of flooding on urban and coastal residents.

Flood prevention structural investments to prevent coastal and riparian flooding include dikes, sea walls, and [. . .].

Social investments...

Institutional investments...

**Storm Surges**

Dasupta et al have estimate potential effects on the coastal zone of the Arab countries and have reached the following vulnerability comparison (2009):

**Figure 14:** Percentage increase in storm surge zone in MENA region
Figure 15: Damage of the urban environment due to the storm surge in Alexandria 2010

Source: XXXX

Salt Water Intrusion

The impact of salt water intrusion and increasing salinization on the foundations of urban structures and lifetimes of buildings cannot be overlooked. In addition, salt water
intrusion would affect availability of groundwater resources for urban needs such as the
situation in Emirates. This phenomenon is especially acute in low land of the coastal
areas and particularly old cities such as Rosetta City in Egypt and {…}.

**Water supply in Cities**

The IPCC has projected that climate change will negatively affect water availability for
urban water supply systems. Higher temperatures and reduced precipitation are expected
to cause supply shortages due to the slower replenishment rates of groundwater aquifers
and reduced surface water. 12 Water supplies may change drastically by 2030, with wide
variation both between and within countries. As covered in chapter 3, water resources in
the Arab countries are already scarce and cities struggle to supply adequate water to their
populations. Due to overexploitation of ground water through private wells, Sana’a may
be the first city in the world to run out of water. 13

Compounding the effects of climate change and urbanization, many cities fail to
properly maintain water utility network. Without routine maintenance, the operational
life of aging water infrastructure and networks may be exceeded, resulting in perpetually
increasing maintenance costs. In rapidly urbanizing areas, unauthorized taps, unmetered
usage, and growing demand can outstrip supply; poor maintenance can lead to substantial
loss through leakage. 14 Additionally, leaking water distribution systems can also lead to
cross contamination and ground instability. Leaking in the water network of Riyadh,
which imports water from some distance, has increased subsurface water levels, and
thereby the water levels in Wadi Hanifah. 15 Infrastructure investments can rehabilitate
and modernize water infrastructure to match grow population 16. Institutional
strengthening can lead to improved planning, regulation, and financing instruments.

[review chapter 3 for overlap]

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14 Alavian et al., 2009: 100.
15 Wheater
16 Alavian et al., 2009: 70-73.
Solid waste and Sanitation

Solid waste is a sector that offers opportunities to both mitigate and adapt to climate change. On the mitigation side, nearly 5 percent of global green house gas (GHG) emissions (1,460 mtCO$_2$e) in 2010 came from post-consumer waste. As mentioned in the urban flooding section, inefficient solid waste management contributes to poor drainage and overall environmental degradation. Globally, up to two-thirds of the solid waste is not collected, and most often municipal authorities focus their limited budget to solid waste collection in wealthy and politically connected neighborhoods. Perversely, while waste generation varies as a function of affluence; it is often the poor who suffer from the impacts caused by poor waste management practices.

All forms of solid waste management present political, economical, or environmental challenges. While middle and high-income communities can explore a wide variety of waste management options such as source reduction, collection, recycling, composting, incineration, or landfills, low-income cities frequently depend on informal recycling and waste dumping. In low-income countries, collection costs can represent up to 90 percent of the municipal waste management budget, leaving very little for waste disposal. Each waste management method presents its own challenges: (i) waste collection is expensive and the collection vehicles generate carbon dioxide, (ii) waste incineration is expensive, generates carbon dioxide, and creates air pollution and ash, (iii) landfills require land, are often placed in areas inhabited by the poor, and contribute methane to the atmosphere. Carbon dioxide is the most common GHG, methane is the second. In Cairo, the burning of waste creates black clouds.

A number of policy options can be used to encourage waste reduction, and thereby reducing GHG emissions, drain blockage, and health issues. These include public education, pricing mechanisms, and technology options. The most wide-reaching approach is to prioritize public education on waste reduction, recycling, and composting.

Pricing mechanisms may be used on both the front and back end of product life to cover

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17 Hoornweg et al, 2010: 40.
the cost of waste management; it can be added to the purchasing price and collected as a
tax or charged by the quantity of waste disposed. Finally, investments in waste
management technology can reduce emissions. In many ways, the improvements in waste
management through appropriate technology can have profound impacts on quality of
life. In Abu Dhabi and other Arab cities, ‘grey water’, or treated sewerage, is being used
to water green spaces and \[\ldots\]. This is discussed in Box X.X.

Table 5 outlines a number of technology options in the waste sector. While many focus
no mitigation, they feature many adaptation benefits as well.

Table 5: Technical Opportunities by Waste Management Component

<table>
<thead>
<tr>
<th>Waste Management Component</th>
<th>Technology Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Reduction</td>
<td>Longer life and more durable products, reusable products, reduced consumption.</td>
</tr>
<tr>
<td>Waste Collection</td>
<td>Use of alternative, non-fossil fuels (bio-fuel, natural gas).</td>
</tr>
<tr>
<td>Recycling/Materials Recovery</td>
<td>Materials recovery facility (MRF) to process source separated materials or mixed waste, although source separated is the preferred option as the materials would have less contamination from other discards. MRFs use a combination of manual and mechanical sorting options. Waste pickers could be used as a source of labor for manual sorting stages.</td>
</tr>
<tr>
<td>Composting/Anaerobic Digestion</td>
<td>Institute composting programs ideally with source separated organics from markets and residential sources. As with recyclables source separated materials reduce the contamination associated with recovery from mixed waste. Compost the organic material after digestion to produce a useful soil conditioner and avoid landfill disposal. Compost added to soils is also an important method to reduce GHG emissions by reducing nitrogen requirements and emissions.</td>
</tr>
<tr>
<td>Incineration / Waste-to-energy / Refuse–Derived Fuel (RDF)</td>
<td>Use the combustible fraction of waste as a fuel either in a dedicated combustion facility (incineration) with or without energy recovery or as RDF as a fuel in a solid fuel boiler.</td>
</tr>
<tr>
<td>Landfill</td>
<td>Capture the methane generated in disposal sites and treated in a flare and/or use as a renewable energy resource.</td>
</tr>
</tbody>
</table>


Transport

[This section is incomplete and welcomes input]

The large distances encountered inside and between cities in the Arab region necessities
the existence of a strong public transportation system. The daily need of the whole
population to adequate transportation system is an essential aspect of life in urban
environment. A public transportation system is therefore a necessary prerequisite for any structured development.

Demand versus supply issues related to CC
Floods are the most devastating aspect in urban environment of the Arab region... flood / heat impacts on roads... Air quality in the urban environment is an essential indicator of the quality of life. Very limited examples of monitoring of air pollution in Arab urban cities of Cairo, Alexandria, Jeddah exist

Congestion in city centers – evacuation routes

**Energy Systems**

[This section is being reworked to emphasize adaptation and welcomes input]

Rapidly expanding populations, economic growth, and widespread subsidies have contributed to a rising demand for energy in the Arab world since the early 1990s. Normally, there are disparities among Arab countries on levels of energy per capita and energy intensity. The energy sector has adverse impacts on air, water, land and marine resources, and contributes to global climate change (Gelil, 2008). On the other hand, the Arab energy sector, the largest economic sector contributing 40 percent of the Arab’s total GDP, has played and will continue to play an important role in both the region’s and the global economy.

In addition to satisfying energy needs for urban, economic and social development, it is the source of oil and gas export revenues estimated as 419 billion US$ in current prices of 2006. The proven reserves of crude oil in the Arab countries is accounted for nearly 58 percent of the world’s total, while those of natural gas were estimated at about 30 percent of the world proven reserves. According to the IEA, Saudi Arabia topped the world lists of oil producers and exporters, while Qatar ranked fourth of the Gas exporters in 2007.

The Arab urbanization is heavily dependent on oil and gas to meet their domestic energy demand. Oil contributes about 54 percent of the total demand and the share of gas represents about 44 percent, while other resources such as hydropower, coal, and renewable resources represent only about 2 percent.
In spite of the vital role of the energy sector in the urban development of the Arab countries, the sector has been faced with several challenges that can affect its contribution to the achievement of sustainable development in the region. These challenges are:

1. First, energy accessibility to some segments of the poor and rural population in some countries such as in Morocco, Algeria, Sudan, and Palestine.
2. Secondly, the large disparity in per capita energy consumption and energy intensity within and among those countries, and
3. Thirdly, the challenge of relying heavily on fossil fuels to meet energy needs with their associated air quality and greenhouse impacts.

In recognition of the above challenges, countries in the region have been continuously revising their policy framework aiming at promoting sustainable management of the energy sector. Varying degrees of progress have been achieved regarding the relevant key energy issues, particularly on improving energy efficiency using cleaner fuels, promoting renewable energy and enhancing regional energy integration. The efficiency of energy production and consumption patterns in the region requires improvement. Though the per capita energy consumption in the GCC sub-region are among the world’s top list, more than 40 percent of the Arab population in rural and urban poor areas do not have adequate access to energy services. It is also noted that almost one-fifth of the Arab population relies on non-commercial fuels for different energy uses.

Stabilizing the composition of the atmosphere requires the re-establishment of the balance between carbon emissions and the capacity of ecosystems, through abating emission sources, and growth of vegetable biomass to absorb them. The region has an opportunity to participate in the global efforts to control greenhouse gases by developing low emission energy sources (solar, wind and hydraulic energy) as well as enriching existing ecosystems that have the capacity to absorb carbon emissions. Achieving this transition would require the technical cooperation and financial support within the region and developing joint strategies and permitting competitive pricing for carbon emission interchange.

In 2007 an initiative is commissioned with earmarking of $750 million by Kuwait, Qatar, Saudi Arabia, and UAE to finance adaptation and emission abatement measures to
counter the effects of climate change on these countries. The fund is intended to increase
the use of more efficient technology to protect the local, regional, and global
environment. It supports the development of technologies to remove and sequester
carbon, as well as to facilitate the transfer of environmental technologies from advanced
countries to the developing countries.

Several projects are being implemented in Arab cities to enhance carbon sinks through
afforestation and carbon dioxide CO₂ capture and storage. The Greater Cairo Ring Road
afforestation project will help improve the air quality of Cairo; the forest is irrigated by
treated agricultural drainage water and is estimated to absorb 100,000 tons of CO₂eq
annually, helping to offset the carbon emissions from vehicles, industry and power plants.

Another remarkable afforestation experience is in the UAE where over 92,000 hectares
have been planted with forest trees which help in reversing desertification and in
stabilizing atmospheric gases. Another pioneering initiative in the UAE is the
construction of the world’s first zero-carbon, zero-waste and car-free-city in Abu Dhabi,
named Masdar City. Solar panels and solar collectors on roofs will generate enough
electricity to meet most of the city’s electricity needs. Water will be provided through a
solar-powered desalination plant. Landscaping within the city and crops grown outside
the city will be irrigated with grey water and treated wastewater produced by the city; the
project will be completed by 2012 (Hamza, 2008).

Some Arab countries such as Egypt, Syria, Saudi Arabia, Algeria and Morocco have
developed energy conservation programs of their own.

Arab cities depend on fossil fuel and hydropower for their power. [Need discussion of
vulnerability of energy infrastructure. Impacts on Hydro. See ESMAP recent
publication]

[Energy access is core to adaptation. How much consideration of climate change &
adaptation in design of Masdar City?]

Where are Arab cities getting their energy from? How will this be affected by climate
change?

Renewable Opportunities...
Actions that enhance rather than reduce vulnerability to impacts of climate change, can include the shifting of vulnerability from one social group or place to another; it also includes shifting risk to future generations and/or to ecosystems and ecosystem services. In many cities, investments for development are being made in a climate maladaptive rather than adaptive way. Removing maladaptation is often the first task to be addressed even before new adaptations. The lack of awareness of most of the vulnerable stakeholders is often the main cause of maladaptation.

An example of maladaptation is the excessive use of air conditioning in urban areas to cope up with increasing average temperature. Excessive use of air conditioning over consumes energy and exacerbates temperature rise leading to creation of heat islands and contributing to air pollution trapping. [This needs to be expanded and better justified]

**Tourism and Cultural Heritage**

[This section welcomes input] Climate change will impact both the physical structures and traditional lifestyles. Many important examples of historic sites exist within the urban conglomerate in the Arab coastal zone. Most of these sites are vulnerable to potential impacts of salt water intrusion (e.g., Khamis, 199?) and need attention for protection and conservation. Tourism is a significant economic sector in some Arab countries that will be very vulnerable to climate change. An increase in average temperatures may cause a decrease in tourism and hence directly peoples’ livelihood, mainly because of hotter summers, extreme weather events, water scarcity and ecosystem degradation. Bleaching of coral reefs will affect tourism particularly in countries in the Red Sea basin. Beach erosion and sea level rise already has had severe impacts on some resort areas in the region (e.g., in Tunisia). It is very likely that it will affect other coastal tourist destinations in the Arab region as well, especially in locations where beaches are narrow and buildings are close to the shoreline.

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19 See GTZ (2009) on climate change and tourism in Tunisia.
Public awareness

Livelihoods

Coral Bleaching

Other options for tourism – green economy – innovative ideas to attract people if source of tourism is loss (Consult section in Arab action plan) Case study: Lebanon skiing, hotels are organizing nature walks to attract people

Disaster Risk Reduction and Management

(This section welcomes input)

The link between climate change and natural hazards are clear. The IPCC has stated that the climate change will bring an increase in the intensity and frequency of extreme weather events, including hot, cold, and precipitation extremes.\textsuperscript{20} Disasters are the combination of hazards, exposure, and vulnerability. The increasing exposure to hazards, brought on by climate change combined with the vulnerability of increased asset and livelihood losses and the exposure of urban systems makes disaster mitigation planning necessary. In developing countries, disaster shocks undermine poverty reduction in all socio-economic groups, increasing inequalities faced by women, the poor, ethnic minorities, children, and the elderly. The Hyogo Framework for Action (HFA), signed in 2005, has increased the level of proactive investment in the assessment and management of risk around the world. Since then, there has been a call to ensure that disaster risk management efforts are also climate smart.\textsuperscript{21}

\begin{footnotesize}
\textsuperscript{20} IPCC, 2007
\textsuperscript{21} IDS, Climate Smart Disaster Risk Management
\end{footnotesize}
As a whole, the Arab region has always been vulnerable to a wide range of natural hazards such as earthquakes, tsunamis, tropical cyclones, landslides, fires, drought and flooding. A comprehensive analysis of disasters in North Africa between 1975 and 2001 (ref) showed that floods affected 230,000 in Egypt and upwards of 50,000 people in Algeria, while droughts in Morocco affected 275,000. Flooding also caused high death tolls in Egypt (673) and Algeria (1,201). The vast majority (921) of flooding deaths in Algeria took place in Algiers, in 2001. For five days in November, flash floods ravaged the city causing approximately US$300 million in economic losses. The high vulnerability was attributed to development in flood prone areas, high population density, lax building standards, poorly-built housing, and grave administrative errors. Since that time, flooding and drought have, in fact, been increasing across the Arab world. Figure 16

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surveys hydro-meteorological and temperature related disaster events which impacted urban areas in the region in the last decade.

Climate change is most likely to increase the both frequency and intensity of hydro-meteorological and temperature related disaster events, while urbanization of low lying and coastal areas increases the exposure of populations. While the importance of site selection, building codes, and general service provision in reducing vulnerability have been discussed, three key areas can further mitigate climate related disaster: coastal protection, early warning systems, and evacuation planning.

“hard measure” Coastal marine defenses, these include sea-walls, embankment dikes, beach nourishment to protect against sea-level rise, coastal erosion and storm surges.

risk of overconfidence –

Response and preparedness

Early warning systems & Evacuation planning – examples of cities with heat warnings, flood evacuations – economic valuation
4. Conclusion

Main Messages:

1. Most of the Arab cities suffer from shortages of clean water resources, sewerage systems and proper wastewater treatment facilities, congested traffic and air pollution and shortage of proactive planning. It also suffers from extensive informal settlements and shortage of institutional capabilities for monitoring and enforcements of planning (El Kholey, 2010).

2. Most of the Arab cities, especially those on the coast, are still lacking preparation or even considerations of climate change. Already existing governance capabilities, awareness and information availability do not reflect strong resilience to climatic changes.

3. Vulnerability assessments of many coastal cities indicate the need for upgrading resilience, protection measures and proactive planning for natural disaster risk reduction and better preparation.

4. Several leading examples of energy alternatives and energy conservation considerations, climate adaptation designs and proactive urban protection measures exist, however, wide spreading activities are still waiting for stronger driving force for action.

5. Concepts such as solar architecture, wind energy, ICZM, zero waste, green architecture and living shoreline protection have to be promoted as the most relevant strategies.

6. Recent political developments in several of the Arab countries have identified the lack of institutional monitoring capability as a major contributor to the lack of compliance to planning regulations in urban and coastal areas.

7. Utilizing studies and research conducted on adaptation to climate change, impacts and proactive planning for ports and quays to reduce its negative impacts on current ports, taking precautionary measures to reduce risks on ports, buildings and current investments caused by extreme climatic events and/or tsunamis.
5. Annex 1: Boxes

Box X.X: Case Study: Alexandria, Egypt

Alexandria is located just outside the low land area of north-east fringe of the Nile Delta, on the Mediterranean Sea. The city is a relatively prosperous urban centre which houses over 40 percent of the national industry, about 60 percent of oil and gas industries, about 80 percent of the seaport traffic, and appreciable portion of the commercial and tourism activities in Egypt. The character of the city is derived from its ribbon like development along the Mediterranean coast.

Figure 17: Extensive coastal urbanization in the water front of Alexandria City

Most urban development that exists in the old city has reached complete saturation resulting in considerable congestion and appreciable environmental degradation. The affluent residential areas are mainly located in the eastern sector parallel to the coast. South of this area are the middle-class residential areas. The western sector includes the main industrial zone and poor-quality housing for lower-income people. In the outer strip, a series of informal and spontaneous housing schemes are rapidly developing due to lack of affordable housing to the unprivileged dwellers.
Social segregation is apparent in Alexandria, with distinct areas being occupied by high-income, middle-income, and low-income and the lowest-income groups. The northern and eastern areas occupied mainly by the affluence, enjoy better road access to the coast, good services and less pollution. Urban poor occupy the southern part which has poor access, deteriorated services, cramped conditions and extensive pollution. The middle strip is occupied by the middle-income groups with reasonable access to services.

Current traffic problems in Alexandria are attributed to unplanned urban development of the city and rapid increase of number of cars over the carrying capacity of the streets; inadequate public transport facilities, shortage of car parking places and inadequate connections between different transport systems in the city. The inadequate road maintenance and management works in addition to weak law enforcement have also added to the traffic problems. Recently, a network of circulation system has been constructed to link the city from east to west. Improving the road network involved construction an elevated highway over the Abu Qir railway, construction of six car parks and widening the Corniche road on the seaside.

Figure 18: Seashore Protection measures to the East of Alexandria
A sea rise induced by global warming of just 30-50 centimeters would significantly accelerate the retreat of the coast line and would put the port and newer suburban areas at great risk, and would certainly jeopardize the tourism industry. In some areas to the East of the city, a relative rise of one meter could submerge lowlands within 30 kilometers of coast endangering a highly populated area south of Abu Qir Bay. Engineering solutions (Figure 19) are currently implemented in several sites to adapt to flooding problems and protect the shoreline zone, at an enormous cost of US $XX billion.

An assessment of the vulnerability of the most important economic and historic centers along the Mediterranean coast (the cities of Alexandria, Rosetta and Port-Said) suggests that, for a sea-level rise of 50cm, over 2 million people will have to abandon their homes, 214,000 jobs would be lost and the cost in terms of land and property value and tourism income lost would be over $35 billion [ref]. Alexandria alone has more than 3 million inhabitants. But it is not really possible to put a monetary value on the loss of the world-famous historic, cultural and archaeological sites.

Box X.X: The Architecture of Hassan Fathy

The beauty of Hassan Fathy traditional architecture represents an art form that has resulted from an understanding of a unique mode of human life and climate conditions. His designs depended on natural ventilation, orientation, and local materials, traditional construction methods and energy-conservation techniques. He carried out detailed studies of temperature and wind patterns.
Hassan Fathy found that Western techniques and materials inappropriate for Egypt's climate and the craftsmen's limited skills, such as reinforced concrete and steel. "Matchbox houses" were too hot in the summer and too cold in winter. He encouraged ancient design methods and materials. He saw a more appropriate method of building in the vernacular architecture of the Nubians (region of southern Egypt), which influenced his ideas greatly. Nubian craftsmen were masters at constructing domed and vaulted roofs of mud brick which they also used for the walls. The structures were cheap, cool in the summer, and the walls were heat-retaining in winter.

His aspiration found expression in many major community projects, whose layouts were based on traditional concepts, but the most important one was the New Gournah village (1945-1948), his best-known project. This village was intended to replace the old village, which is built on the site of the ancient town of Thebes in Luxor, Egypt. The old village was inhabited by about 7,000 peasants whose houses were built around old tombs. In the new village, Fathy experimented with, and tested his traditional forms and method of construction. While implementing the Nubian building techniques, he aimed to train Egyptian craftsmen to build their houses using mud brick or adobe, which was not only ideally suitable to the local conditions of Upper Egypt, but also a fraction of the cost.

The site plan of new village consisted of the mosque, the marketplace, the khan (lodging place for travelers or merchants), the village hall, the theatre, the permanent exhibition hall, the schools and the housing. In designing the streets of the village, Fathy was inspired by the beautiful streets of old Cairo. The primary intention was to express and support the social structures of families and tribes who lived in four distinct hamlets. Fathy’s main concern was to identify dwellings which were a marriage “between the imagination of the people and the demands of their countryside (Fathy, 1973).” Undoubtedly, Fathy’s planning approach unlocked a very important door for architects and planners to create dynamic village planning elements, whose flexibility could allow a new spectrum of possibilities for living and adapting to climate.
The New Gournah experiment was never completed, and very few of Fathy’s buildings have survived the changing construction styles of the local community. Despite this, those buildings that remain demonstrate how vernacular architecture is often climate appropriate.

Source: Abdel-moniem El-Shorbagy

Figure 19: Old Gournah, Luxor, Egypt.


Figure 20: New Gournah, Luxor, Egypt.
Chapter 5

Box X.X: Green building and LEED

In general, two major strategies have been used to improve energy efficiency in the building sector and thus reduce its GHG emissions. The first strategy is to improve building an envelope for improved energy performance. This is widely known as green building, sustainable building or energy efficient building concepts. The second strategy

Figure 21: The mosque of New Gournah


Source: http://www.qantara.de/webcom/show_article.php/_c-310/_nr-164/i.html
is to improve efficiency of energy consuming equipment used inside the buildings such as home appliances, lighting systems, air conditioning systems, computers and other office equipment and the like. In response to recent environmental, economic, market and regulatory drivers, green building concepts and practices have become widely promoted worldwide. The U.S. Green Building Council has developed a Green Building Rating System called the Leadership in Energy and Environmental Design (LEED), (USGBC, 2008).

The UAE is pioneering to apply the LEED certification system in new buildings, and in 2005 established the Emirates Green Building Council, meant to become a model for the Arab region to follow (Emirates GBC, 2008). Bahrain is also working towards achieving the same goal. Several other Arab countries have similarly been developing energy codes. Many Arab countries have already established different kinds of building codes. As part of the national energy efficiency strategy of Jordan, thermal insulation in residential and commercial building in certain zoning areas should be enforced. In addition, the preparation of an “Energy Efficiency Code” is a part of such a strategy (Shahin, 2005).

After many efforts to promote green architecture by several Egyptian institutions, Egypt developed residential building energy efficiency codes in 2003, and the new codes have initially been implemented on a voluntary basis. If fully enforced, it was estimated that these codes would save about 20 percent of building energy consumption. According to Joe Huang (2003), there is little indication that previous efforts have succeeded in changing overall design practices in Egypt towards improved energy efficiency. Furthermore, the extent of the codes’ enforcement and impacts of their implementation on building energy efficiency have not been assessed yet.

In Lebanon, a thermal energy standard for building is under development with the support of the ADEME of France. In addition, the Lebanese construction law provides economic incentives for voluntary thermal insulation of building. However, due to a
weak legislative and institutional framework, subsidies of energy prices, and the absence of a national strategy, many energy efficiency projects in Lebanon, especially funded by donors from the EU, have failed to achieve tangible results (Mourtada, 2008).

In Syria, a code of practice of thermal insulation for buildings is being developed. The aim is to provide information to consumers regarding the advantages of building insulation in order to affect insulation purchase decisions. These guidelines would provide best practices of recommended insulation levels for new and existing buildings (Zein, 2005).

In Kuwait, where air-conditioning accounts for 50 percent of building energy demand, a code of practice for energy conservation was developed to set limits for the electrical consumption of air-conditioning systems for buildings. The code stipulates energy conservation measures and limits for different types of buildings. Achieving sustainable building designs in the Arab countries is at its early stages of development, and only a very limited amount of scholarly review to document such efforts has been undertaken.

For the last few decades, urbanization in the Arab region, especially in the GCC, has been characterized by forms of imported western architecture which are far from being in harmony with the Arab social, geographical and climatic conditions. High rise buildings with large areas of glass facade, and huge demand for electricity for air conditioning can be seen in all new urban centers such as Dubai, Abu Dhabi, Doha, and the others. These unsustainable designs of residential and commercial buildings, besides being big consumers of energy and water, are massive contributors to GHG emissions.

The second GHG mitigation strategy in the building sector mostly reported in the national communication reports includes efficient lighting systems, certification and labeling of home appliances, and dissemination of improved stoves for cooking in rural areas. Lebanon, Tunisia, Algeria, Syria, and Egypt have projects for certification of home appliances at different stages of development. The Egyptian government has successfully
developed energy efficiency standards and energy labels for the three most market penetrated appliances in Egypt, namely room air conditioners (AFED, 2010)

Box X.X: Green Belts

6th of October city (SW of Cairo)
Rabat, Casablanca

Box X.X: Using treated recycled sewage water to green Abu Dhabi
Plans are under way to increase water efficiency in agriculture, above, fit water-saving devices to residential and public buildings and cut "wasteful" landscape use
Abu Dhabi plans to introduce the use of treated sewage water for agriculture, landscaping and district cooling to help to reduce the amount of fresh water removed from the Arabian Gulf. The emirate is among the world's highest consumers of water and these plans are intended to improve its management of water.

Most of the emirate's water is desalinized seawater, which is expensive to produce. This is supplemented by groundwater used for agriculture. The Government has identified treated water as a resource in its own right. The moves are an attempt to reduce Abu Dhabi's reliance on desalination, which incurs large financial and environmental costs.
The high salt concentration of brine pumped back into the Gulf damages coral and the marine environment.
In 2007, the emirate's desalination plants produced a total of 856 million cubic meters of desalinated water. It costs around US$1 (Dh3.67) to produce one cubic meter of desalinated water, not including the cost of transportation. Saudi Arabia, another country that relies heavily on desalination, faces similar challenges. "If emirates continue with desalination use as we do today, the country will be the biggest consumer of its own oil.

In Abu Dhabi agriculture requires most water and, with forestry, accounts for 76 percent of the emirate's water use. The use of treated sewage water to irrigate crops is illegal in Abu Dhabi. However, the technology exists to do this safely, and several trial projects are under way. Most public parks in the emirate are already irrigated by treated sewage effluent, but landscaping projects in the new private developments rely on desalinated water.

"There has been a huge amount of waste in the past that inefficient irrigation systems and water-thirsty plants have made the sector inefficient." There has also been too much landscaping in a country that can ill-afford the water needed for this. "Abu Dhabi does not need all the shrubbery and grass. It is a total waste." Abu Dhabi city currently relies on a sewage treatment plant in Mafraq, where more than 450,000 cubic meters of waste water are treated daily.

A consortium, is building two new plants, with a joint capacity of 430,000 cubic meters of sewage per day, in Al Wathba and in Allahamah, 40 kilometers from Al Ain. The project is due for completion in 2011, as is a further project to build two more plants with a joint capacity of 380,000 cubic meters per day, in Al Wathba and Al Saad, by a consortium including ADWEA, Emirates Utilities Company Holding and Biwater.

Sources: Vesela Todorova; SAMMY DALLAL / THE NATIONAL

**Box X.X Creating Greener cities in the Arab Countries**

**Masdar City**

A pioneering initiative in the UAE is the construction of the world’s first zero-carbon, zero-waste and car-free-city in Abu Dhabi, named MASDAR City. The city is planned to host 40,000 residents and receive another 50,000 daily commuters. It is envisioned to be a free zone clean-tech cluster home to around 1,500 visionary companies and research centers. The MASDAR Institute of Science and Technology is the first comer to the city
and will be home to 100 students and faculty by fall 2009. Cars will be banned within the
city; travel will be accomplished via public mass transport systems, with road and
railways connecting commuters to other locations outside the city. The city will be
walled, to keep out the hot desert wind. The lack of cars will allow for narrow, shaded
streets that will also improve air circulation and reduce demand for air conditioning.
The city will be oriented northeast to minimize the amount of direct sunlight on
buildings’ sides and windows. Solar panels and solar collectors on roofs and elsewhere
will generate enough electricity to meet most of the city’s electricity needs. Water will be
supplied through a solar-powered desalination plant. Landscaping within the city and
crops grown outside the city will be irrigated with grey water and treated waste water
produced by the city.
It is planned that MASDAR City will be completed and be fully functional by 2012 (The
Economist, 2008). Recently, MASDAR City was elected to host the newly established
International Renewable Energy Agency (IRENA); this is a milestone achievement for
Abu Dhabi and marks the first time that an Arab city plays host to the headquarters of an
international organization (MASDAR, 2009); AFED 2010

Sources: The Economist (2008). MASDAR Plan;

Box X.X: Climate Resilient Cities
Resilience is, “the capacity of a system to absorb and utilize or even benefit from
perturbations and changes that attain it…”23 In the context of climate change and disaster
risk management, resilience reflects how the robustness of infrastructure and
preparedness of communities to perceived threats increases their ability to cope with
change. There are many ways which cities can reduce their vulnerability to climate
change impacts, and globally, there are numerous ongoing initiatives; these include the

23 Holling, 1973
World Bank Climate Resilient Cities Primer\textsuperscript{24}, the ICLEI USA Climate Resilient Communities Program\textsuperscript{25}, the Capacity Strengthening of Least Developing Countries for Adaptation to Climate Change (CLACC) Program\textsuperscript{26}, the Asian Cities Climate Change Resilience Network (ACCRN)\textsuperscript{27}, the IDS Strengthening Climate Resilience (SCR) program\textsuperscript{28}, and the UNISDR Making Cities Resilient Campaign.\textsuperscript{29} While there are no urban resilience initiatives with an Arab focus, the Arab Climate Resilience Initiative does include urban issues.\textsuperscript{30}

Each of these programs guides cities through a variation of the following activities:

(i) Assessments of extreme weather impacts, natural hazards exposure (of both natural and built systems), vulnerable groups, and institutional capacity
(ii) Consultations with citizens and community organizations
(iii) Setting preparedness goals (short, medium, and long term)
(iv) Development of a climate preparedness plan
(v) Establishment of early warning systems
(vi) Instituting appropriate building standards
(vii) Reconsidering planning and zoning regulations
(viii) Identification and enactment of ‘no-regrets’ policies
(ix) Ensuring that infrastructure is sensitive to the needs of the poor
(x) Facilitating household coping strategies

\textsuperscript{25} ICLEI USA (2009), Climate Resilient Communities. \url{www.icleiusa.org/adaptation}
\textsuperscript{26} IIED (2009), \textit{Climate Change and the Urban Poor: risk and resilience in 15 of the world’s most vulnerable cities}, London: International Institute for Environment and Development (IIED). \url{http://www.iied.org/pubs/pdfs/G02597.pdf}
\textsuperscript{28} IDS (2010) Climate Smart Disaster Risk Management. \url{http://community.eldis.org/scr/}
\textsuperscript{29} UNISDR, \url{http://www.unisdr.org/english/campaigns/campaign2010-2011/}
\textsuperscript{30} UNDP (2010) Arab Climate Resilience Initiative \url{http://www.arabclimateinitiative.org/}
Incorporating climate information across sectors (health, tenure, education, housing, energy, etc.)

Supporting sustainable livelihoods

Creating networks among cities to share climate planning information
6. Annex 2: Preliminary Outline of Chapter

This original chapter outline was developed and agreed upon by the authors in January 2011, at a workshop in Lebanon jointly prepared by the League of Arab States and the World Bank.

Livelihoods and living conditions in urban and coastal areas in a changing climate

I. Introduction to urban climate change impacts and vulnerabilities
   a. Discussion of urbanizing trend in the Arab region, how climate change impacts are encouraging rural-urban migration.
   b. Land use and urban planning
   c. Generalized climate impacts for the Arab urban areas, including urban heat island
   d. Concentration of people and assets in low-lying and/or coastal areas, and tendency of the poor to concentrate in the most vulnerable areas.
   e. Risk associated with extreme events and excessive urbanization in the coastal zone.
   f. Livelihoods, people lose not only assets, but jobs/livelihoods – link to informal settlements

II. Climate adaptation in the urban setting
   a. Adaptation actions tend to be cross-sectoral
   b. Governance structures in Arab countries Governments tend to be centralized, making urban level decision making difficult (counter example: there is a local initiative in Morocco – presented in Cancun)
   c. Are climate funds available to finance urban level activities?

III. Making resilient cities - Adaptation actions as they relate to sectors
   a. Urban planning and building development:
      i. How are cities expanding?
      ii. Site Selection and considerations of climate changes
      iii. Unregulated development
      iv. Use of green infrastructure
      v. Relationship to transportation demand
      vi. Sand storms
   b. Buildings
      i. Traditional architecture
         1. Hassan Fathy
      ii. Building codes
      iii. Green building
      iv. Heat waves, urban heat islands and its implications
   c. Solid waste/Sanitation/drainage
      i. Urban flooding concerns
      ii. Water supply contamination
      iii. Landfills
      iv. Black clouds (burning of waste) Examples: Cairo, Tehran
   d. Transport
      i. Demand versus supply issues related to CC
      ii. flood / heat impacts on roads
      iii. air quality
      iv. Congestion in city centers
   e. Energy Systems
      i. They are vulnerable but are also part of the solution (conserve)
      ii. Where are Arab cities getting their energy from? Fossil fuels, hydro… how will this be affected?
      iii. Problems of mal-adaptation – Air conditioning in GCC
   f. Tourism and Cultural Heritage
      i. Climate change will impact both the physical structures and traditional lifestyles
      ii. Public awareness
iii. Other options for tourism – green economy – innovative ideas to attract people if source of tourism is loss (Consult section in Arab action plan) Case study: Lebanon skiing, hotels are organizing nature walks to attract people

g. Disaster Risk Reduction and Management:
i. Disaster trends in Arab world in relation to their impacts on urban areas
ii. Coastal protection against sea level rise and land subsidence
iii. Response and preparedness
   1. Evacuation planning

Case studies

h. Considering that the study will divide the region, the current aim is to include one case study in each division; (i) Maghreb, (ii) Nile Basin, (iii) Mashreq, and (iv) the Gulf Region. If possible, these will be chosen to include diversity among locations (inland versus coastal) and sizes (medium versus megacities).

Possible BOXES:
1. Concept of climate resilient cities
2. Greenbelt: 6th of October city (SW of Cairo)
Rabat, Casablanca
Abu Dhabi – treated recycled sewage water to green the city
3. Green building/LEED? UAE
LAS is creating code on green building
7. Bibliography


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Livelihoods and Living Conditions in Urban and Coastal Areas


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