

4.8 VULNERABILITY AND ADAPTATION OF THE PUBLIC HEALTH SECTOR

4.8.1 METHODOLOGY

Scope of Assessment

The assessment focuses on direct and indirect impacts on the human health sector, as defined below:

- The direct effects result from changing temperatures that trigger the outbreak of infectious diseases; from heat waves that can increase morbidity and mortality; and other extreme weather events and their consequences such as floods, storms, and massive fires, which can cause an increase in the number of casualties;
- The indirect effects of climate change on human health include droughts and floods affecting agriculture and leading to malnutrition; scarcity of clean water, which widely impairs hygienic conditions; and migration due to changing environments, which makes humans vulnerable to a whole host of diseases.

The assessment covers the whole country, focusing on vulnerable groups, as identified by stakeholders during the scoping phase, that include the elderly, women, children, workers in certain occupations, population groups with low socio-economic status and refugees. The year 2004 is taken as a baseline year and the whole timeframe for the analysis extends until the year 2030.

Methods of Assessment

As a result of limited data availability, a qualitative assessment is conducted to evaluate the impacts of climate change on human health in Lebanon. The future variation in the demographic, socio-economic and technological driving forces of the country is forecasted based on the two baseline socio-economic scenarios. The sensitivity and adaptive capacity of vulnerable groups is defined and the likely climate change impacts are identified through a literature review.

Development of the sector under socio-economic scenarios

Under scenario A, the likely developments in the provision of health services are limited to a low growth in the demand for health services and in hospital admissions in

cases of emergency due to a low population growth in addition to a higher reliance on public provision of health services due to a low GDP growth. The current conditions of the health care system along with the standards of living will remain the same.

Under scenario B, the current conditions of the health care system will improve. While the high population growth implies higher demand for health care services and higher admissions in case of emergency, the high preparedness and increased use of prevention measures in the health care system will allow for better health services.

4.8.2 VULNERABILITY ASSESSMENT

The sensitivity of the health sector is very high. Increases in average temperatures may lead to extreme heat waves and extended dry periods during summer which would affect vulnerable populations, especially those living inland where temperature increase are expected to be more severe. Other extreme weather events such as floods can also be destructive to human health and well-being by increasing event-related deaths, injuries, infectious diseases, and stress-related disorders (USEPA, 2010).

In addition, the overall adaptive capacity of the health sector is considered low due to 1) lack of economic resources since the budget allocated to MoPH never exceeded 4% of the total government budget, 2) poor infrastructure such as flood control structures, building insulation, sanitation facilities, waste water treatment and water systems and drainage and mass transit that can improve access and outreach in the case of weather-related disasters, 3) weak institutional arrangements, 4) unequal access to improved infrastructures and health care systems and 5) pre-existing disease burdens. However, advances in technology, such as new drugs or diagnostic equipment and the high level of "human capital" or knowledge in Lebanon are enhancing the adaptive capacity of the sector. Impacts will be more severely felt under Scenario A than under Scenario B which signals a higher adaptive capacity due to public investment in the health care services.

Taking into account sensitivity to climate change and adaptive capacity, the most vulnerable populations are:

Elderly population: Senior citizens (>65 years) are mostly sensitive to thermal stress during heat waves and heat stress due to their body's weak ability to control their

internal temperature. They have therefore a higher risk of heatstroke, cardiovascular and respiratory disease, and heat-related mortality. Their vulnerability is due to their low adaptive capacity amid the lack of public safety nets such as pensions and insurance systems for this group of the population. Additionally, the elderly population can face unequal access to healthcare, as they are often unable to travel long distances to the nearest health facility.

Women: They are mostly sensitive to thermal stress and extreme weather events due to physiological (e.g. menopausal women) and social factors (discrimination and poverty). Not having the same or direct access to the financial, technological and social resources that men have, in addition to limited participation in decision-making may have consequently made women less able to confront climate change (UNDP, 2009).

Children: Children are vulnerable to thermal stress and extreme weather events given their dependency and low natural resilience. Children are in a rapid stage of development and are less equipped to deal with deprivation and stress, due to rapid metabolism, immature organs and nervous systems, developing cognition, limited experience and various behavioral characteristics (Bartlett, 2008). Therefore, they are at increased risk of heat strokes, heat exhaustion and dehydration, injury, surrounding death, and infectious disease outbreaks. In addition, children's relatively lower level of understanding and especially their lack of social power within family and community (Bartlett, 2008), makes it more difficult for them to adapt to climate change implications.

Laborers in outdoor working environments: They are at higher risk of heat strokes due to the nature of their work that exposes them to extreme weather conditions.

Population groups with low socio-economic status: Given their low access to livelihoods assets, the poor infrastructure of their households and their unbalanced diet, the population groups with low socio-economic status are more sensitive to infectious diseases and mental illnesses, and have limited access to medical care. In addition, less adequate types of housing among this group might increase their risk of heat-related mortality. These populations are mainly concentrated in Tripoli, Akkar/Minieh-Dennieh, Jezzine/Saida, and Hermel/Baalbek.

Refugees: Refugees, constituted primarily of Palestinians and Iraqis, live in camps with poor building structures

and lack of proper public infrastructure leading to water shortages, contaminated water supplies and poor sanitation. These conditions result in a higher risk for water-borne disease transmission. In addition, seasonal agricultural labor, mostly associated with Bedouins in the Bekaa valley, rely on tents for housing which increase their vulnerability to natural disasters.

4.8.3 IMPACT ASSESSMENT

In the Eastern Mediterranean Region which includes Lebanon, the total deaths from malnutrition, diarrhea, malaria, floods, and cardiovascular diseases attributable to climate change for the year 2000 was estimated at 5,650/million population and the total estimated disease burden attributable to climate change for the year 2000 was estimated at in DALYs (Disability-Adjusted Life Years) 166,620/million population (WHO, 2007a).

The expected direct and indirect impacts of climate change on health in Lebanon are:

Heat waves and heat-related impacts: Exposure to extreme and prolonged heat is associated with heat cramps, heat syncope, heat exhaustion and heat stroke (Nuwayhid et al., 2009), which affect those with existing heart problems, asthma, the elderly and the very young. Furthermore, intense short-term fluctuations in temperature can also seriously affect health, causing heat stress (hyperthermia) or extreme cold (hypothermia), and lead to increased death rates from heart and respiratory diseases (WHO, 2010b). In Lebanon, a strong association between temperature and mortality was found where a 1°C rise in temperature above the minimum mortality temperature threshold (T_{MM}) of 27.5°C yielded a 12.3% increase in mortality and a 1°C rise below T_{MM} yielded a 2.9% decrease in mortality (El-Zein et al., 2004). Overlaying these results with the PRECIS projections reveal that an increase in mortality above T_{MM} is expected to vary between 12.3% and 24.6 %, and a decrease in mortality below T_{MM} is expected to vary between 2.9% and 5.8% by 2030. The calculated percentages when applied to the crude death rate of 4.1 per thousand of 2004 (Ammar, 2009) and the population growth figures used in Scenarios A and B reveal that:

- For Scenario A, the average mortality above T_{MM} caused by climate change ranges between 2,483 and 4,967 additional deaths/year between 2010 and 2030;
- For Scenario B, the average mortality above T_{MM}

caused by climate change ranges between 2,627 and 5,254 additional deaths/year between 2010 and 2030.

Vulnerable population groups, especially the elderly and population groups in the more socio-economically deprived areas, in semi-arid areas and in areas with lower access to health services are more at risk as a result of their high sensitivity and lower adaptive capacity.

Floods: The effects from natural disasters can be either directly sensed through claiming the lives of many people and injuring a lot more, or indirectly through displacing people, destroying their crops, and temporarily disrupting their livelihoods especially in the less developed areas with weak socio-economic structures. Victims of natural disasters are at a high risk of malnutrition, diarrhea and

water-borne diseases caused by crowding and lack of hygiene (WHO, 2007b), and women, children and the elderly, especially the uninsured, would be highly affected in such events.

Infectious diseases: They are considered to be indirect effects of climate change on health since it is difficult to discern their 'additional' i.e., the increase in health problems that can be attributed to climate change (Nuwayhid et al., 2009). However, the evidence on the associations between climatic conditions and infectious diseases is well established at the global level (WHO et al., 2003). Infectious diseases that are climate sensitive and that may occur in Lebanon due to changes in climate are described in Table 4-15.

Table 4-15 Climate sensitive infectious diseases

Type		Relevance
Vector Borne diseases transmitted by arthropods, such as mosquitoes, ticks, sandflies, blackflies and rodents	Malaria	Changing patterns of rainfall, humidity and particularly seasonal variation of temperature influence the geographical distribution and intensity of transmission of Malaria (Confalonieri et al., 2007). Although the cases of malaria reported by MoPH had all originated in Africa, it is feared that the expected increase in temperature in Lebanon might widen the area of distribution of the vectors, favoring their growth and development over time. In that case, population groups with lower socio-economic status, no insurance coverage, and lower access to health care, as well as children and the elderly will be more vulnerable
	Dengue Fever	Its transmission increases with high rainfall, high temperature, and even, as some studies show, during droughts (Confalonieri, et al., 2007). Lebanon does not currently appear among the countries at risk of dengue transmission (WHO, 2003), however, with the expected increase in temperature and drought periods, dengue transmission might emerge in Lebanon
Rodent-borne diseases transmitted directly to humans by contact with rodent urine, feces, or other body fluids		Environmental factors that affect rodent population dynamics include unusually high rainfall, drought, introduction of exotic plant species and food sources (Confalonieri et al., 2007). Diseases associated with rodents and ticks include leptospirosis, tularaemia, viral hemorrhagic diseases plague, Lyme disease, tick borne encephalitis and Hantavirus pulmonary syndrome (WHO et al., 2003). These diseases might flourish in Lebanon in case of increased floods
Water-borne and food-borne diseases	Cholera Typhoid Hepatitis A Diarrhea	The outbreaks of these diseases occur where water supplies, sanitation, food safety and hygiene practices are inadequate. The potential contamination of drinking water supplies and disruption of sewer systems and/or wastewater treatment plants and flooding that could result from climate change could lead to an increased incidence of cholera, typhoid and Hepatitis A cases in Lebanon. Regions with lower access to sanitation will be more exposed to water-borne diseases, and those with lower access to health care and insurance coverage, in addition to children and the elderly, will be more affected (WHO, 2010c)

Respiratory diseases: They may be exacerbated by warming-induced increases in the frequency of smog (ground-level ozone) events and particulate air pollution (USEPA, 2010). Sunlight and high temperatures, combined with other pollutants such as nitrogen oxides and volatile organic compounds, can cause ground-level ozone to increase. In Lebanon, the proportion of the urban population with existing respiratory problems would be at a higher risk of damage to lung tissue as rising air temperatures cause a higher build-up of ground-level ozone concentrations. Climate change can also affect natural or biogenic sources of particulate matter (PM) such as wildfires and dust from dry soils (USEPA, 2010).

Malnutrition: Increasing temperatures on the planet and more variable rainfalls are expected to reduce crop yields in many tropical developing regions, where food security is already a problem (WHO, 2010b). Food security in Lebanon is also at risk, since Lebanon relies heavily on food imports. The expected reduction in crop yields to result from local climate variations would affect the most economically disadvantaged groups.

In general, impacts will be more severely felt under Scenario A than under Scenario B which signals a higher adaptive capacity due to public investment in the health care services. Even though Scenario A assumes a low growth in population size which implies a low growth in the demand for health services and a low growth in hospital admissions in cases of emergency, the low GDP growth entails an unequal access to health services leading to a lower adaptive capacity especially among the vulnerable groups. On the other hand, the improvement of the current conditions of the health care system along with the standards of living characterizing Scenario B in addition to the high preparedness and increased use of prevention measures in the health care system could allow for better health services leading to higher adaptive capacity of the population groups.

4.8.4 ADAPTATION MEASURES

The rebuilding and maintaining of public health infrastructure is often viewed as the “most important, cost-effective and urgently needed” adaptation strategy to climate change in the human health sector. Climate-related adaptation strategies should not be considered in isolation of broader public health concerns such as population growth and demographic change, poverty, public health infrastructure, nutrition, risky behaviors, and inadequate use of antibiotics, and environmental

degradation. All of these factors will influence the vulnerability of populations and the health impacts they experience, as well as possible adaptation strategies.

Adaptive actions to reduce health impacts can be considered in terms of the conventional public health categories of primary or anticipatory adaptation where a hazard exposure is avoided, secondary or reactive adaptation where early intervention is implemented after a disease has begun, and tertiary prevention where the adverse effects of an already present disease or injury are minimized (WHO et al., 2003). By an initiative of WHO-Lebanon, MoPH and MoE, and in collaboration with AUB, the main adaptation measures for the health sector in Lebanon have been identified by the stakeholders to alleviate impacts of climate change and improve the adaptive capacity of public health services. A national framework of action was drafted, based on the general framework of action on climate change established by WHO and endorsed by the government of Lebanon. The objectives of the proposed national framework of action are as following:

Objective 1: To ensure public health concerns and health protection from climate change are at the centre of national, regional and international action on climate change

- Research national evidence and conduct sustained evidence-based advocacy to raise awareness;
- Assess the burden of disease by developing a list of indicators on which data needs to be collected and fed into registries for monitoring and surveillance and assess the magnitude of current health problems nationally;
- Form an inter-sectoral committee on which representatives from all ministries and concerned national authorities serve. The Committee shall oversee issues of climate change and health. This committee shall report to the Council of Ministers to suggest health protection measures that shall be integrated into the activities of all ministries.

Objective 2: To Implement adaptive strategies at local and national level to minimize impacts of climate change on population's health

- Undertake assessment of health vulnerability to identify the short, medium, and long term additional direct and indirect threats to health

from climate change and map health resources available to cope with any additional burden of climate change on health;

- Strengthen health system monitoring by empowering the MoPH capacity of monitoring and early warning on a specific set of indicators such as meteorological conditions, environmental determinants related to energy, emissions, Pollution Standards Index, water security indicators, vector profile distribution and food security;
- Empower and ensure sustainability for existing environmental health functions and services. Priority threats are water security for health, water quality degradation, droughts, heat waves, food security and safety, vectors redistribution, air quality degradation, floods and other climate related natural disasters;
- Based on health resources mapping and identified gaps, strengthen health systems' preparedness to cope with the additional burden of climate-sensitive health problems. Priority groups of diseases are water-borne diseases, food-borne disease, malnutrition associated with food insecurity, health effects of heat waves and extreme cold conditions, respiratory and other diseases associated with air pollution, vector-borne diseases and health effects of climate related disasters. Develop specified and standard technical units for the diagnosis such as laboratories;
- Oversee the process of undertaking interdisciplinary applied research and demonstration projects on health vulnerability to climate change and on effectiveness of health protection measures. Ensure translation of scientifically based applied research findings into policies, practice, and working strategies.

Objective 3: To support "healthy" development strategies in other sectors that protects and promotes health and mitigates climate change

- Build the capacity of health sector professionals in the identification of health impacts from other sectors (e.g. transport, energy, food, water, housing and urban development) that have bearings on health. Capacity building shall be done to technical people, concerned authorities and policy makers;

- Engage health sector leaders and professionals in determining and supporting policy choices of other sectors that promote and protect health;
- Establish institutional and legislative mechanisms to facilitate and mandate the health sector engagement in determination of development policies and choices in other sectors.

Objective 4: To strengthen the institutional capacity of the public health systems for providing guidance and leadership on health protection from climate change.

- Establish a national focal point on climate change and health who would be appointed by the Ministry of Public Health to enable health sector leadership and collaboration with other sectors;
- Establish a health and climate change task force within the Ministry of Public health with membership of concerned stakeholders especially those involved in preventative and protection functions and those involved in preparedness and in response to the climate-sensitive health issues;
- Strengthen the existing units in order to address the climate change impacts. Define vulnerable groups and activate epidemiological surveillance. Incorporate new health outcomes in the Epidemiological Surveillance Unit that are expected to be of a great burden due to climate change. Increase and improve active reporting. At the preventive level, raise awareness on the health effects of climate change through organizing awareness events and training health care practitioners;
- Establish the institutional legislative mechanisms with the national UNFCCC focal point to mandate the health sector leadership on health protection from climate change within the national UNFCCC processes. MoPH as an essential stakeholder in climate change and health and a legal representative shall lead the committee and shall report to the government.

In addition to the national framework of action, enhancing the Early Warning Alert and Response System (EWARS) is crucial to improve the capacity of the current system to respond to climate change impacts. This can be achieved through the development of regional definitions for heat alerts/warnings, building the capacity to monitor dynamic changes in risk patterns at a high level of spatial

and temporal resolution, development of preparedness/response strategies based on community needs and priorities and development of public communication strategies to ensure that warning information and recommended response strategies are conveyed to the populations at risk.

4.9 VULNERABILITY AND ADAPTATION OF THE TOURISM SECTOR

A close linkage exists between climate and tourism since climate defines the length and quality of tourism season and plays a major role in destination choice and tourist spending. Climate also affects a wide range of environmental resources that are critical attractions for tourism, such as snow conditions, biodiversity, water levels and quality. Moreover, climate has an important influence over environmental conditions that can deter tourists including disease spread, and extreme events such as heat waves, floods and extreme storms (UNWTO et al., 2008).

Tourism in Lebanon mainly consists of recreational tourism that includes beach holidays, winter sports, summer holidays in the mountains, cultural, religious, and adventure tourism, in addition to business tourism and health and education tourism (MoE, 2001). Related activities and infrastructure are concentrated in three areas: The high mountains where ski resorts and winter chalets are located; the hills overlooking Beirut and the coast where "country clubs" are found; and the coastline where beach resorts, public beaches and marinas are located, mainly on the northern coast (MoE, 2005). In recent years, alternative types of tourism and recreational activities have grown in Lebanon among which is ecotourism which has registered a significant increase in the number of ecotourism providers throughout the years since 1991 (MoE, 2001).

4.9.1 METHODOLOGY

Scope assessment

The assessment covers all the touristic areas of Lebanon with focus on the sites and activities that are likely to be vulnerable or "hotspots" such as coastal archaeological sites (e.g. world heritage sites of Tyre and the Fortress of Saida) and coastal touristic infrastructure, such as beach resorts, public beaches and marinas that may be damaged by sea-level rise, high mountains that may be affected by and shortening of the winter season and a

reduction in snow cover and mountainous summer resort areas that may be affected by increase in temperatures. The assessment covers the whole year to tackle summer and winter climate changes. The baseline year is 2004, and projections are made until 2030 by forecasting the impacts of future variation in the demographic, socio-economic and technological driving forces as well as climate change on the tourism sector.

Development of the sector under socio-economic scenarios

In Lebanon, tourism growth and its sensitivity to climatic change are influenced by three main factors: 1) economic stability, whereby high prosperity levels in the country result in growth of the tourism sector; 2) security and political stability, whereby the absence of conflict and strife dispel uncertainties regarding investment in tourism; and 3) resources' availability, especially forests and the availability of water supplies that could become a major constraint.

Taking these factors into account, under scenario A, tourism will probably be among the main active economic sectors, having an important contribution to GDP. Both mass tourism and ecotourism will be growing with greater emphasis on ecotourism due to better understanding of the recreational value of natural assets, participation of civil society in its protection and law enforcement on forest management. This would create alternative livelihoods, especially for populations in remote areas, which would in turn influence internal migration and local sustainable economic development. However, the low resources availability under this scenario might limit ecotourism growth.

Under scenario B, a moderate growth in the tourism sector and mainly in mass tourism on one hand and a low growth of ecotourism on the other hand due to lack of awareness and degradation of available natural resources will entail a massive burden on environmental resources, leadingly to an unsustainable growth.

4.9.2 VULNERABILITY ASSESSMENT

The relationship between tourism and climate is very complex and remains difficult to define. Tourism is sensitive to changes in temperature, rainfall, snowfall and extreme weather events that could lead to shifts in a variety of outdoor tourism and recreation opportunities in Lebanon, such as skiing in winter and beach activities in summer. The added effect of sea level rise may lead to coastal