Climate Change Adaptation in the Health Sector Using Integrated Water Resources Management Tools

Health

UNITED NATIONS
الاسكوا
ESCWA

World Health Organization

Economic and Social Commission for Western Asia

Climate Change Adaptation in the Health Sector Using Integrated Water Resources Management Tools

E-mail: publications-escwa@un.org;
website: www.unescwa.org

United Nations publication issued by ESCWA.

References have, wherever possible, been verified.

Symbols of the United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

E/ESCWA/SDPD/2016/Module.3
16-00295

Contents

List of figures

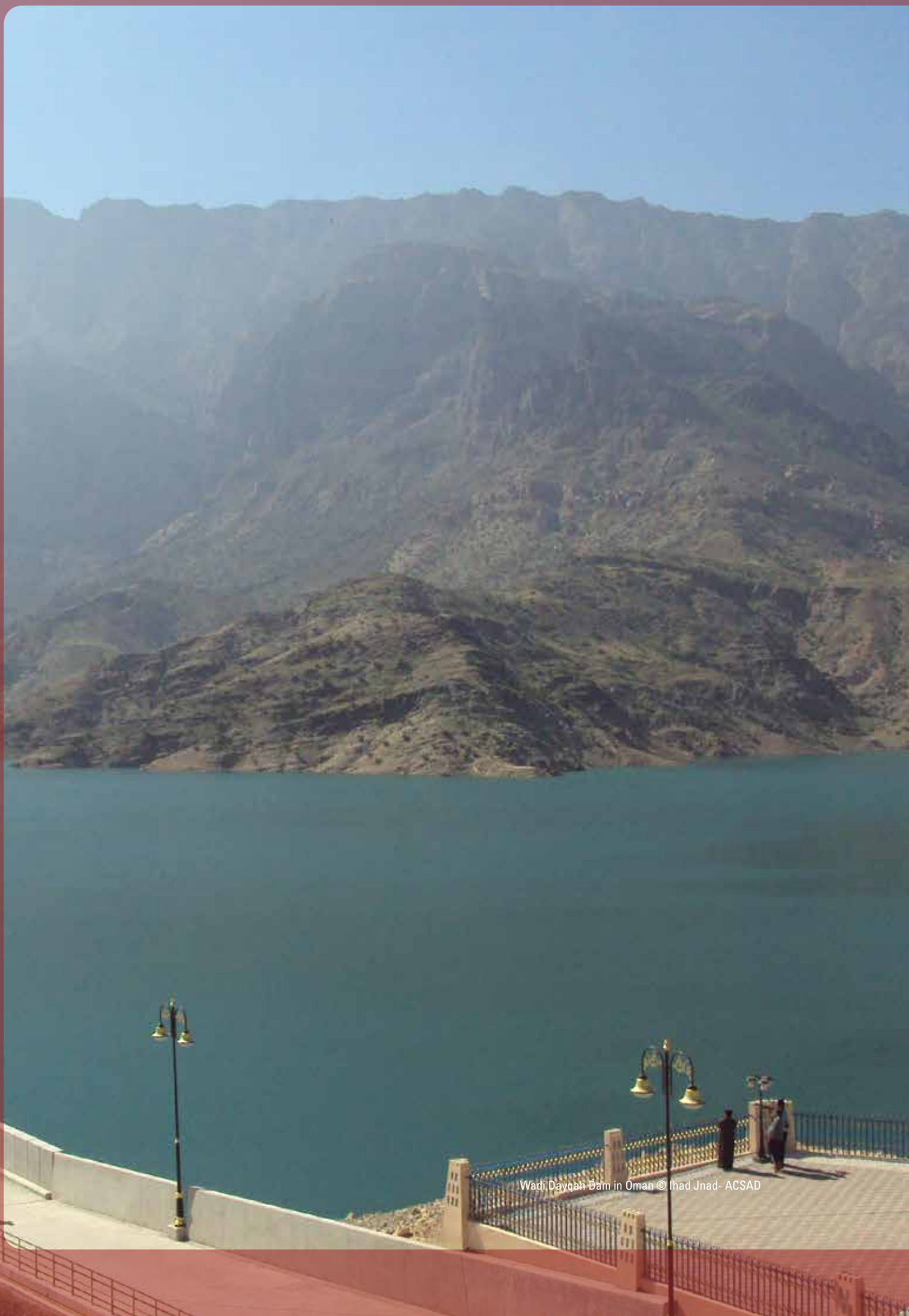
List of tables

Acronyms

ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands
ACWUA	Arab Countries Water Utilities Association
CCA	climate change adaptation
CDC	centers for disease control
ESCWA	United Nations Economic and Social Commission for Western Asia
GHG	greenhouse gas
GIS	geographic information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IWGCCH	Interagency Working Group on Climate Change and Health
IPCC	Intergovernmental Panel on Climate Change
IWRM	integrated water resources management
LEG	Least-developed Countries Expert Group
MDG	Millennium Development Goal
NAP	national adaptation plan
NAPA	national adaptation programmes of action
NAMA	nationally appropriate mitigation actions
NGO	non-governmental organization
RICCAR	Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
SDG	Sustainable Development Goal
TNC	third national communication
UN	United Nations
UNDA	United Nations Development Account
UN Environment	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WHO/CEHA	World Health Organization Centre for Environmental Health Activities

CH. 1

Introduction



Wadi Daycah Dam in Oman © Ihad Jnad- ACSAD

Introduction

About the training manual

The training manual has been developed within the activities of the United Nations Development Account (UNDA) project on developing the capacities of Arab countries for climate hange adaptation by applying Integrated Water Resources Management (IWRM) tools. The project aims to provide a set of regionally appropriate IWRM tools for supporting climate change adaptation in five key sectors namely agriculture, economic development, environment, health, and human settlements by deriving a training manual that includes the five modules on the selected sectors.

The project was led by the United Nations Economic and Social Commission for Western Asia (ESCWA) in cooperation with the United Nations Environment Programme Regional Office for West Asia (UN Environment), and was implemented in partnership with the following organisations for three out of the five modules:

- Agriculture module: Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ);
- Health module: World Health Organization Center for Environmental Health Activities (WHO/CEHA);
- Human settlements module: Arab Countries Water Utilities Association (ACWUA).

The Environment module and the Economic development module were prepared by UN Environment and ESCWA, respectively. This UNDA project builds on the results of the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) that is led by ESCWA and implemented by the League of Arab States (LAS) and United Nations organizations.

Health sector background

The Arab countries, like many other parts of the world, are expected to be strongly impacted by climate change. Climate change impacts are expected to affect quantity and quality of the region's water resources. Previous local studies in many of the Arab countries showed an increase in the magnitude and frequency of extreme temperatures and a decrease in the precipitation levels, the resulting surface runoff, and ground water recharge values. The already water-stressed region will go through even more water-stressed conditions because of climate change.

All development sectors are expected to be negatively impacted by climate change. The sectors that are expected to be significantly impacted are:

- Water
- Agriculture (and food security)

- Ecosystems
- Health
- Economic growth

Climate change mitigation has been in the forefront of discussion and research for decades. It is now evident that climate change impacts are already occurring and are expected to intensify for a long period of time. Thus, efforts also need to focus on the adaptation to climate change impacts.

In order to make the necessary adaptation to the consequences of climate change, many stakeholders have to be well informed. Knowledge of the consequences of humankind's behaviour on our climatic system, presented, for example, in the latest Intergovernmental Panel on Climate Change (IPCC) assessment reports, is well founded and adequate for the people working in the field. However, more specific information is needed for the implementation of concrete measures at the local level. It has been shown that the lack of such information is one of the most significant bottlenecks to concrete action, in particular with regard to adaptation, but also for the implementation of integrated activities that would promote both mitigation and adaptation.

Climate change and its health linkages in the water sector started to receive more focused attention throughout the last few years. The reported and expected significant impacts on public health are directly affecting the economic development of countries, especially those who are most vulnerable to the impact of climate change and/or those who already suffer from water-stressed conditions. It is imperative to recall that public health is a major aspect management and governance of water and should always be addressed when analysing the impact of climate change on the water sector.

Climate change is expected to impact water resources mainly in two pathways: on the one hand through increased water scarcity and on the other hand through an increase in the frequency and intensity of extreme weather events (such as floods and droughts).

Water scarcity will lead to a decreased access to water supplies for many categories of the population, which will result in less water for hygiene. Water quality deterioration that can lead to potentially increased water-borne and food-borne diseases is also another concern that should be addressed by the water managers and planners. In addition water scarcity will lead to less water for food production and cause food insecurities leading to undernutrition of the vulnerable groups of the community.

A major area that needs to be addressed concerning public health is the possible impacts of climate change on vector-borne diseases. Issues stemming from this category of impacts are as follows:

- Changes in temperature will affect their development, reproduction, behaviour and survival rates;
- Changing temperature and precipitation may shift the geographic range in which they can live and the seasonal period of disease risk;
- Temperature also can affect pathogen development within vectors; precipitation can influence the availability of breeding sites; and climatic variables can affect the distribution and abundance of their vertebrate host species.

Water-borne infectious diseases are expected to worsen as climate change impacts such as increased temperatures, flooding, and other changes in the water cycle occure.

An example of an area of concern is the infectious diarrhoea where infection is spread through contaminated food or drinking water, or from person to person as a result of poor hygiene. In addition, severe diarrhoea leads to fluid loss and may be life-threatening, particularly for young children and people who are malnourished or have impaired immunity.

The increased frequency of extreme events (floods, for example) is expected to impact the infrastructure of countries prone to such events. Health protection programmes will directly be impacted by these events. For example, flooding can directly cause a disruption of the existing wastewater treatment plants of the country; lead to more contamination potential of all water resources; and thereby negatively impact the human health. In addition a by-product of these events will impact the historical human settlements pattern and possible displacement events, loss of housing facilities and loss of health-care facilities.

Adaptation to the impacts of climate change is required. Implementation of adaptation programmes has to be conducted in an integrated and comprehensive manner. According to the Assessments of Impacts and Adaptations to Climate Change (AIACC) final report, released in 2007, there are nine important lessons about adaptation to be learned, as well as, many more lessons that are specific to particular places and contexts [http://start.org/download/publications/AIACCfullreport.pdf]. The general lessons, formulated as recommendations, are as follows:

- Immediately start adaption efforts;
- Create conditions to enable adaptation;
- Integrate adaptation with development;
- Increase awareness and knowledge;
- Strengthen institutions;
- Protect natural resources;
- Provide financial assistance;
- Involve those at risk;
- Use place-specific strategies.

The said report also strongly stresses the role of knowledge transfer and the strengthening of institutions in creating a robust carrying capacity that will enable different elements of society to adapt to climate change impacts and support vulnerable communities.

Training objectives and methodology

This training is designed to bring together, in a facilitated and highly interactive setting, a group of 25-30 professionals (see below for targeted stakeholders), in order to develop the capacities of the Arab countries in the area of climate change adaptation with a specific focus on the water sector to protect public health.

The expectation is that participants taking part in the training have an acceptable understanding of IWRM. The material is designed to support a facilitated, multi-day workshop that will empower participants to understand the tools and concepts needed to build programmes, direct staff and allocate resources as they develop and integrate IWRM as a concept for adaptation to climate change in the water sector in the Arab region. In addition, participants to the training will have a comprehensive overview of climate change impacts on health in the water sector in the Arab region.

The training material presents basic facts on the inter-relationship between the water and health sectors, IWRM tools and other modern tools needed to adapt to future conditions, and how to prioritize adaptation measures and implementation considerations. Case studies and exercises from the Arab region are incorporated to learn from experiences of 'real world' projects and programmes. Specific objectives of this health module are as follows:

- Increase understanding of government officials and regional stakeholders of the impact of climate change on water resources;
- Framing the linkages between climate change, water sector and flood-related diseases, heatwave-related mortality and morbidity, vector-borne diseases, water-related illnesses, food-borne diseases and malnutrition and other health-related effects;
- Review the vulnerability assessment protocols and indicators in the water sector;
- Enhance government capacity to incorporate IWRM tools into strategies, policies, plans and programmes of water management in the health sector in order to be better prepared for future climatic conditions (i.e. Climate Change Adaptation – CCA);
- Present tools for adaptation in the water sector in order to protect public health;
- Review the governance framework and implementation mechanisms towards identifying the needed adaptation interventions for the health sector.

The exercises included in the Annex to this module are:

Exercise 1. Climate impacts on water and public health and tracking climate readiness for a region/country
Exercise 2. Convening a methodological framework for the vulnerability assessment
Exercise 3. Distribution of roles and responsibilities in the health and water sectors
Exercise 4. Crisis management and long-term strategies within the health sector
Exercise 5. Moving from science to policy in Morocco

Targeted stakeholders

With water resources intersecting numerous sectors, and given the myriad forms of governmental institutions dealing with policy-making, planning and implementation, this training module benefits a wide variety of officials from the public sector, academia, non-governmental organisations, and the private sector. The module will also benefit those interested to learn about the different aspects of climate change impacts on water resources, the associated linkages to health and the use of Integrated Water Resources Management (IWRM) as a tool for climate change adaptation in these two sectors. The following target groups should find this module of particular interest:

- Decision makers and technical staff in the water and health sectors who are concerned with the health dimensions of climate change and with developing and implementing policies, programmes or projects;
- Decision makers and technical staff in other government sectors concerned with water and health dimensions of climate change (such as spatial planning, environment, agriculture, food, disaster risk reduction, transport, industry, labour, education, etc.);
- Stakeholders involved in the development and implementation of national adaptation plans (NAPs) and national adaptation programmes of action (NAPAs), nationally appropriate mitigation actions (NAMAs) and national communications;

- Representatives involved in the global United Nations Freamework Convention on Climate Change (UNFCCC) process, such as negotiators and UNFCCC focal points;
- General health and water sectors staff and other professionals providing water and health services;
- Women and other vulnerable population groups;
- Civil society and to a lesser extent local community representatives;
- Non-governmental organization (NGO) experts active in the area of climate change and/or water and health;
- Academics, scientists and researchers working on climate change adaptation in the water and health sectors.

Module content

In addition to this introductory chapter, the module consists of the following chapters:

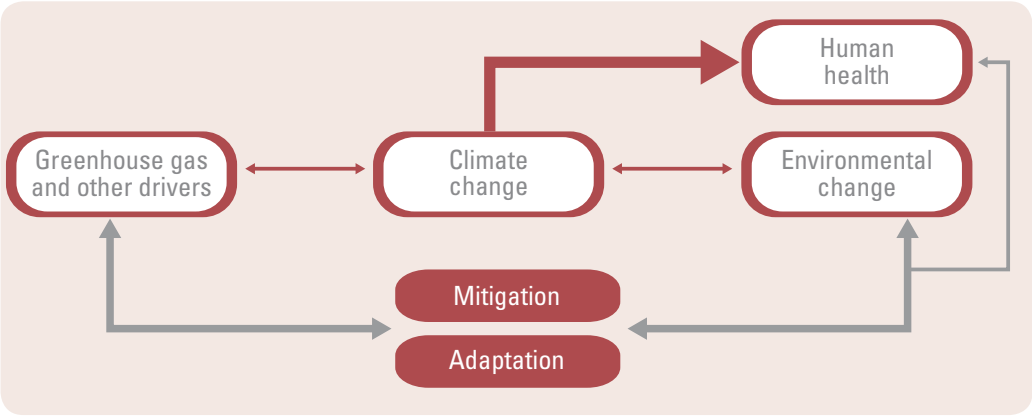
- **Chapter 2.** This chapter frames the impacts of climate change on water and health, and the linkages between these.
- **Chapter 3.** RICCAR indicators and outputs and their role in identifying adaptation measures, as well as tools for assessing vulnerability are the focus of chapter 3, setting the stage for the next chapter's focus on adaptation.
- **Chapter 4.** This chapter, through IWRM and other tools, takes up the stocktaking of adaptation measures targeting health and water impacts, as well as the means to evaluate and prioritize which adaptation measures should actually be considered.
- **Chapter 5.** Governance, legislative context, stakeholders, barriers and other issues pertaining to implementation of adaptation measures are the focus of chapter 5.
- **Chapter 6.** This chapter suggests areas for action to follow up on adaptation programme development at the national and global policy levels.
- **References and Further Readings.** A listing of the references that supported the preparation of this module, as well as selected readings that may be of interest.
- **Annex.** A set of exercises providing an opportunity for practitioners to extend their understanding of the various concepts underlying IWRM.

CH. 2

Framing Climate Change Impacts on Water and Health

Framing Climate Change Impacts on Water and Health

"In addition to the direct effects of heat on humans, the major impacts of climate change on human health are through changes to the human environment such as rising oceans, changing weather patterns, and decreased availability of fresh water. Mitigation of climate change refers to actions being taken to reduce greenhouse gas emissions and to enhance the sinks that trap or remove carbon from the atmosphere to reduce the extent of global climate change. Adaptation refers to actions being taken to lessen the impact on health and the environment due to changes that cannot be prevented through mitigation. Appropriate mitigation and adaptation strategies will positively affect both climate change and the environment, and thereby positively affect human health. In addition, some adaptation activities will directly improve human health through changes in our public health and health care infrastructure." (Portier et al, 2010)



Impacts of climate change on water resources

Semi-arid and arid areas are particularly exposed to the impacts of climate change on freshwater. Higher water temperatures, increased precipitation intensity, and longer periods of low flows exacerbate many forms of water pollution, with impacts on ecosystems, human health, water system reliability and operating costs. Climate change affects the function and operation of existing water infrastructure as well as water management practices, with the negative impacts of climate change on freshwater systems outweighing any benefits.

In the last decade, climate change has emerged as an equally challenging threat to water availability in the region, whereby increased global temperatures are leading to changes

in the hydrologic cycle and increased water demand. Expected biophysical and socio-economic impacts on water resources with climate change are summarized in table 1.

Table 1. Some impacts on water resources expected with changing climate

Biophysical resources	Major impacted components	Potential effects
Hydrologic resources	• Precipitation • Evaporation • Transpiration • Runoff • Recharge	• Soil moisture changes • Reduced ground water recharge • Water shortages or surpluses • Dam failure due to floods • Dam storage loss due to sedimentation
Water quality	• Water temperature • Water salinity • Pollutant concentrations • Fauna and flora	• Changes in chemical quality • Changes in biological quality • Changes in thermal quality
Aquatic systems	• Stream flows • Erosion and sedimentation • Water levels in surface water • Water levels in aquifers • Water fluxes in the subsurface	• Droughts or floods • Dam failure due to floods • Dam storage loss due to sedimentation
Water supply	• Water demand per capita • Agricultural water demand	• Water demand increase beyond projected levels
Water management systems	• Stream flows • Water level in surface water bodies • Water levels in aquifers	• Reduced water supply • Changing loads on water treatment systems • Changing hydropower production potential

Source: Based on El-Fadel and Bou-Zeid, 2003.

Higher temperatures and changes in extreme events, including more and more intense floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution – from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt – and also cause thermal pollution with possible damage to ecosystems, human health, and water system reliability and operating costs. In addition, sea-level rise is projected to extend areas of salinization of groundwater and estuaries resulting in a decrease of water availability for ecosystems and humans.

In some cases, climate change might have positive impacts such as increased growth rates and food conversion efficiencies; increased length of growing season; species range expansion; and

the availability of new land due to decreased ice cover. Society should aim to understand and maximize the benefit of these positive impacts that can support adaptation, for example by using a prolonged growing season to increase the number of annual harvests.

Globally, the harm caused by climate change to freshwater systems is expected to outweigh the benefits by far. At a global level, by the 2050s, the area of land affected by increasing water stress caused by climate change is projected to be more than double that with decreased water stress. Areas in which runoff is projected to decline obviously face a reduction in the value of the services their water resources can supply. Increased annual runoff in some areas is projected to lead to increased total water supply. But in many regions this benefit is likely to be counterbalanced by the damage caused by increased variability in precipitation and seasonal run-off, shifts in water supply, reduced water quality and flood risks.

Water is central to many different sectors; hence, the impacts of climate change are expected to have far-reaching effects on society. Economic sectors that are projected to be most affected are agriculture (increased demand for irrigation and forestry), energy (reduced hydropower potential and cooling water availability), recreation (water-linked tourism), fisheries and navigation. Because of the importance of these sectors for national and individual welfare, climate change impacts on water have important direct and indirect effects, while serious impacts on biodiversity also loom (table 2).

Climate change and variability and associated changes in the available water resources and their quality are also responsible for increased health risks through direct effects (such as drowning or trauma in floods, post-traumatic mental disorders in natural disasters) and exposure to health hazards caused by growing contamination of water (for example, by pathogens, waste and toxic chemicals), less household hygiene, reduction of food safety, and an increase in the number and geographical distribution of disease carrying vectors. These changes can result in an increase in emerging and re-emerging infectious diseases. A special concern is linked to the disruption of water supply and sanitation systems during extreme events that might result in an increase in water-borne infectious diseases.

Adverse effects of climate change on water aggravate the impacts of other stresses and pressures, such as changing consumption and production patterns, land use change, urbanization and population growth. Responses to climate change and other pressures may have irreversible long-term impacts, such as land degradation caused by inappropriate long-term irrigation.

Box 1. Integrated gender aspects into adaptation measures

Mainstreaming of gender aspects will help assure the success of policies, programmes and projects for adaptation to climate change such that human health is offered better protection.

Gender should not be treated as a standalone sector; instead it should be an integral part of policy making as well as reflected in the policies themselves, as currently women barely participate in formulating policies.

Mainstreaming of gender components should be approached through institutional mechanisms, active participation at all levels and decision-making, while policies, programmes and projects facilitate women's access to – and control over – natural resources, knowledge, information, and credit.

This mainstreaming will support national, sub-regional and regional programmes towards achieving the needs of the region.

Impacts of climate change on women's health

The study of the impact of climate change on health is rather challenging. In few instances, health problems, be it death or injury can be directly linked to climate or weather changes such as heatstroke due to heatwaves associated with an increase of humidity in the Gulf region.

For example, in a clinical study in Kuwait (1998-2001), anuria (kidney shutdown) cases had risen along with an increase of pregnancy-induced hypertension. Hurricanes and floods, which are also directly linked to climate changes, cause an increase in mortality while surviving victims are susceptible to a high risk of malnutrition, diarrhoea and waterborne diseases due to lack of hygiene.

However, the challenge is even greater when indirect health effects are considered (Tolba and Saad, 2009). For instance, pregnant women and children are at high risk of contracting malaria, with adverse outcomes of low birth weight, maternal anaemia and abortions (Adam, Khamis, and Elbashir, 2005). In Yemen, severe paediatric malaria is endemic to the coastal plains as well as to the inland mountains, and is a substantial burden on health services in Yemen (Tolba and Saad, 2009).

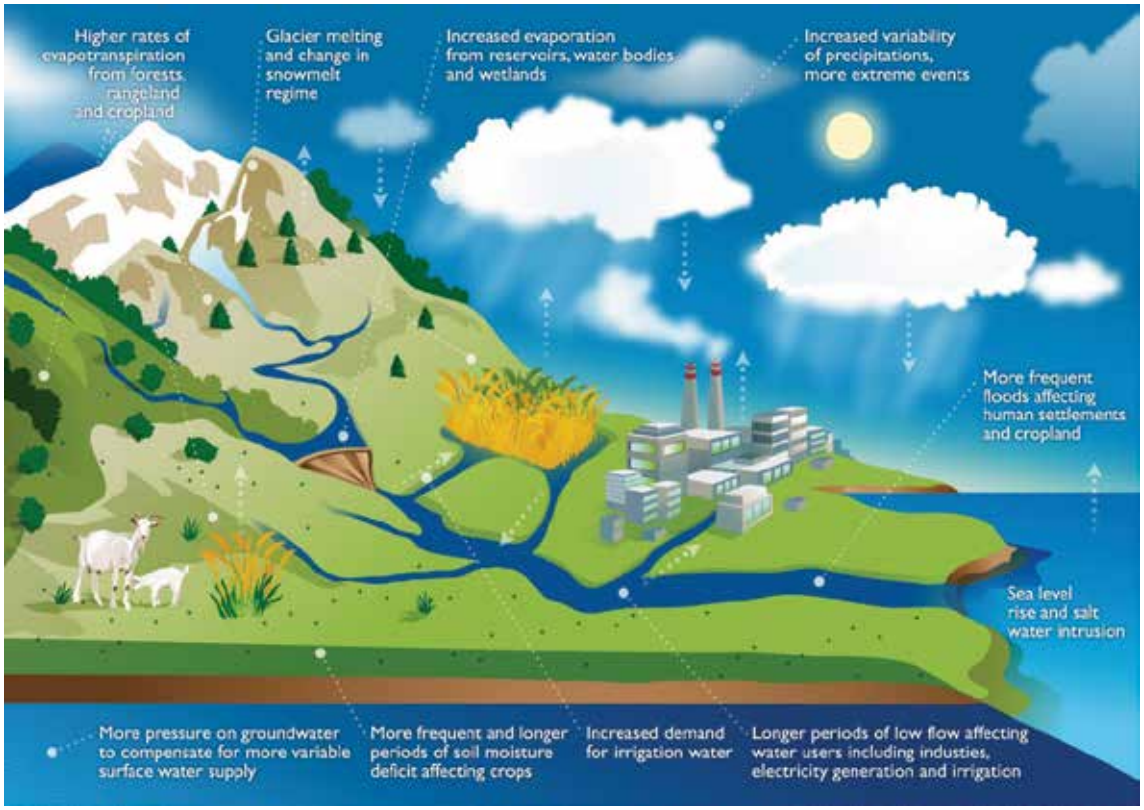
The average risk of dying from pregnancy-related disorders in a developing country is about 250 times that of developed countries. Women in Arab countries, especially the least developed ones, are already suffering unacceptably high rates of morbidity and mortality connected with pregnancy and reproductive functions. The average maternal mortality rate in the Arab countries is around 270 deaths per 100,000 live births. This rises to over 1,000 deaths in the poorest Arab countries (Mauritania and Somalia) and falls to a level of 7 for every 100,000 births in Qatar (UNDP, 2006).

In Iraq, maternal mortality has tripled to 370 per 100,000 live births over the past decade, with anaemia affecting about 70per cent of pregnant women, increasing these risks. This high maternal mortality rate is a good indication of lack of support and care women suffer from during pregnancy and childbirth (UNDP - RBAS, 2006).

Source: Tolba, M. K., and Saad, N. W. (eds.) (2009). Report of the Arab Forum for Environment and Development - Impact of Climate Change on Arab Countries, pp. 87-95.
Adam, I., Khamis, A., and Elbashir, M. (2005). Prevalence and risk factors for plasmodium falciparum malaria in pregnant women of eastern Sudan. Malaria Journal, 4 (18).
UNDP (2006). Human Development Report 2006 Beyond Scarcity: Power, poverty and the global water crisis.
UNDP - RBAS (2006). *T*he Arab Human Development Report 2005: Towards the Rise of Women in the Arab World.

Furthermore, the impacts vary in time and space; some impacts are on a daily/local scale (such as lower oxygen content), others are on longer/larger scales (such as changes in algal blooms over weeks or months, changes in species composition over many years, groundwater level variations and alterations to groundwater flow directions). Figure 1 depicts the impact of climate change on all elements of the hydrologic cycle.

Figure 1. Climate change impacts on the water cycle



Source: Available from http://www.fao.org/nr/water/news/clim-change.html.

Current water management practices may not be robust enough to cope with the future impacts of climate change on water supply reliability, flood risk, health, agriculture, energy and aquatic ecosystems. In many locations, water management cannot satisfactorily cope with current hydrologic variability that can lead to extensive flood and drought damage. In addition, natural changes can be exacerbated by illegal activities such as unauthorized well-drilling, which underlines the need for strong management rules and their enforcement.

The climate change impacts on freshwater resources put at risk sustainable development, economic growth, poverty reduction, production and availability of food, and the health of people and ecosystems, thus reducing the ability to achieve the Millennium Development Goals (MDGs) and the more global Sustainable Development Goals (SDGs). Countries with economies in transition and less developed countries are among the most vulnerable to the adverse effects of climate change, and widespread poverty limits their ability to adapt.

Recognizing the impacts of climate change on different regions of the world, the United Nations has devoted SDG 13 to take urgent action to combat climate change and its impacts. The targets of this goal are to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries; integrate climate change measures into national policies, strategies and planning; improve education, awareness raising and human and institutional capacity in the areas of climate change mitigation, adaptation, impact reduction and early warning; implement the commitment undertaken by developed-countries to address the needs of developing countries in the context of meaningful mitigation actions;

Table 2. Risks for water, health and other sectors through climate change

Phenomenon	Examples of major projected impacts by sector, mainly through water			
	Water resources	**Agriculture, ecosystems**	**Health**	**Industry and society**
Heavy precipitation events	• Flooding • Adverse effects on quality of surface and groundwater due to sewer overflows • Contamination of water supply • Water scarcity may be relieved	• Damage to crops • Soil erosion • Inability to cultivate land due to waterlogging of soils	• Increased risk of deaths, physical injuries and infectious, respiratory and skin diseases • Risk of psychological disorders	• Disruption of settlements, commerce, transport and societies due to flooding, migration • Pressures on urban and rural infrastructures • Loss of property
Higher variability of precipitation, including increased droughts	• Changes in run-off • More widespread water stress • Increased water pollution due to lower dissolution of sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution • Salinization of coastal aquifers	• Land degradation • Lower yields/ crop damage and failure • Increased livestock deaths • Increased risk of wildfire	• Increased risk of food and water shortage • Increased risk of malnutrition • Increased risk of water and food-borne diseases	• Water shortages for settlements, industry and societies • Reduced hydropower generation potentials • Potential population migration
Increased temperatures	• Increased water temperatures • Increase in evaporation • Earlier snow melting • Permafrost melting	• Less water available for agriculture, more irrigation needed • Changes in crop productivity • Changes in growing season	• Changes in vector-borne diseases • Increase of fatalities due to heatwaves, and decreased personal productivity	• Risk for infrastructure fixed in permafrost • Degradation of freshwater quality

	• Prolonged lake stratification with decreases in surface layer nutrient concentration and prolonged depletion of oxygen in deeper layers • Increased algae growth reducing dissolved oxygen levels in the water body which may lead to eutrophication and loss of fish • Changes in mixing patterns and self purification capacity	• Changes in species composition, organism abundance, productivity and phonological shifts, such as example earlier fish migration	• Increased risk or respiratory and skin diseases due to increased production of pollen by each plant and a loss in productive ozone layers	

Source: Bates and others, 2008; IPCC, 2007.

and promote mechanisms to strengthen capacity in terms of effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.

Adaptation to climate change is consequently indispensable and urgent since the climate is already changing in some respects, and mitigation will take too long to show effects. Further climate change throughout this century and beyond is almost certain even if global mitigation efforts prove successful. In addition, it is more cost effective to start preparing for adaptation now.

Adaptation represents an important challenge for all countries, especially for those with economies in transition, but few have developed adaptation strategies so far. Knowledge and experience of adaptation in a transboundary context are especially lacking.

Impacts of climate change on health

Climate change poses a significant threat to public health at a global level. According to the IPCC Fouth Assessment Report, climate change contributes to the global burden declared of disease and premature death.

Addressing the impacts of climate change on human health is challenging because of the wide spectrum of determinants that influence health including the physical and social environment, the introduction of new technologies, and changing political landscapes that reshape social and

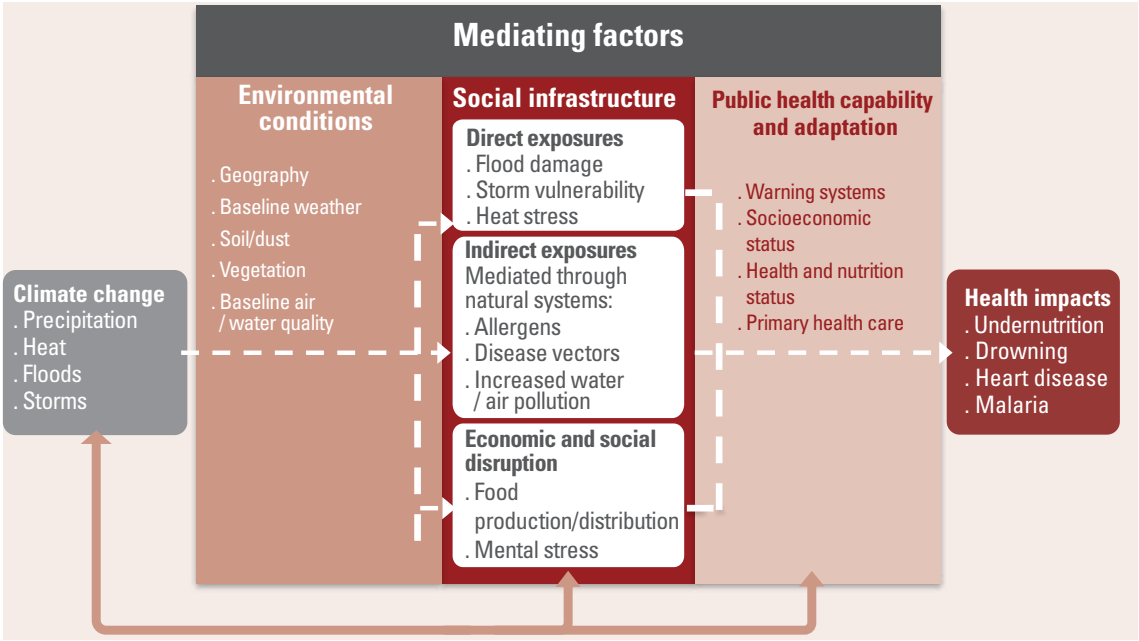
economic conditions. Health is directly and indirectly related to the impacts of climate change. Direct impacts of climate change on human health include mortality and morbidity from extreme weather events (floods, heatwaves, droughts and hurricanes) while indirect impacts on human health include longer-term climatic changes that affect the range and reproductive rates of disease vectors, extending transmission seasons, increasing the incidence of food- and water-borne diseases, and resulting in poor air quality and food insecurity (IPCC, 2007; 2014). Figure 2 provides a conceptual framework depicting the links between climate change and human health.

In a recent report, the World Health Organization (WHO) attributed 0.2 per cent of annual global mortality to climate change (WHO, 2009). The same report attributes about 1.2 million annual deaths to urban air pollution, 2.2 million to diarrhoea, 3.5 million to malnutrition, and 60,000 to natural disasters, all of which are climate-sensitive outcomes prone to increase with a warmer and more variable climate. Despite the multiplicity of possible impacts, the threat that climate change is likely to pose to human health and security should not be underestimated (WHO/EMRO, 2008). The interactions between environment and health are complex, highly dependent on local conditions, and dynamically shaped by national, regional, and international pressures.

More recent statistics from a WHO assessment, taking into account only a subset of the possible health impacts and assuming continued economic growth and health progress, concluded that climate change is expected to cause approximately 250 000 additional deaths per year between 2030 and 2050: 38 000 due to heat exposure in elderly people, 48 000 due to diarrhoea, 60 000 due to malaria, and 95 000 due to childhood undernutrition (WHO, fact sheet No. 266, 2015).

Figure 2 shows three primary exposure pathways, by which climate change affects health: directly through weather variables, such as heat and storms; indirectly through natural

Figure 2. Primary exposure pathways by which climate change affects health



systems, such as disease vectors; and pathways heavily mediated through human systems such as under nutrition. The green box indicates the moderating influences of local environmental conditions on how climate change exposure pathways are manifest in a particular population. The grey box indicates that the extent to which the three categories of exposure translate to actual health burden is moderated by such factors as background public health, socioeconomic conditions, and adaptation measures. The green arrows at the bottom indicate that there may be feedback mechanisms, positive or negative, between societal infrastructure, public health, adaptation measures, and climate change itself (IPCC Fifth Assessment Report, 2014).

Extreme weather event impacts on health

Extreme weather events including floods, droughts, storms, fires, and heatwaves have had an impact on morbidity and mortality. These weather events are expected to increase and intensify as a result of global climate change (IPCC, 2007). Victims of these disasters often find shelter in inadequate housing that lacks basic environmental services, therefore increasing the risk of water-, air- and vector-borne illnesses and rising rates of hunger and malnutrition (WHO/EMRO, 2008).

Extreme weather events have been associated with a variety of psychological impacts due to loss, social disruption, displacement, and repeated exposure to natural disasters. The Centers for Disease Control (CDC) projects indicated that, by 2050, 200 million people will be displaced by climate change-related factors worldwide (CDC, 2010).

Geographic displacement, loss or damage of property, death or injury of loved ones and recovery efforts, following natural disaster events, will exacerbate mental health problems and stress-related disorders, which include post-traumatic stress disorder, depression, anxiety, sleep difficulties, and sometimes drug or alcohol (World Bank, 2011). These events may impact livelihoods and socioeconomic and demographic situations, which in turn result in increased rates of violence and injuries. Some studies have shown a relation between such mental health disorders or stress resulting from climate change and other negative health effects, such as blood glucose levels and cardiovascular disease (World Bank, 2011).

Flood-related diseases

Floods disrupt basic sanitation systems, increasing probabilities of diarrheal disease outbreaks through the faecal-oral route. They also typically contaminate drinking water sources and facilities with pathogens present in human or animal sewage, increasing the risk of outbreaks of waterborne diseases such as dysentery, hepatitis A, cholera, typhoid fever, or leptospirosis.

Floods may indirectly lead to an increase in vector-borne diseases through the expansion in the number and range of vector habitats.

Heatwave-related mortality and morbidity

Heatwaves can cause death (i) directly through causing heat illnesses and (ii) by aggravating pre-existing heat-sensitive medical conditions. Additional risk factors for heat-related mortality are mediated through the additional pressure on water and electrical systems, risk-associated behavioural responses, and worsening environmental conditions, especially air quality.

Box 2. Climate change-related hazards and risks in (North Africa): (Adapted from WHO, UNFCCC Climate and Health Country Profile-2015)

EGYPT

Egypt, with the Mediterranean coastal region in the North and a very dry climate in other areas, is highly vulnerable to climate change. Much of the population lives on the Nile Delta, and any change in sea level rise threatens agricultural, water and economic security. Furthermore, the country's double burden of disease will be exacerbated by climate change. Increased temperatures could result in increased heat stress and higher rates of diseases such as skin cancers. Infectious and vector-borne diseases could also be exacerbated by changing weather and rainfall patterns.

Main climate-related hazards and risks in Egypt:

Under high emissions scenarios, the following is predicted:

Mean annual temperature: projected to rise by about 5.6°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.6°C.

Flooding due to sea level rise: An annual average of about 2.4 million people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If emissions decrease rapidly and there is a major scale up in protection (i.e. continued construction/raising of dikes), the annual affected population could be limited to about 700 people. Adaptation alone will not offer sufficient protection, as sea level rise is a long-term process, with high emissions scenarios bringing increasing impacts well beyond the end of the century.

Infectious and vector-borne diseases: In the baseline year of 2008, there were an estimated 2,700 diarrhoeal deaths in children under 15 years old. Under high emissions scenarios, diarrhoeal deaths attributable to climate change in children under 15 years old is projected to be about 10.9per cent of about 1,000 diarrhoeal deaths projected in 2030. Although diarrhoeal deaths are projected to decline to about 300 deaths by 2050, the proportion of deaths attributable to climate change could rise to approximately 15.2 per cent.

Undernutrition: Climate change, through higher temperatures, land and water scarcity, flooding, drought and displacement, is expected to negatively impact agricultural production and cause breakdowns in food systems, leading to food insecurity. Vulnerable groups risk further deterioration into food and nutrition crises if exposed to extreme weather events. In Egypt, the prevalence of child malnutrition in children under age 5 is expected to go much higher than the current level of 7.0 per cent (2014).

Heat-related deaths in the elderly (65+ years): projected to increase to approximately 47 deaths per 100,000 by 2080 compared to the estimated baseline of about one death per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to under 9 deaths per 100,000 in 2080.

Increased heat-related morbidity can occur, such as mortality, through direct heat illness or through aggravation of pre-existing diseases. Either of these outcomes may require primary care or hospitalization, and a proportion of this morbidity may eventually result in mortality. Though heat-related deaths are often documented as such, heat illnesses sometimes pass unnoticed or unreported in low and middle income countries, calling for the use of proxies for baseline data when planning and designing public health actions. Heatwaves increase the risk of hyperthermia (excessive body temperature) that entails serious risks for health and may result in death. Hyperthermia may result in heat exhaustion, cramps and/or heat stroke. Furthermore, the stress from extreme weather events is associated with myocardial infarction, sudden cardiac death and stress-related cardiomyopathy. People with pre-existing illnesses such as cardiovascular and respiratory diseases are more prone to heat cramps, heat syncope, heat exhaustion, and heat stroke as a result of elevated temperatures.

Indirect health consequences of climate change

The increased temperatures and more variable precipitation that have been documented over the past two decades, and which are projected to continue into the next century (IPCC, 2007), have indirect effects on health. Changes in temperature, humidity and rainfall affect vector-borne disease transmission as well as waterborne and food-borne disease. These changes also interfere with agricultural systems and affect crop yields, which could create food and water shortages leading to malnutrition. The WHO estimated that in the year 2004, the world faced a total of 141,277 deaths and disease burden of 5.4 million Disability-Adjusted Life Years (DALYs) as a result of global climate change. The same report estimated that the Eastern Mediterranean Region (EMR) faced a total of 20,000 deaths and disease burden of 755,870 DALYs as a result of global climate change (WHO, 2004). This is likely to be an underestimation since the exposure was only measured in terms of carbon emissions and the outcome measures were limited mainly to diarrhoea, lower respiratory infections and malaria.

Box 3. Women's role in climate change adaptation

Women's roles vary in urban, rural and Bedouin communities, both inside and outside their homes. Roles range from food preparation, child care and disease prevention. In rural areas, additional responsibilities may include care of large animals, raising poultry, breeding small ruminants, land cultivation and harvesting, while in desert areas, additional responsibilities would be fetching water, collecting shrubs and small ruminants grazing. Women may also have income-generating roles, such as manufacturing and marketing certain products.

As women are often a source and transmitter of heritage, they transfer traditional knowledge and skills related to water resources, agriculture, health and appropriate nutrition, including how to cope with harsh conditions such as high temperatures and drought.

Women are often the first line of defence when it comes to children's personal hygiene, clothing, nutrition and other factors that help prevent disease, not only by taking charge of such matters but also by teaching their children. Special attention must be paid to training women, especially with regards to water scarcity and climate variability.

Vector-borne diseases

Climate-related environmental changes such as increased temperatures, variable humidity and rainfall trends may affect the density of vector populations, their transmission patterns, and infection rates (WHO, 2003). Furthermore, rapid human developments have led to increased water demand and construction of dams and irrigation canals and have spurred changes in mosquito populations. As a consequence, vector-borne illnesses—closely associated with temperature and humidity conditions—such as malaria, dengue fever, Rift Valley fever, and West Nile virus may intensify, re-emerge in previously endemic areas, or emerge in areas not previously affected.

Water-related illnesses

Inadequate water supplies, either in quantity and quality, may lead to increased risk of waterborne illnesses such as diarrhoea, typhoid, hepatitis, dysentery, giardiasis, bilharziasis, and cholera. Cholera epidemics are likely to emerge in areas experiencing warmer weather and water, such as the Arabian Peninsula. Forty per cent of mortality in children under five years of age is related to diarrhoeal disease.

The increasing pressure on fresh water resources has led to a rise in the use of wastewater for irrigation. But if improperly treated, the use of wastewater can create increased health risks to farmers, families, and consumers (WHO/EMRO, 2008).

Food-borne diseases and malnutrition

Globally about 800 million people suffer from malnutrition with 3.5 million deaths per year, (WHO 2009; WHO/EMRO, 2008). Climate change affects the agricultural sector and food production and thereby threatens the basic needs of people in the region. Increased temperature, less water available for irrigation, and more variable precipitation will reduce crop yields in some regions.

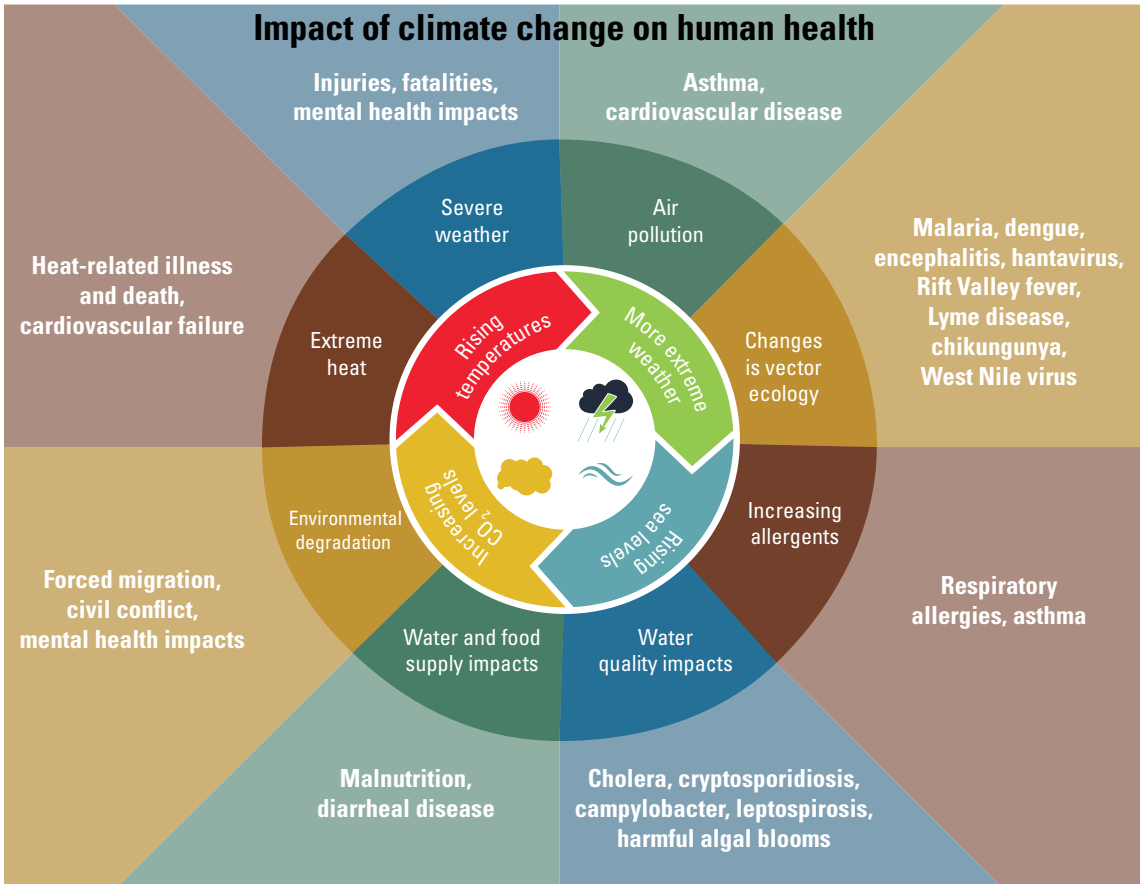
Climate change is likely to increase the occurrence of the kind of worldwide agricultural price shocks experienced in 2007-2008 and again in 2010-2011 (World Bank, 2011).

Food-borne illnesses result from the ingestion of spoiled or contaminated food such as seafood contaminated with metals or crops with pesticide residues or microbes (Interagency Working Group on Climate Change and Health (IWGCCH), 2010). Extreme weather events such as droughts encourage the proliferation of crop pests and the spread of mold that may be harmful to humans. Changes in climate may also affect environmental ocean parameters that lead to the proliferation of existing or new pathogens that are harmful to human health (Centers for Disease Control (CDC), 2010). Harmful algal blooms produce toxins that when ingested through shellfish will also cause human diseases. The increase in pests and weeds could also lead to a wider use of pesticides and a higher risk of pesticide exposure (CDC, 2010).

Other health effects

Weather conditions including temperature, humidity, and wind also affect ambient air quality, which is largely determined by anthropogenic sources of pollutants. Climate-related environmental factors including dust storms, rainfall, and increases in temperature, raise the ambient concentrations of aeroallergens (including pollen

Figure 3. Impact of climate change on human health



Source: Adapted from U.S. Climate resilience Toolkit https://toolkit.climate.gov/topics/human-health.

and dust), ground level ozone, and suspended particulate matter, which exacerbate respiratory illnesses (IWGCCH, 2010). Figure 3 shows a representation of specific diseases and health impacts associated with rising temperatures, rising sea levels and weather extremes.

Increased human exposure to toxic substances as a result of climate change-related factors may be linked to cancers in humans. For example, volatile and semi-volatile carcinogens are transferred from water and wastewater into the atmosphere as a result of higher ambient temperatures, and toxic pollutants are washed out by heavy rains and floods contaminating runoffs and ultimately water resources (Macdonald and others, 2003). However, limited evidence has been established on these transfers and their impact on people's exposure to carcinogens and ultimately their impact on cancer outcomes (IWGCCH, 2010).

Cardiovascular illnesses have been linked to climate change-related variables such as average daily temperatures (World Bank, 2011). Physiological adjustments to cold and warmth are associated with changes in blood pressure, blood viscosity and heart rate, all important determinants of mortality related to cardiovascular diseases and strokes (World Bank, 2011).

Box 4. Climate change-related hazards and risks in Oman

The Sultanate of Oman is located in the southeast of the Arabian Peninsula, with a population of 4 million and an economy predominantly dependent on oil. The country is one of the most water scarce in the world and climate change is likely to worsen drought and desertification, threaten water security and disrupt agricultural production. Rising temperatures increase the risk of heat-related morbidity and mortality. Furthermore, the incidence and severity of natural disasters, such as the cyclones experienced in recent years, are expected to rise.

Main climate-related hazards and risks in Oman

Under high emissions scenarios, the following is predicted:

Mean annual temperature: is projected to rise by about 5°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.5°C.

Flooding due to sea level rise: an annual average of about 81,300 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If emissions decrease rapidly and there is a major scale up in protection (i.e. continued construction/raising of dikes), the annual affected population could be limited to about 100 people. Adaptation alone will not offer sufficient protection, as sea level rise is a long-term process, with high emissions scenarios bringing increasing impacts well beyond the end of the century.

Infectious and vector-borne diseases: By 2050, under both emissions scenarios, approximately 200,000 people are projected to be at risk of malaria, a decline from the baseline value of just over 681,000. A high emissions scenario is projected to see the population at risk increase towards 2070 whereas a rapid decrease in emissions could support the continued decline of malaria risk towards 2070, with the population at risk projected to be just over 6,100.

Undernutrition: Climate change, through higher temperatures, land and water scarcity, flooding, drought and displacement, negatively impacts agricultural production and causes breakdown in food systems. These disproportionally affect those most vulnerable to hunger and can lead to food insecurity. Vulnerable groups risk further deterioration into food and nutrition crises if exposed to extreme weather events. In Oman, the prevalence of child malnutrition in children under age 5 is expected to grow much higher than the current level of 8.6 per cent (2009).

Heat-related mortality in the elderly (65+ years): projected to increase to about 34 deaths per 100,000 by 2080 compared to the estimated baseline of just over 3 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to about 7 deaths per 100,000 in 2080.

Source: Adapted from WHO, UNFCCC Climate and Health Country Profile-2015.

Linkages between the impact of climte change on water resources and health

As indicated earlier, the impact of climate change on water quality and quantity is direct, evident, and has been proven by an overwhelming majority of studies. Certain countries are more prone to the impact of climate change on water resources than others. The Arab countries are one of the most vulnerable countries to the impact of climate change on all sectors with a specific concern for the water sector.

The close linkage between the water quality and quantity and impacts on the public health is also very direct and clear, since water has a profound influence on human health. At a very basic level, a minimum amount of water is required for consumption on a daily basis for survival and therefore access to some form of water is essential for life. However, water has much broader influences on health and well-being and issues, such as the quantity and quality of the water supplied, are important in determining the health of individuals and whole communities.

The first priority must be to provide access for the whole population to some form of improved water supply. Even though access may be restricted by many reasons, climate change would come as an important factor that will affect the availability of water and its quality. These linkages between the water issues and health must be addressed if public health is to be protected and made less vulnerable to the impact of climate change on water resources.

The quality of water does, however, have a great influence on public health; in particular the microbiological quality is important in preventing ill health. Poor microbiological quality is likely to lead to outbreaks of infectious water-related diseases and may cause serious epidemics.

Chemical water quality is also important and its impact on health tends to be chronic with long-term effects, and time is available to take remedial action. Acute effects may be encountered where a major pollution event has occurred as in the case of disaster and failure of some water utilities and sanitation infrastructure due to extreme events of droughts and floods, two elements that are expected to increase in frequency due to climate change.

Weaknesses in the linkages between the climate change component, water resources, health, and gender are further exacerbated by the absence of gender-specific data and information. Research in various sectors and institutions is often conducted separately, thereby discouraging joint research and weakening the reliance on scientific research. Meanwhile, partnerships and integration are still lacking between the private sector, civil sector and the public sector, which are failing to deliver on principles of sustainable development at all stages of planning, implementation, monitoring and evaluation.

Microbiological drinking-water quality and human health

Climate change is expected to impact the microbiological quality of drinking water due to the decrease in surface runoff and the associated increase in the level of their microbial contamination. Thus, an increase in the spread of important infectious and parasitic diseases such as cholera, typhoid, dysentery, hepatitis, giardiasis, guinea worm and schistosomiasis can be expected as a result of climate change impact on water resources.

Many other diseases are also associated with water in other ways. Water may act positively in the control of some diseases through its use in hygiene, and may act as a source or vector for others where contact with water is required for disease transmission or where agents of diseases or insect vectors require water in which to complete their life cycle. The various relationships between water and disease are summarized in table 3.

Table 3. Diseases related to water and sanitation

Group	Disease	Route leaving host	Route of infection
Diseases which are often water-borne	Cholera	faeces	oral
	Typhoid	faeces/urine	oral
	Infectious hepatitis Giardiasis	faeces	oral
	Amoebiasis	faeces	oral
	Dracunculiasis	faeces	oral
	Cholera	cutaneous	percutaneous
Diseases which are often associated with poor hygiene	Bacillary dysentery	faeces	oral
	Enteroviral diarrhoea	faeces	oral
	Paratyphoid fever	faeces	oral
	Pinworm (Enterobius)	faeces	oral
	Amoebaisis	faeces	oral
	Scabies	cutaneous	cutaneous
	Skin sepsis	cutaneous	cutaneous
	Lice and typhus	bite	bite
	Trachoma	cutaneous	cutaneous
	Conjunctivitis	cutaneous	cutaneous
Diseases which are often related to inade	Ascariasis	faecal	oral
	Trichuriasis	faecal	oral
	Hookworm (Ancylostoma / Necator)	faecal	oral / percutaneous
Diseases with part of life cycle of parasite in water	Schistosomiasis	urine/faeces	percutaneous
Diseases with vectors passing part of their life	Dracunculiasis	cutaneous	percutaneous

Source: Adapted from Bradley, D J, 1981 London School of Hygiene and Tropical Medicine.

The above-mentioned diseases are caused by the ingestion of contaminated faecal material transmitted by the faecal - oral route. Infectious agents of all types may be transmitted by the faecal - oral route via water, including viruses (such as infectious hepatitis, rotavirus and Norwalk agent); bacteria (such as cholera, typhoid and dysentery); and parasites (such as Giardia, Cryptosporidium and Entamoeba).

Faecal pollution of drinking water may be driven by the lower water quantities or the pollution episodes caused by wastewater plants malfunction or destruction due to extreme events of floods.

Box 5. Leishmaniasis in Tunisia

Leishmaniasis is an endemic NTD (neglected tropical disease) in the MENA region that represents a significant health burden. The disease is caused by infection with a Leishmania parasite, transmitted by a sandfly vector. Globally, approximately 1.3 million cases of leishmaniasis occur annually, and approximately 1.7 billion people globally live in areas where they may be at risk of developing a form of the disease (Piglott, and others, 2014). Between 2004-2008, 7631 cases of Leishmania were reported by Potigo, 2010 and other cases by Alvar and others, 2012. Climate change is reducing the number of cold days and nights and raising minimum temperatures (IPCC, 2013), helping significantly in the reemergence of diseases such as the Leishmania whose main vector is ZCL (zoonotic cutaneous form of leishmaniasis).

A male Phlebotomus sp. sandfly. © World Health Organization (PHIL #3812), 1975

The Agence Tunisienne de Coopération Technique and l'Observatoire des Maladies Emergentes undertook an adaptation project, which is the "Analysis of the Health Impacts of Climate Change Adaptation Strategies: The case of transmission of zoonotic cutaneous leishmaniasis (ZCL) from Leishmania major in Tunisia", which studied climate change adaptation strategies that reduce transmission of zoonotic cutaneous leishmaniasis from Leishmania major in an area at risk of the disease in Tunisia. Using a multidisciplinary ecosystem approach, the project tested technical solutions (such as early warning systems for epidemics), to identify and test appropriate preventive actions to mitigate the vulnerability of women to the disease. For women,

The disfiguring scars caused by zoonotic cutaneous leishmaniasis can have psychological and social consequences for its victims. (IDRC, 2010-2011)

the lasting marks of the disease can be devastating and can have psychological and social consequences for its victims (IDRC, 2010-2011).

The research team found that with the current warming trend, the hot season is prolonged and cuts into the two intermediate seasons, spring and fall. The growing length of the hot season and its overlap with the rainy season means the period of time favorable to ZCL transmission is increasing.

Water management and irrigation practices are being adapted to limit exposure to the disease by limiting nighttime irrigation to reduce contact with sandflies; improve water management and irrigation systems to limit soil saturation and conserve moisture; monitor temperatures, rainfall, sand rat populations, and vegetative cover for early warning signs; and keep livestock, waste and manure away from households.

Source: Piglott, D. a., Golding, N., Duda, K., Battle, K., Brady, O., Messina, J., and others (2014). Global distribution maps of Leishmaniases. Elife 3.
Alvar, J., Velez, I., Bern, C., Herrero, M., Desjeux, P., Cano, J., et; al. (2012). Leishmaniasis worldwide and global estimates of its incidence. PLoS One 7.
IPCC (2013). The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingodom and New York, NY, USA: Cambridge University Press.
IDRC, D. (2010-2011). Climate Change Adaptation in Africa Program. 2010-11 Annual Report.

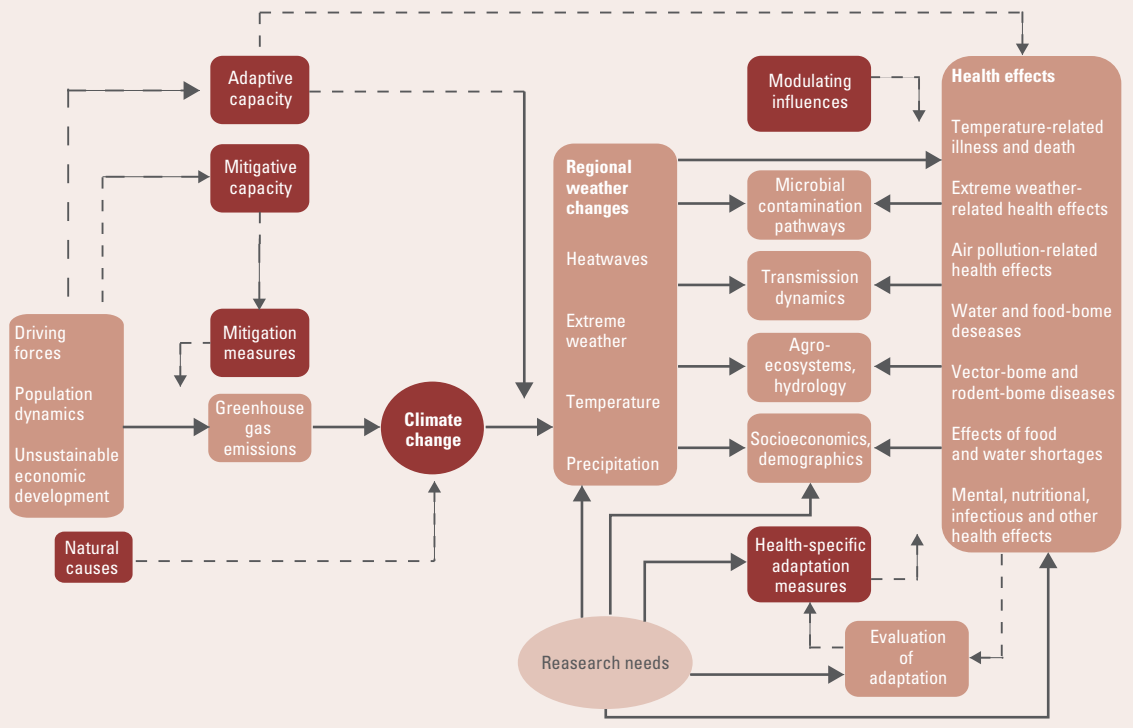
The annex provides an exercise that guides practitioners in determining immediate and long-term effects of extreme weather and climate change on water safety and the resulting potential negative health outcomes. See exercise 1: Climate impacts on water and public health and tracking climate readiness for a region/country.

CH. 3

Impact and Vulnerability Assessment of the Health Sector Based on RICCAR Outputs

Impact and Vulnerability Assessment of the Health Sector Based on RICCAR Outputs

Figure 4. Climate change and health: pathway from driving forces through exposure to potential health effects



Arrows under research needs represent input required by the Health sector.
Source: WHO, 2003.

RICCAR indicators and outputs that feed into the identification of adaptation measures

Vulnerability and adaptation assessments do not only improve the understanding of the linkages between climate change and health, they can also serve as baseline analysis against which changes in disease risks and protective measures can be monitored. They can also provide the opportunity for building capacity and can strengthen the case for investment in health protection.

In its attempt to carry out a vulnerability assessment for the Arab region, the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) selected the water sector, biodiversity and ecosystems, agriculture, infrastructure and human settlements, and people as the main sectors for the assessment. Figure 7 outlines the possible impacts of climate change on these sectors. The impacts on human health were detailed within the people sector.

Figure 5. RICCAR sectors and impacts selected for the Arab region vulnerability assessment

Sectors	Impacts	(Sub) Vulnerability
Water	Change in water availability	V0
Biodiversity and Ecosystems	Change in area covered by forests	V1
	Change in area of wetlands/marshes	V2
Agriculture	Change in water available for crops	V3
	Change of rangeland for livestock	V4
Infrastructure and Human Settlements	Change in inland flooding area	V5
	Change in coastal flooding area	V6
People	Change in water available for drinking	V7
	Change in health due to heat stress	V8
	Change of employment rate in the agricultural sector	V9

Source: Adapted from Adelphi, 2013; VA-WG.

RICCAR explained that water availability provides the entry point when preparing the vulnerability assessment for the Arab region.

The issue of public health as discussed by RICCAR

"Water, already a scarce resource in the Arab region, may further decrease in quality and quantity which will put pressure on the availability of drinking water for the population. Climate change effects on agricultural production in already arid and semi-arid areas may lead to a loss of labour opportunities in the agricultural sector and trigger further migration to urban centers, which may in turn cause social disturbances and put further stress on already densely populated areas" (RICCAR, 2015).

"Increasing temperatures, decreasing rainfall as well as the increased frequency and intensity of extreme weather events, such as heatwaves and dust storms will be some of the most severe challenges posed by climate change to the population in the Arab region, threatening their livelihoods and health. Higher temperatures, especially in the summer months, may have severe impacts on public health, in particular affecting the young and elderly and those working in economic sectors requiring outside work, such as agriculture, security and construction" (RICCAR, 2015).

Thus, RICCAR identified the following three key climate change impacts on people to be included in the vulnerability assessment of the Arab region:

- Change in the availability of water for drinking;
- Change in the rate of employment in the agricultural sector;
- Change in the state of human health due to heat stress.

RICCAR vulnerability indicators of exposure, sensitivity, and adaptive capacity indicators are detailed in the introductory training manual. The RICCAR modelling outcome has predicted at least an increase of 2°C within the next few decades. As far as the health sector is concerned, the people of the Arab region will then be subjected to impacts of less water availability for drinking, hygiene, and agricultural production. This will directly impact the population through the many pathways indicated in the previous chapter. The water availability decrease through decreased precipitation and increased temperature patterns will almost hit all countries of the Arab region especially those depending greatly on the surface water resources to cater for their agricultural production such as Egypt, Jordan, Morroco, the Sudan, the Syria Arab republic, Tunisia, etc. Heatwaves have also been predicted to come on a more frequent pattern with higher intensity and longer durations. The direct and indirect impacts of heatwaves were also discussed in chapter 2.

Vulnerability assessment tools for climate change impacts on the health sector

Health vulnerability assessment

A useful definition of 'vulnerability' in the public health context is the "the degree to which a system is susceptible to injury, damage, or harm". This broad definition emphasizes the importance of well functioning institutions and the accessibility to quality healthcare that safeguards individual and population health. In this module, vulnerability will be defined as being a function of exposure, sensitivity, and adaptive capacity. Sensitivity encompasses (1) the ability of a community to withstand these exposures and the range of associated impacts; and (2) physiological (such as co-morbidities or disabilities) and socio-economic factors (such as poverty) that increase the susceptibility of individuals to the exposure. The concept of sensitivity also includes access to functioning infrastructure that can influence how people withstand an exposure (such as availability of electricity during an extreme heat event). The potential public health impact, jointly produced by exposure and sensitivity, can be offset by adaptive capacity. Adaptive capacity refers to behavioural, institutional, and technological responses and adjustments to lessen the potential impact. Typically, such adaptations limit damages, provide recovery opportunities, and enhance coping with consequences.

Protecting health from climate change: Vulnerability and adaptation assessment using WHO guidance

In response to the 2003 request made by the World Health Assembly to WHO to support countries in strengthening actions to protect health from climate change, WHO built on past guidance and technical tools to outline a flexible process for vulnerability and adaptation assessment. The guidance is designed for countries to assess which populations are most vulnerable to different kinds of health effects, to identify weaknesses in the systems

that should protect them, and to specify interventions to respond. Further, the resulting assessments can improve evidence and understanding of the linkages between climate and health, serve as a baseline analysis against which changes in health risk and protective measures can be monitored, provide the opportunity for building capacity, and strengthen the case for investment in health protection.

Steps in assessing vulnerability and adaptation

Assessment steps should be consistent with the risk management framework. They need to be considered in future policy development. It is worth mentioning that not all steps may be possible or desirable, and the determination of which steps are included depends on the objectives and resources available for the assessment.

1. Determine the scope of assessment

The first step is to specify the scope of assessment in relation to:

- The health and community security issues of concern today and of potential risk in the future;
- The geographical region to be covered by the assessment; and
- The time period.

Interactions between weather, climate and health are location-specific; using epidemiological evidence based on local data, if available, is therefore important. Assessments should include current vulnerability to climate variability to inform understanding of what could occur with climate change. The extent to which an assessment addresses these issues depends on the goals of the assessment and the resources available.

The national boundaries may not be the most appropriate geographical framework for assessment. Climate, diseases and vectors do not respect national boundaries, and other countries may therefore need to be considered to assess the national risk.

The responsible national or regional health authority can identify the health outcomes to be included in collaboration with, when appropriate, (1) the authorities responsible for the social security, environmental affairs and meteorological offices; (2) the research community; and (3) other stakeholders, such as nongovernmental organizations, business and the public.

2. Describe the association between disease outcomes and climate variability and change

Once health outcomes (the climate-sensitive diseases) are identified for inclusion in the assessment, the current evidence (published literature) should be reviewed. A variety of statistical methods are available to analyse associations with exposure to weather or climate, taking into account modifying and/or interacting factors. Meteorologists can provide input into how to define and describe the important types of weather exposure; for example, the severity and recurring periods of extreme weather events.

For each chosen outcome, determining the factors that could modify its association with weather and climate variables is important. Modifying factors will vary by disease outcome and could include socioeconomic and other variables.

The current burden of climate-sensitive diseases can be described using the following indicators and outcomes:

- the current incidence and prevalence of the disease and the trend (is the disease increasing or decreasing?), which may be available from routine statistics from the appropriate national agency;
- the attributable burden of a disease to climate and/or weather, such as what proportion of all cardiovascular deaths is attributable to high or low temperatures or the number of deaths caused by floods.

For vector-borne diseases, having a map showing the current geographical distribution of human cases and vectors may be useful. Finally, environmental and socioeconomic conditions also influence human vulnerability and need to be considered within the assessment.

Fountain. © Fawzia Al-Ruwaih

3. Identify and describe current strategies, policies, and measures that reduce the burden of climate-sensitive diseases

Activities and measures that individuals, communities and institutions currently undertake to reduce the burden of disease should be identified and evaluated for effectiveness. Adaptation measures can be identified from: (1) review of the literature; (2) information available from international and regional agencies and national health and social welfare authorities (ministries of health); and (3) consultations with other agencies and experts that deal with the impact of the health outcome of concern. Identifying successful adaptations being undertaken to address the negative effects of climate variability and those implemented in anticipation of climate change is important. For example, is an early warning system for heatwaves in place?

The key questions to address for a specific health outcome include the following:

- What is being done now to reduce the burden of disease? How effective are these policies and measures?
- What could be done now to reduce current vulnerability? What are the main barriers to implementation (such as technology or political will)?
- What strategies, policies, and measures should begin to be implemented to increase the range of possible future interventions?

4. Review the health implications of the potential impacts of climate variability and change on the other sectors

The impact of implemented strategies, policies and measures in response to actual or projected climate change needs to be evaluated in terms of potential health effects. For

example, in cases where domestic water storage is recommended, the implementation of this measure may have implications for vector breeding and the transmission of dengue. Water development projects should be subject to environmental and health impact assessment.

5. Estimate the future potential health impact

The climate change community often chooses from the present until 2050 and until 2100 as the reference periods for projecting the impact of climate change. This requires using climate scenarios such as those adopted by RICCAR. The time scale of the assessment depends on the scope and purpose of the assessment. However, addressing potential effects both in the near term (the next 20 years) and the long term (up to 2050 or 2080) is advisable. The focus on the near term provides relevant information within the usual planning horizon of health agencies. A further need is looking beyond the near term to develop comprehensive adaptation measures.

Models of climate change should include projections of how other relevant factors may change in the future, such as population growth, income, fuel consumption and other relevant factors. Scientists, policy-makers and the public must recognize the existence of multiple sources of uncertainty, from climate projections to the potential future public health effects. This step should be realistic about the likelihood that the uncertainty can be resolved in a meaningful period.

Future capacity to adapt to the effects of climate change depends on the future levels of economic and technological development, local environmental conditions and the quality and availability of health care and of public health infrastructure. Social, economic, political, environmental and technological factors strongly influence health.

6. Synthesize the results and draft a scientific assessment report

Convening an interdisciplinary panel of experts with relevant expertise is one approach to developing a consensus assessment. Assumptions that underlie any quantitative estimates should be clearly described, and such quantitative estimates should be clearly identified with a climate scenario. The degree of certainty of a statement should be provided (see chapter 4). The most vulnerable population groups should be identified.
Value judgments have to be made in summarizing the assessment. In particular, decisions should be taken about:

- how to balance near-term and long-term effects;
- how to weight the different potential effects in different population groups;
- how to balance the more certain, quantifiable potential effects with those that are less certain and not quantifiable, as well as the qualitative effects; and
- how to balance the interests of the various stakeholder groups: experts, people potentially affected and decision-makers.

7. Identify additional adaptation policies and measures, including procedures for evaluation after implementation

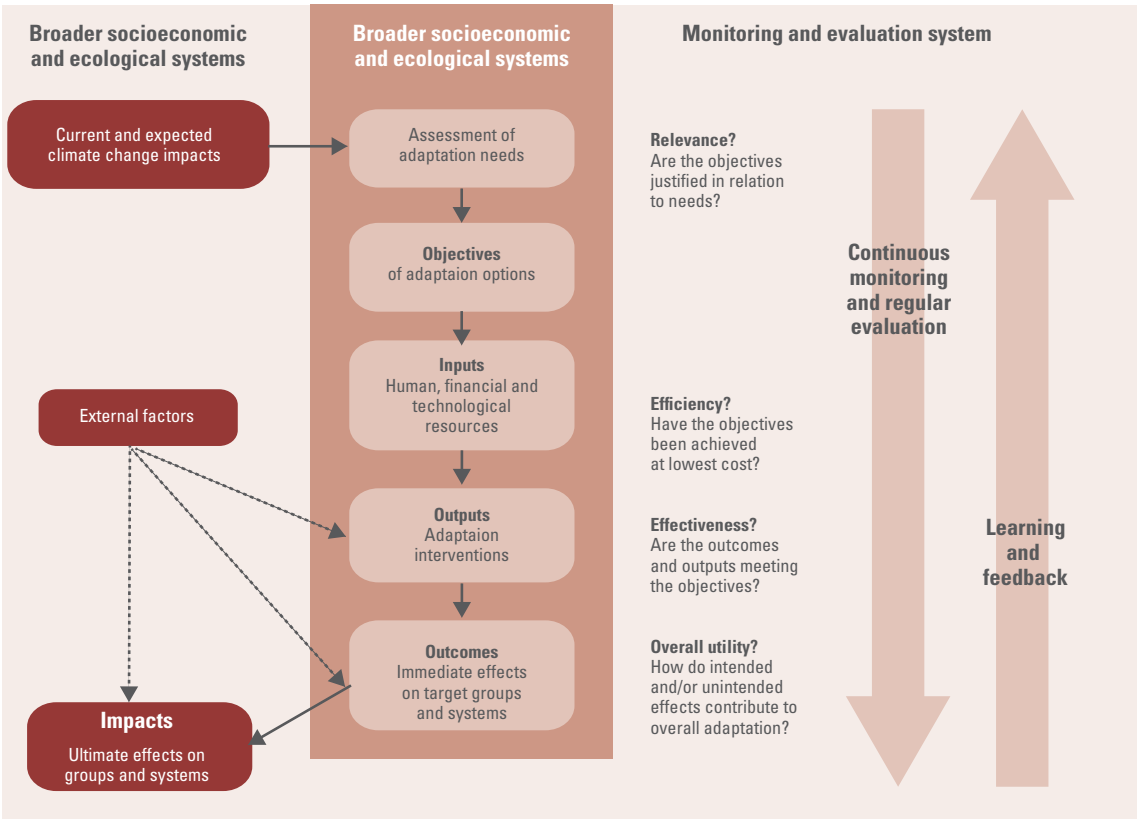
This step includes identifying possible adaptation measures that could be undertaken over the short term to increase the capacity of individuals, communities and institutions

to effectively cope with the weather or climate exposure of concern. These measures should be possible to institute within the population's access to material resources, technology and human and social capital. For example, if heat-related morbidity and mortality are health issues in an urban area and if an early warning system for heatwaves is not in place, then would implementing such a system be likely to benefit population health? Strengths and weaknesses as well as opportunities and threats to implementation should be evaluated and priorities set.

Every country needs to adapt to long-term climate change. The aim of this step is to identify possible measures that can be taken today and in the future to increase the ability of individuals, communities and institutions to effectively cope with future climate exposure, including extremes. Figure 6 depicts a framework for adaptation, monitoring and evaluation that was proposed by the UNFCCC, 2010.

Many of the possible measures for adapting to climate change lie primarily outside the direct control of the health sector. They are rooted in areas such as sanitation and water supply, education, agriculture, trade, tourism, transport, development and housing. Inter-sectoral and cross-sectoral adaptation strategies are needed to reduce the potential health impact of climate change. A policy analysis will determine the feasibility of and priorities among these options. In general, many of the policies and measures identified also promote sustainable development.

Figure 6. A proposed framework for adaptation, monitoring and evaluation



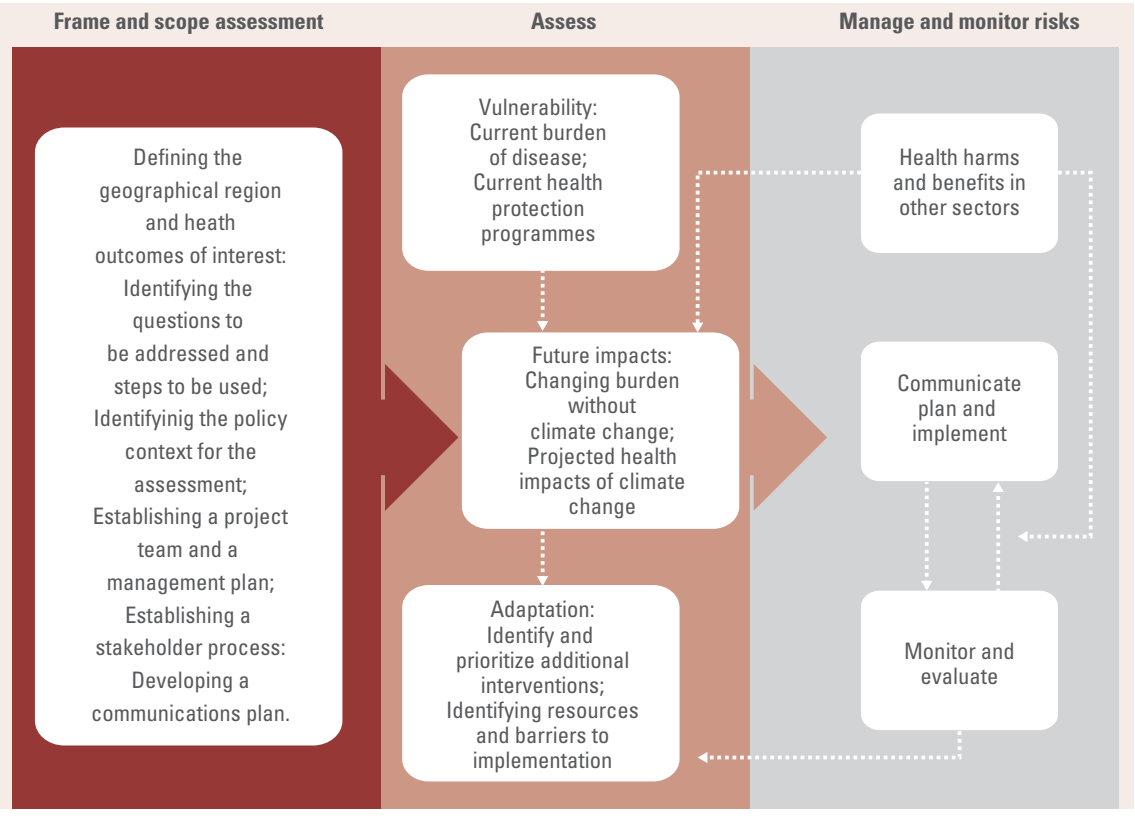
Source: UNFCCC, 2010 (as depicted by PROVIA Guidance on Assessing Vulnerability, Impacts and Adaptation to Climate Change Consultation Document). UNEP, 2013.

Criteria should be established in advance for evaluating possible adaptation measures. Evaluation should be an ongoing process both to identify opportunities for improving the effectiveness of the measures but also to identify maladaptation and unintended consequences as quickly as possible. The traditional public health methods for evaluating the efficacy and effectiveness of a particular intervention should be applied, with appropriate consideration of the local circumstances.

Figure 7 details the WHO guidance framework to protect health from climate change through health adaptation planning. This framework is designed to ensure that the process of iteratively managing the health risks of climate change is integrated into the overall NAP process, including assessing risks; identifying, prioritizing, and implementing adaptation options; and monitoring and evaluating the adaptation process. Supported by the Least-developed Countries Expert Group (LEG), the United Nations Framework Convention on Climate Change (UNFCCC) and other relevant partners (such as UNDP, UN Environment, WHO, development agencies and nongovernmental organizations), countries can use the NAP process to start planning their mid- and long-term priorities to build resilience to climate change across all relevant sectors.

To achieve the goals of healthy people in healthy communities, it is critical that the health sector is properly represented in the NAP process. Not including the health sector in adaptation planning can miss critical actions to protect population health, and can result in policies and programmes in other sectors inadvertently causing or contributing to adverse health impacts, thereby also undermining efforts to protect the environment.

Figure 7. WHO guidance to protect health from climate change through health adaptation planning: health within the NAP process (HNAP)



The health national adaptation process (HNAP) should be the health component of the national adaptation plan (NAP), including as an output a detailed health adaptation plan designed to achieve the national health adaptation goals within a specific period of time and given available resources.

In line with the official IPCC definition, the vulnerability of a particular system is highly contingent upon four main components: the magnitude of its exposure to climate change hazards, its degree of sensitivity to the hazards, the resulting amount of impact and its level of adaptive capacity.

Box 6. Lessons learned from Georgia, USA – Vulnerability sssessment case study

Heat-related illness in Georgia

Heat-related illness in Georgia accounted for approximately ten classified deaths annually from the period 1999 to 2010. A recent study in Georgia using data from 2002 to 2008 found that on average 1,937 individuals visited emergency departments in the summer months for heat-related illness (i.e. any symptoms related to heat exhaustion, heatedema, heat stroke, or heat-related accidents) every year. Moreover, it is estimated that one in seven Georgia residents are employed in agriculture, forestry, and other related areas. Thus, occupational exposure to extreme heat events is also of concern.

Factors associated with heat-related illness

This case study defined vulnerability using three groups of factors: sensitivity, adaptive capacity and exposure. Four different measures were used for sensitivity to extreme heat. First, a poverty measure was included in the analysis because previous research has shown that this socioeconomic indicator was associated with increased heat-related mortality. Second, data on the percentage of householders living alone greater than or equal to 65 years of age were used because social isolation, particularly in the elderly, was found to increase the risk of heat-related illness. Third, as a measure for renal disease, which was shown to have increased mortality during an extreme heat event, counts of haemodialysis patients were used, which were collected at the zip code level and provided by the Center for Medicare and Medicaid Services. Other health outcomes could be used as well, as numerous studies on heat-related illness have shown a positive relationship between ambient temperatures and the number of heat-related hospitalizations and deaths, diabetes, cardiovascular issues and diseases of the nervous system. Lastly, communities with sparse vegetation have been associated with higher ambient temperatures that can increase heat exposure for individuals. Satellite imagery from 2006 was classified to represent impervious surfaces (such as streets, rooftops), as provided by the United States Geological Survey. In the context of this case study, adaptive capacity was defined as the ability for a community to cope with a hazardous exposure. As a measure for adaptive capacity, the number of medical infrastructure facilities per county was used (i.e. total number of hospitals, surgical facilities, ambulatory services, and Red Cross shelters). The number of heat events was used as a measure for hazardous heat exposure. A heat event was defined as two or more consecutive days when the heat index was >100°F. This information was obtained for every county in Georgia during 2002-2011. A more expansive healthcare

infrastructure was considered to indicate a higher adaptive capacity to cope with the health impacts during extreme heat.

Approach to construct vulnerability index

After identifying the six factors associated with heat-related illness to be used for an overlay analysis, the relevant data was acquired and imported into a geographic information system (GIS). A domain weighting approach was used, where the factors representing sensitivity, exposure, and adaptive capacity were weighted equally. Specifically, the factors of sensitivity (poverty, elderly living alone, renal disease, impervious surfaces) accounted for one third of the composite heat vulnerability index; historic heat exposure accounted for one third, and hospital insufficiency also account for one third of the composite vulnerability index. Within each layer, the data were classified and assigned different weighting factors, which allowed for capture of geographic variability within the data layer seen in the map of county heat-event exposure. For example, poverty data was initially categorized (i.e., per cent population under the poverty limit) into four categories (scores) using a quartile classification method, and then assigned a weighting factor according to increasing risk: 0.25, 0.5, 0.75, and 1.0. The category with the highest risk would be assigned 1.0 and the category representing the least risk would be assigned 0.25. After all weighting factors were calculated within each layer, a spatial index was created by overlaying each layer and adding the values that overlapped (i.e. an additive overlay index). Theoretically, further weight schemes could be used on each layer according to their known importance to the health outcomes. However for this analysis, the factors representing sensitivity, exposure, and adaptive capacity were weighted equally.

Results

The final vulnerability analysis for the state of Georgia shows that vulnerability to heat-related illness extends beyond urban zones. In western metropolitan Atlanta, several areas are designated as high categories for vulnerability, due to the high percentage of impervious surfaces in combination with a percentage of elderly living alone. It was also noted that several rural areas are also designated as most vulnerable of Georgia, which experienced relatively more historic hazardous heat events, had less access to hospital infrastructure (i.e. decreased adaptive capacity), and had relatively higher percentages of people living alone. Furthermore, previous heat exposure in combination with hospital insufficiency accounts for two-thirds of the composite vulnerability index score, which in southern rural Georgia are both relatively high. Future work includes an addition of locations of cooling shelters to assess if vulnerable communities have access to these during extreme heatwaves. Additionally, this kind of a vulnerability assessment could be validated by linking observed heat-related health data collected by the Georgia Department of Health.

Adapted from: Center for Disease Control and Prevention, CDC, 2014, Assessing Health Vulnerability to Climate Change, A Guide for Health Departments, Climate and Health Technical Report Series, Climate and Health Program.

Annex A provides an exercise that guides practitioners in determining immediate and long-term effects of extreme weather and climate change on water safety and the resulting potential negative health outcomes.

Practitioners can refer to the annex for an exercise to carry out a vulnerability assessment of the health sector in one of the countries of the Arab region, using scoring and vulnerability ranking scales (see exercise 2: Convening a methodological framework for the vulnerability assessment).

CH. 4

Identification of Adaptation Measures and Options (IWRM Tools) for the Health Sector Based on the Impact and Vulnerability Assessment Results

CH. 4

Identification of Adaptation Measures and Options (IWRM Tools) for the Health Sector Based on the Impact and Vulnerability Assessment Results

According to Assessments of Impacts and Adaptations to Climate Change (AIACC) final report (2007), the following recommendations are to be adopted:

- Start adaptation immediately;
- Create conditions to enable adaptation;
- Integrate adaptation with development;
- Increase awareness and knowledge;
- Strengthen institutions;
- Protect natural resources;
- Provide financial assistance;
- Involve those at risk;
- Use place-specific strategies.

The following sections will pave the way for adopting such recommendations into the development, implementation, and verification of adaptation to climate change programmes in the health sector with the emphasis on the IWRM tools.

Stocktaking for available adaptation measures

The literature provides many priority interventions that can be adopted by the health sector in order to adapt to the impact of climate change. The national circumstances should be reflected in needed adaptation interventions depending on the strength and resilience of the institutions of the different sectors and the health sector in particular. Below is a summary of the many possible adaptation measures that can be considered towards the development of a national action plan to adapt to the impacts of climate change, while table 4 below provides a sample matrix that can be used to record different types of adaptation measures based on target areas.

Institutional and strategic interventions

- Support "healthy" development strategies in other sectors that protect and promote health and mitigate climate change;
- Implement adaptive strategies at local and national level to minimize impacts of climate change on the population's health;
- Enhance intersectoral coordination and regional collaboration;
- Ensure mainstreaming of public health concerns and health protection from climate change in all national, regional and international action on climate change;
- Enact positive discrimination for women in legislation to ensure their active participation and enrolment in the developmental process, thereby strengthening their capacity and access to decision-making at different levels;

Monitoring water quality in Anbar, Iraq. © Sadeq Oleiwi Sulaiman

- Establish political institutions for assistance and coordination of activities for change adaptation and climate change.

Environmental quality monitoring and control

- Monitor air and drinking water quality;
- Intensify water pollution control activities and ensure safe reuse of wastewater;
- Enhance environmental sanitation;
- Secure minimum household water requirements to maintain health;
- Ensure regional, national and local data is available, and that it is disaggregated by gender.

Health institutions enhancement

- Maintain and upgrade national public health infrastructure.

Awareness and capacity development

- Review public awareness programmes (food handling, storage, governmental food monitoring actions) and integrate them into an adaptation action plan;
- Build capacity for prevention and response to disease epidemics;
- Strengthen and expand capacity intervention of the different plans and national programmes under climate change;
- Direct adaptation measures to the most vulnerable categories: women and especially rural women, children and the elderly;
- Strengthen the institutional capacity of the public health systems for providing guidance and leadership on health protection from climate change.

Early warning systems

- Develop early warning systems (EWS) and control programmes for infectious diseases;
- Establish weather and seasonal forecasting and early warning systems, disaster planning and educational and public awareness programmes;
- Develop early warning for weather for the prevention of its effects on the population
- Integrate disaster risk management within the national strategy as well as capacity-building programmes to assign and activate all responsibilities;
- Enhance surveillance system.

Table 4. List of potential adaptation measures for the health sector

	Prevention measures	Measures to improve resilience	Preparation measures	Response measures	Recovery measures
Institutional and strategic interventions					
Environmental quality monitoring and control					
Health institutions enhancement					
Awareness and capacity development					
Early warning systems					

Evaluating and prioritizing adaptation measures and the selection criteria

The methodology for identifying the needed adaptation measures for the water sector can be implemented through the following action plan and activities:

A. Consulting with stakeholders is the first step towards identifying the adaptation measures

The aim of such a consultation is to:

- Have clear effective and useful opinions, comments, recommendations, and possible changes on the project work plans, actions, tasks and methodologies adopted to fulfil the necessary objectives;

- Foster stakeholder participation in research projects to bridge the gap between scientists, policy-makers and all other relevant parties;
- Engage stakeholders to streamline the flow and sharing of information, and avoid duplication of work and undue delays in taking decisions;
- Improve understanding of local knowledge and practices and public awareness, which are essential for successfully implementing adaptation measures, avoiding maladaptation and unsustainable solutions.

B. Review all possible adaptation measures for water availability and water quality as well as the health-related adaptation measures in connection with water ones

The revision process can be achieved through detailed investigation of all possible adaptation measures outlined in literature. The revision process will have to focus on the following issues:

- Review all possible adaptation measures for water availability for conventional and nonconventional water as wastewater reuse, water desalination, weather modification, brackish water and industrial wastewater;
- Review all possible adaptation measures for water demand management, residential water supply, surface water development and groundwater recharge;
- Review all possible adaptation measures for water quality in terms of pollution, protection and management;
- Review all possible adaptation measures for water monitoring systems, measures to improve system efficiency, watershed management, urban water use, flood control, research programmes, institutional reform and irrigation water;
- Review all possible adaptation measures related to socio-economic issues;
- Review all possible adaptation measures related to health issues in terms of the legislative, institutional, plans and programmes.

Based on this revision, all possible adaptation measures for the health and water sectors can then be listed (an example is shown in table 5).

C. Evaluate all possible adaptation measures for their suitability and applicability to the study area under consideration, and suggest and prioritize the best possible adaptation measures

Even though there is a large number of alternative methods for the selection and prioritization of adaptation measures (table 5), there is still no single commonly accepted one. Some of the widely used attributes include: benefits (i.e. win-win), co-benefits with other adaptation measures and with other policies (i.e. sustainable development, land use planning, risk management, etc.), costs (financial resources used may include: capital investment, operational costs, indirect costs, etc.), sustainability, flexibility, effectiveness, time spent for planning and implementation of the adaptation measure, timeframe for which the adaptation measure will be effective, technical feasibility of the adaptation measure, barriers to its implementation, equitability, robustness, social acceptance, autonomous adaptation (i.e. raising awareness and providing information, etc.), type of adaptation measure (i.e. technological, informational, infrastructural, organizational, behavioral, ecosystem-based and socio-economic) and internal/external impacts.

Table 5. An overview of decision tools for prioritization and selection of adaptation measures

Method	Prevention measures
Benefit-cost analysis	UNFCCC, 2008; Schipper and others, 2010; De Bruin and others, 2009; UKCIP, 2007; Brouwer and van Ek, 2004; Anika and others, 2012; EC, 2013; Lim and others, 2004; Brown and others, 2011; Bizikova and others, 2008; Pütz and others, 2011; OECD, 2009
Cost-effectiveness	UNFCCC, 2008; Schipper and others, 2010; UKCIP, 2007; Anika and others, 2012; Lim and others, 2004; Bizikova and others, 2008; OECD, 2009
Multi-criteria analysis	UNFCCC, 2008; Schipper and others, 2010; De Bruin and others, 2009; UKCIP, 2007; Brouwer and van Ek, 2004; Bell and others, 2002; Anika and others, 2012; Lim and others, 2004; Bizikova and others, 2008; Pütz and others, 2011; OECD, 2009
Policy exercise	UNFCCC, 2008
Tool for environmental assessment and management	UNFCCC, 2008
Adaptation decision matrix	UNFCCC, 2008
Screening of adaptation options	UNFCCC, 2008; UKCIP, 2007
Climate-related risks estimate as indicators of necessity for adaptation responses	UNFCCC, 2008

Source: Adapted from Dogulu, N. and Elcin Kentel, 2015.

Prioritization methods using various aggregation mechanisms (i.e. combining with weights) estimate an overall performance for each alternative adaptation measure. The ones with higher performances are then selected to be implemented first. Since adaptation operates at different spatial and societal scales and the success is evaluated against different criteria at these different levels, relative weights allocated to each criterion should not be given but rather should emerge from societal processes of consent and action.

In order to facilitate the evaluation process, the following method can be adopted:

- A method based on multi-criteria score should be used in order to derive an accurate evaluation. A set of criteria has to be selected (based on different sources such as IPCC from the assessment guideline report). Example criteria for screening the appropriate adaptation for a region are shown in table 6. Each stakeholder should complete is own version of this table

- The final score represents the sum of the weights of each sub-criteria used in the evaluation multiplied by the ratio.
- Weights should be assigned by the experts based on the regional conditions and in accordance with their importance in the evaluation, and should sum up to 100 per cent (see table 6).
- The ratio is the stakeholder judgment for each proposed adaptation under each sub-criteria having a range from 1 to 5, where 1 represents the lowest level and 5 represents the highest ratio level.
- Table 7 identifies the adaptation categories and measures.
- Next, for each stakeholder enter the scores from table 6.
- The scores (or percentages) of each stakeholder in each row should be summed and divided by the number of stakeholders in order to derive an average score (and percentage) for each adaptation measure.
- Lastly, sort and input the adaptation measures based on their score into table 8 in descending order from highest to lowest priority.

According to the evaluation of the opportunities, barriers, and suitability of each suggested adaptation to climate change, risks will be ranked according to combination of elements from various options (decision support tool). The "best" or "preferred" option involves the costs, benefits and impacts of alternative strategies comparison.

It is suggested that the most feasible immediate actions should be set first especially those that deal with management of existing infrastructures, including the institutional frameworks that deal with those infrastructures.

Setting priorities requires choosing criteria to weigh different concerns. These criteria can also act as indicators of the success or failure to realize the objectives, and can be used by a monitoring/evaluation programme for the adaptation strategies, policies and measures. A matrix or other tool should be used to facilitate this process through collecting experts' feedback.

The final scores can then be calculated based on averaging the scores obtained from stakeholders' responses (an example is shown in table 7). The prioritized adaptation measures based on this analysis should be summarized after including the results from all stakeholders (an example appears in table 8).

D. Develop needed mechanisms and interventions to integrate the proposed adaptation measures in national policies and action plans

Across different countries and regions, a variety of policy instruments and tools (mechanisms and interventions) aim to integrate the proposed adaptation measures into national policies and action plans. To achieve this integration, the following should be considered:

- All international environmental standards, policy tools and instruments related to climate change have to be reviewed. The most suitable combination of these instruments and tools can then be suggested;
- Initially, the overall goals should be determined through the issuance of environmental standards;
- The means to achieve those goals should be selected through either command-and-control and/or market approaches (including environmental subsidies, taxes, deposit/refund system, and/or permit trading systems);
- Legislating goals and means should be identified, then monitored and enforced.

Table 6. Criteria used for evaluating the suggested adaptation measures

Criteria	Sub-criteria	Description	Weight	Sub-weight
Sustainability	Mitigation (adaptation) benefits	Changes in the level of greenhouse gas emissions created by the adaptation measure	25	10
	Ecosystem impact	The degree of environmental impacts on biodiversity		7
	Equity	Number of people benefiting from the adaptation - if possible disaggregated by gender, age, class		8
Effectiveness	Robustness (ability to adopt under different scenarios)	Elaborate how effective this measure could be for a diverse range of plausible future scenarios	20	5
	Reliability	Identify if this measure is untested or the effectiveness of this measure if proven		5
	Cost effectiveness (Low regret)	Identify if this measure will bring high relative benefits to the costs		10
Risk and urgency	Urgency	Identify the time frame of impact occurrence from recent past, present until short- and long-term future	15	5
	Degree of risk (potential extent of future risks)	Identify potential extent of future risks from minor and reversible until irreversible		5
	Uncertainty or precautionary	Estimate how well the risks are understood		5
Opportunity	Ancillary benefits	Identify how this measure will contribute to other community goals	10	3
	No-regret option	Identify if this measure has benefits regardless of actual climate change impacts		3
	Window of opportunity	Identify if there is currently a window of opportunity to implement this measure		4

Criteria	Sub-criteria	Description	Weight	Sub-weight
Implementation	Initial cost	Identify the approximate cost of implementation; the cost could be compared with cost of inaction over time	30	5
	Operating and maintenance cost	Identify the cost of operation and maintenance over time, compared to other budget expenditures		5
	Public acceptability	Elaborate on public support or opposition to this measure		5
	Funding sources	Identify availability and sources of potential funding		5
	Capacity (information, technical, staff, resources)	Estimate if current capacity is sufficient and, if not, identify capacity gaps		5
	Institutional	Identify if implementation is within local control or it requires coordination with, or action by, other jurisdictions		5
Final score	Sum of all scores multiplied by weight (maximum score is 500)		Divide the result by 5 to get a per cent	

Table 7. Evaluation results of suggested adaptation measures according to stakeholder participation

Implementer	Stakeholder 1		Stakeholder 2		Stakeholder 3		Stakeholder 4		Stakeholder 5		Stakeholder 6		Overall	
Criteria / Sub-criteria	Score		Score		Score		Score		Score		Score		Score	
Weight	Total		Total		Total		Total		Total		Total		Total	
Sub-weight	100	%	100	%	100	%	100	%	100	%	100	%	100	%
Adaptation category A														
Adaptation measure 1														
Adaptation measure 2														
Adaptation measure 3														
Adaptation category B														
Adaptation measure 1														
Adaptation measure 2														
Adaptation measure 3														
Adaptation category C														
Adaptation measure 1														
Adaptation measure 2														
Adaptation measure 3														

Table 8. Prioritized adaptation measures based on multi-criteria analysis

Suggested adaptation measure	Score

Throughout the process, stakeholder involvement is essential so that the results of the impact assessment and strategic choices are owned by the implementing agencies, and this has been facilitated by the range of solutions and strategies that has broadened over time by improvements in technologies. What has changed is our understanding and implementation of the integrated ensemble of water management measures that conform to modern principles and policies.

CH.

5

Adaptation Measures Implementation Matrix

Adaptation Measures Implementation Matrix

"Adaptations employ a diverse portfolio of planning and practices that combine subsets of:

- Infrastructure and asset development;
- Technological process optimization;
- Institutional and behavioural change or reinforcement;
- Integrated natural resources management (such as for watersheds and coastal zones);
- Financial services, including risk transfer;
- Information systems to support early warning and proactive planning.

Although approaches vary according to context and the level of government, there are two general approaches observed in adaptation planning and implementation to date: top-down and bottom-up. Top-down approaches are scenario-driven and consist of localizing climate projections, conducting impact and vulnerability assessments, and formulating strategies and options. National governments often take this approach. National adaptation strategies are increasingly integrated with other policies, such as disaster risk management. These tendencies lead to adaptation mainstreaming, although there are various institutional barriers to this process. As the consideration of the social dimensions of climate change adaptation has attracted more attention, there has been an increased emphasis on addressing the needs of the groups most vulnerable to climate change, such as children, the elderly, disabled, and poor. Bottom-up approaches are needs driven and include approaches such as community-based adaptation (CBA). CBA is often prominent in developing countries, but communities in developed countries also use this approach. Where a combination of top-down and bottom-up activities has been undertaken, the links between adaptation planning and implementation have been strengthened. In either approach, participation by a broad spectrum of stakeholders and close collaboration between research and management have been emphasized as important mechanisms to undertake and inform adaptation planning and implementation.

Local governments and actors may face difficulties in identifying the most suitable and efficient approaches because of the diversity of possible approaches, from infrastructure development to "softer" approaches, such as integrated watershed and coastal zone management. National and subnational governments play coordinating roles in providing support and developing standards and implementation guidance. Therefore, multilevel institutional coordination between different political and administrative levels is a crucial mechanism for promoting adaptation planning and implementation."

Source: Mimura and others, 2014.

Institutional and legislative analysis and assessment for adaptation implementation plan

Assessments of vulnerability, impacts and adaptation will often seek to understand institutional and legislative contexts. This also includes political, social and economic factors

that structure individual choices. Such methods are broadly categorized as institutional analysis (Hinkel and Bisaro, 2013a as described by Tearfund, 2010). Below is a description of some approaches towards achieving this form of analysis:

Governance description

Governance description approaches describe the actors and institutions relevant for adaptation. These types of analyses have been applied all around the world in the context of climate change. For example, Tol and others (2008), as described by Tearfund (2010), review the institutional context for adaptation in coastal zone management in Europe, and identify three levels of decision-making: national governments, local governments and private individuals. They find that national level decisions are partly determined by European Union policies, such as the Coastal Bathing Water Directive, the Water Framework Directive and the Habitat Directive. This type of approach requires no strong theoretical assumptions on the part of the analyst, and contributes to adaptation by providing a more comprehensive description of the policy context in which adaptation takes place.

Governance design

Governance design addresses the question of how to design effective institutions, on the theoretical assumption that the link between institutions and outcomes can be understood and predicted with some confidence. One particular kind of governance design approach that has been applied extensively in the adaptation literature is policy analysis. Policy analysis seeks to determine "which of various alternative policies will achieve a given set of goals in light of the relations between the policies and the goals" (Nagel, 1999). It is applied ex-ante to improve the design of policies, programmes or projects.

Much of the literature has employed policy analysis to analyse mainstreaming of adaptation into policies. Because adaptation occurs in all sectors and at all levels of social organization, the goal of adaptation policy is generally to ensure that existing policies address relevant climate risks and to increase the capacity of individuals and societies to respond to these risks. This indicates that adaptation is not a stand-alone policy domain; adaptation is rather the task of integrating or mainstreaming the consideration of climate change risks into existing sectoral policies. The recommendations of high-level adaptation policy documents, such as the European Union White Paper on Adaptation (European Commission, 2009), are illustrative, as they focus on the need to increase the consideration of climate risks across all sectors.

One focus of mainstreaming studies has been development policy, where mainstreaming has been carried out through portfolio screening in order to identify climate risks that might conflict with development policy goals.

However, if climate is already being considered, the critical task is "climate-proofing" the policy in question. "Proofing" policies involves addressing relevant risks early in the policy formulation process to identify any obvious effects on other sectors or objectives. The practice of proofing policies is well established in other sectors, such as health and rural sectors. One example is the tool developed by GIZ for climate-proofing development plans (GIZ, 2011).

Governance emergence

These methods aim to understand and explain governance emergence. A distinction is made between approaches that assume that it is possible to generalize beyond a single case and those that do not.

These approaches face the general challenge that the ratio between the number of relevant variables and the number of cases is often too high to derive statistically significant results. Nonetheless, with these limitations in mind, carefully constructed studies comparing a large number of similar cases have produced an accumulation of evidence leading to conclusions about general characteristics of socio-ecological systems that can be related to desirable outcomes.

An example is the institutional prescriptions for adaptive water governance (Huitema and others 2009, as described by Tearfund, 2010). In relation to adaptation, these prescriptions provide input regarding institutional attributes that enhance the adaptive capacity of actors faced with climate risks. These general prescriptions need to be supplemented by contextual knowledge when implementing adaptation interventions. The fact that the prescriptions remain general and require contextualization differentiates the approach from that of policy design, which assumes that outcomes can be predicted ex ante. Table 9 describes the institutional set-up methods.

Table 9. Institutional analysis methods

Method type	Governance description	Governance emergence		Governance design	
		Understanding case	Generalizing design principles	Policy screening	Policy proofing
Task	Identifying the relevant actors and institutions for adaptation	Explaining the emergence of governance systems that enable adaptation		Identifying policies that ensure goals are not negatively affected by climate change impacts	
Adaptation situation	Vulnerability impacts and adaptation are a result of many actors interacting and making interrelated decisions			Climate change risks to policy goals are not known	Climate change risks to policy goals are known
Theoretical assumptions	None	Attributing an outcome to an institution is only possible on a case-by-case basis	It is difficult to attribute outcomes to a particular institution	There is a direct predictable relationship between policies and outcomes	

Box 7. Case study: Community-based water management in the Yemen: Improving climate change awareness, water management, and child health, and Empowering Women

The inadequate access to drinking water leads to the spread of diseases such as malaria, bilharzia and diarrhea (Assad, 2010). Concurrently, water scarcity has negative implications for food security and malnutrition, which affect women and children; thereby, increasing women's workload as distances to clean water sources increase, making the daily task of collection more time consuming.

During dry seasons, water collected in open reservoirs represents the only source for the local community. There are only 3 cisterns, which can store up to 10,000 m^3 of water/year for the entire community. This makes the area very poor in water resource availability. A community-based water management project in the Amran district of the Yemen has a strong focus on gender. The German Agency for Technical Cooperation (GTZ) project emphasizes on building women's capacity to participate in water management-related decision-making, and raising women's awareness of methods to conserve and purify water.

Several project strategies were used to empower women, including the following:

- Launching literacy classes to teach adults
- Establishing 38 village water committees (VWCs) with strong female participation
- Distributing sand filters to schools, mosques, and non-governmental organizations. The Yemeni Women's Union played a leading role in raising awareness of the health benefits of sand filters. Women were trained on filter use, cleaning, and maintenance (Ghayth Aqua-tech, 2012).

Positive results occurred within several areas:

- ***Water management.*** Female VWC members noted that women's participation in committees meant that they were able to address the real needs of the water sector and to raise awareness about cistern management and use. The elected water management committee was formed and composed of 5 males and 3 females who were responsible for implementing this initiative;
- ***Health.*** Achievements included reductions in waterborne diseases affecting children and decreased expenditure on health (Verner, 2012);
- ***Attitudes toward women.*** Women's effective participation, both in the project and in the VWCs, sensitized men and religious and community leaders to gender inequalities in adaptation;
- ***Women's empowerment.*** Some female committee members noted that women's participation encouraged them to take part in the local council elections, increasing women's access to decision-making processes Assad, 2010.

Achievement of project targets (Colburn, 2009):

1. ***Project target #1:*** 80 per cent reduction of diarrhea in children under the age of five in households adopting H_2O purifying technologies.
- Project achievement: 84 per cent reduction = exceeded target by 4 per cent

2. ***Project target #2:*** Thermotolerant coliform (TTC) in household drinking water is reduced to 0 in households (HH) adopting purifying technologies.
- Project achievement: 71 per cent of HH reduced to 0 and a 90 per cent reduction in average bacteria count in all project areas.

3. ***Project target #3:*** 50 per cent reduction in reported cases of diarrhea among children under the age of 5 within target villages.
- Project achievement: 66 per cent reduction = exceeded target by 16 per cent

---

Sources: Assad, R. (2010). Field notes on the gender-related aspects of a GTZ community-based water management project in Yemen. (Eschborn, Germany, GTZ).
Silver Filters. (n.d.) Retrieved from http://www.silverfilters.org/Images/Girlandfilter.jpg.
Ghayth Aqua-tech. (2012). Final report of Local Community Initiatives in Water Governance. Yemen.
Verner, D. (2012). MENA Development Report Adaptation to a Changing Climate in the Arab Countries: A Case for Adaptation Governance and Leadership in Building Climate Resilience (Washinghton DC, World Bank).

Identification of barriers to adaptation to climate change impacts

The transfer of technologies and practices that have the potential to reduce or adapt GHG emissions and CC impacts are often hampered by various constraints called "barriers" (IPCC TAR, 2000). Thus, selecting the best CC adaptation measure should be based on barriers-opportunities analysis to decrease the gap between the market potential of a technology or practice and the economic, socioeconomic or technological potential.

According to Pierre Mukheibir report (2005), the common barriers to implementing some adaptation measures and practices are related to financial, planning, institutional and technical capacity, and social aspects. The most common barriers for adapting a climate adaptation measure focus on either the lack of local capacity to implement the suggested strategies or on low financial resource bases to cover the capital and running costs of most of the strategies. While local governments compete for nationally allocated funds for capital expenditure, running costs are mostly covered from local revenues, which for the smaller and remote local municipalities are insufficient to ensure water security at this level.

The Organization for Economic Co-operation and Development (OECD, 2006) reported that the main barriers to mainstreaming adaptation to climate change are the lack of awareness of climate change within the development community and limitations on resources for implementation. The OECD suggested that several opportunities exist for more effective integration of climate change adaptation within development activities. These include the following:

- Making climate information more relevant and usable;
- Developing and applying climate risk screening tools;
- Using appropriate "entry points" for climate information;
- Shifting emphasis to implementation rather than developing new plans;
- Encouraging meaningful co-ordination and the sharing of good practices.

Kareiva and others (2007) have summarized the barriers and opportunities to successful implementation of climate change adaptation strategies (table 10). Barriers and opportunities may be categorized into policies and procedures, human and financial capital, institutional coordination and collaboration, and information and tools.

Table 10. Barriers and opportunities to successful implementation of climate change adaptation strategies

Barrier	Opportunity
POLICIES AND PROCEDURES	
Legislation and agency policies may be highly static, inhibit dynamic planning, impede flexible adaptive responses and force a fine-filter approach to management.	Re-evaluate capabilities of, or authorities under, existing legislation to determine how climate change can be addressed within the legislative boundaries.
Seasonal management activities may be affected by changes in timing and duration of seasons.	Review timing of management activities and take advantage of seasonal changes that provide more opportunities to implement beneficial adaptation actions.
Agency policies do not recognize climatic change as a significant problem or stressor.	Take advantage of flexibility in the planning guidelines and processes to develop management actions that address climate change impacts.
HUMAN AND FINANCIAL CAPITAL	
Lack of incentive to take risks, develop creative projects; reward system focuses on achieving narrowly prescribed targets; funds allocated to achieve targets encourage routine, easily accomplished activities.	Shift from a culture of punishing failure to one that values creative thinking and supports incremental learning and gradual achievement of management goals.
Little to no climate expertise within many management units at the regional and local level; disconnect between science and management that impedes access to information.	Use newly created positions or staff openings as opportunities to add climate change expertise; train resource managers and other personnel in climate change science.
National and regional budget policies/processes constrain the potential for altering or supplementing current management practices to enable adaptation to climate change; general decline in staff resources and capacity.	Look for creative ways to augment the workforce and stretch budgets to institute adaptation practices (such as individuals or parties with mutual interests in learning about or addressing climate change that may be engaged at no additional cost).
INSTITUTIONAL COORDINATION AND COLLABORATION	
Political boundaries do not necessarily align with ecological processes; some resources cross boundaries; checkerboard ownership pattern of public and private lands at odds with landscape-scale management.	Identify management authorities/agencies with similar goals and adjacent lands; share information and create coalitions and partnerships that extend beyond political boundaries to coordinate management; acquire property for system expansion.

INFORMATION AND TOOLS	
Often no inventory or baseline information on condition exists, and nothing is in place to detect climate change impacts.	Identify existing monitoring programmes for management; develop a suite of climate change indicators and incorporate them into existing programmes.
Historic conditions may no longer sufficiently inform future planning (such as, "100-year" flood events may occur more often and dams need to be constructed accordingly)	Evaluate policies that use historic conditions and determine how to better reflect accurate baselines in the face of climate change; modify design assumptions to account for changing climate conditions.
Lack of decision support tools and models, uncertainty in climate change science, and critical gaps in scientific information that limits assessment of risks and efficacy and sustainability of actions.	Identify and use all available tools/ mechanisms currently in place to deal with existing problems to apply to climate-change related impacts.
Occurrence of extreme climate events outside historical experience.	Use disturbed landscapes as templates for "management experiments" that provide data to improve adaptive management of natural resources.
Stakeholders/public may have insufficient information to properly evaluate adaptation actions, and thus may oppose/prevent implementation of adaptive projects (such as those that have ground-disturbing elements like salvaging harvests after disturbance and using herbicides before revegetating). Appeals and litigation from external public often result in the default of no action.	Inform public and promote consensus-building on tough decisions; invite input from a broad range of sources to generate buy-in across stakeholder interests.

Source: Adapted from Karieva and others, 2007.

Overcoming the barriers could be achieved through:

- Promoting Integrated Water Resources Management;
- Improving NAPAs and ensuring they are trans-boundary in scope;
- Supporting the local level and participation;
- Managing uncertainty by adaptive planning;
- Finding fresh and flexible funding;
- Moving water to the forefront.

Progress on adaptation in different sectors will require an understanding of why and how national level authorities and policy may not be conducive to integrating adaptation within these sectors. Similarly, identifying and capitalizing upon existing opportunities will pave the way forward.

To strengthen national policy frameworks, Tearfund proposed five steps. Table 11 details these steps and the approach needed to implement them.

Table 11. Approaches to strengthen the national policy frameworks

Step	Goal	Approach
1.	Identify barriers and opportunities in relation to a good enabling environment for the integration of adaptation into the health sector.	Key questions to consider are: Are there any legislative constraints or gaps that could inhibit implementation of effective adaptation?
2.	Undertake a 'Strengths, Weaknesses, Opportunities, Threats' (SWOT) analysis (or similar) of the overall findings from step 1, with the aim of identifying ways to overcome problems and capitalize on strengths and opportunities.	SWOT analysis would form the basis of an attempt to seek ways of using the strengths to improve or overcome the weaknesses. As well as analysing specific documents, plans and events, it is important to note that processes are also conducive to integration. For example, preparing national communications and NAPAs, which involve the engagement of multiple stakeholders, particularly those at the national level, has been a good step forward for the integration agenda, despite the fact that NAPAs themselves are, arguably, currently too segregated from existing development planning.
3.	Identify any catalysts that could aid the creation of supportive or stronger enabling environments, as expressed in national policy.	Key questions to consider are: • Are there any lessons to be learned from the disaster management community's experience in raising the priority of risk reduction following disaster events? • What is public/the media's opinion on climate change impacts affecting the country? How regularly is climate change mentioned in the press? Do NGOs or CBOs working among communities report an awareness or concern regarding climate risks? • Is there any recent or new scientific evidence or are there observable impacts of climate change? • How and why were the priorities expressed in a NAPA or national communication decided upon?
4.	Facilitate awareness-raising among national authorities regarding the links between climate risks and present-day conditions.	Awareness-raising can include activities such as: • National media campaigns on climate impacts. • Internal government awareness-raising on the linkages between climate change, different sectors, and the health sector. • No-regret and low-regret approaches (which, as well as supporting adaptation, are effective in achieving development objectives regardless of climate change).

5.

a. Identify political champions to help overcome any barriers (such as lack of political will for adaptation, and lack of budgetary support) and to create and maintain high-profile momentum amid changing priorities.

b. Develop regular contact with such key individuals as part of the ongoing multi-stakeholder dialogue on adaptation within the health sector. For example, key individuals could be asked to chair such meetings.

c. Seek to influence national authorities and donors, drawing upon 'champions' for assistance to counteract and address clashes between sectors.

Key questions to consider are:

- Is there anyone who can help strengthen the link on adaptation between the health ministry and national authorities (such as the finance and planning ministries or prime minister/ president's office) to help secure political support and financing for capacity development and implementation, and aid coordination across sectors?
- For example, who was instrumental in the NAPA process or in the writing of national communications to UNFCCC?
- Who is best placed to strengthen the links between the health ministry and the likely priority subnational and local levels?

Source: Based on Tearfund, 2010.

Box 8. Barriers to adaptation to climate change: Yemen case study

Yemen's NAPA identifies efforts to address climate change and other important environmental issues, and the synergies and barriers to adaptation. The report was based on a general classification of adaptation barriers, potential barriers to implementation of adaptation measures including analyses and evaluation of each barrier according to the degree of severity. A summary of results are presented in table 12 below.

Barriers were classified according to the level they are influencing (numbers shown next to each barrier will indicate its level):

1. Barriers at Multilateral Environmental Agreements level.
2. Barriers at national policy level.
3. Barriers at programme/project level.

Barriers were also classified based on their nature/type (numbers shown next to each barrier will indicate its nature):

1. Institutional barriers.
2. Political barriers.
3. Cultural barriers.
4. Economic/financial barriers.
5. Technical barriers.
6. Social barriers.

A rough assessment of each barrier was achieved according to the degree of severity and barriers were classified into three levels:

1. High-severity (H) barriers.
2. Medium-severity (M) barriers.
3. Low-severity (L) barriers.

Table 12. Summary of potential barriers to implementation of adaptation measures in Yemen

Barriers	Level	Type	Severity
Weak institutional structures and environmental legislations (weak interrelated, lack of executive bills, poor implementation of laws and bills, weak law enforcement)	2	1	H
The institutional arrangement for vulnerability and assessment (V&A) studies is weak	2, 3	1	H
Lack of policies to facilitate the implementation of Yemen NAPA	2	1, 2	H
Uncertainty about effectiveness and appropriateness of adaptation options	1, 2	5	M
Lack of appropriate data (in terms of lack of adequate monitoring and collection, difficulties experienced in accessing databases, lack of technical capacity to analyse and manipulate data for V&A and lack of quality assurance)	1, 2, 3	5	H
Uncertainties in regional, local climate change scenarios, socio-economic scenarios	1, 2, 3	4, 5	H
Public awareness for policymakers and decision makers on the subject of V&A is inadequate (lack of knowledge on CC and V&A, lack of ability of technical personnel to convey clearer and concise information on CC and V&A issues to policymakers and decision makers)	2	2, 3, 5	H
Financial support is limited (inadequate financial capacity to develop or modify existing models and methodologies, lack of financial sources to implement the adaptation measures)	3	4	H
Technical support is limited (lack of methodologies to identify and collect information, apply models and interpret results, inadequate technical capacity to develop or modify existing models and methodologies)	2, 3	5	H
Lack of coordination on cross-sectoral issues. Coordination and cooperation among national and technical cooperation programmes/projects are very weak	3	1, 2, 5	M
Lack of awareness on vulnerability and climate change issues	1, 2, 3	4, 5	H
Little research work on the practical application of policy measures for adapting to climate change. National scientific community has not had an active role in addressing vulnerability and adaptation issues	1, 2, 3	4, 5	H

Poverty 1. Compounding problems of poor/worsening local conditions, such as land degradation 2. Lack of community resources (financial, human, social) to enhance own resilience 3. Lack of local institutional capacity and resources to support community resilience building	1, 2, 3	4, 6	H
Low investment in environment-friendly technologies	2, 3	5	M

Source: Based on Yemen NAPA, 2006.

Annex A presents two exercises that revolve around the broader theme of implementation. The first exercise deals with the distribution of roles and responsibilities in the health and water sectors, looking at stakeholder mapping and the responsibilities of key actors involved in the governance of climate adaptation for health sector and the relationships between these actors. The second exercise addresses crisis management and long-term strategies within the health sector, revolving around the need to distinguish between crisis management on the one hand and longer-term strategies on the other. See exercise 3 (Distribution of roles and responsibilities in the health and water sectors) and exercise 4 (Crisis management and long-term strategies within the health sector).

CH. 6

Areas for Action: Suggestions for Follow-up

Areas for Action: Suggestions for Follow-up

Following up on adaptation programme development at the national policy level

In order to have in place an efficient adaptation action plan for all sectors, it is imperative that countries should carry out the following necessary steps:

Carrying out national assessments

National and regional assessments of the potential health impacts of climate change must be carried out in order to provide needed information about future impacts on vulnerable areas and populations.

Health impact assessments will provide information to integrated climate change assessments, strategies or action plans.

Key areas such as diarrhoeal disease, vector-borne disease and malnutrition should receive special attention in these assessments. However, a prerequisite to accurate assessment is to obtain accurate climate information at the local level, particularly on climate variability and extremes.

The need for standardized methods and tools for such assessments is highly needed and authorities should shy away from the ad hoc style of assessments.

Box 9. NAPA in Somalia, the formulation process

The NAPA formulation process was based on the annotated guidelines for the preparation of NAPA (UNFCCC, 2002) and adjusted according to the context.

The steps taken included:

- Build the NAPA team and the multi-disciplinary team
- Synthesize available information including past assessments, strategies, and consultations
- Carry out participatory, rapid assessment of vulnerability and potential increases in climate hazards and risks and identify potential adaptation activities with ranking criteria for prioritization
- NAPA team to carry out ranking exercise and communicate findings for validation
- Develop project profiles and submit NAPA to UNFCCC

Guiding principles for the NAPA formulation process

- Multidisciplinary approach
- Participatory approach

- Complementary approach
- Sustainable development
- Country-driven approach
- Cost effectiveness
- Conflict prevention and peace building.

The NAPA team and multidisciplinary climate change working groups

A NAPA project management team (PMT) was established. At the start of NAPA preparation, during the period of the transitional federal government, the PMT was under the directorship of the Ministry of Fisheries and Environment. The PMT for NAPA fell under the government structure and NAPA focal points were established to lead the NAPA process under the Ministry of National Resources. The NAPA political focal point is the minister of national resources and the NAPA operational focal point is the special advisor to the minister. The Ministry of National Resources oversees four key sectoral areas including: agriculture and livestock; fisheries and marine resources; water; and environment and wildlife. UNDP provided technical advice to the PMT and on-the-field logistical and operational support to the NAPA focal points and climate change working groups. This support included a NAPA technical advisor, a vulnerability assessor, and several national field officers.

Multidisciplinary climate change working groups (CCWG) were also established at a national level for federal Somalia and at a regional level. The regional CCWGs were chaired and co-chaired by the Ministry of Planning and the Ministry of Environment respectively and were comprised of key stakeholders across government, and a range of non-state actors from civil society, academia and NGOs. The CCWGs were the modality for the identification and review of regional and local level information relevant to the environment.

The NAPA process of consultation

The approach used for the three regional consultations drew from a number of existing approaches including the UNDP adaptation policy framework (APF), Care International climate vulnerability and capacity analysis (CVCA), IUCN framework for social adaptation to climate change, CIDA community vulnerability and adaptation assessment and action and the NAPA guidance notes issued by the UNFCCC.

The UNFCCC definition of vulnerability as a function of exposure, sensitivity and adaptive capacity was used to frame the analysis, and the tools developed for understanding these three aspects draw from vulnerability-based, hazards-based and livelihood-based methods of analysis. The three aspects were explored and analysed using a sectoral perspective as well as stakeholder perspective.

The sectors include:

a. Water resources;
b. Agriculture and food security;
c. Animal husbandry, grazing and rangelands;
d. Health;
e. Marine and coastal resources;
f. Infrastructure;
g. Forests; and
h. Natural disasters.

The groups consulted included:

a. State actors;
b. Traditional and religious elders;

c. Agro-pastoralists;
d. Youth;
e. Women;
f. NGOs;
g. Academics;
h. Informal governing institutions and authorities; and
i. Private sector.

Consultative workshops were held at the state and regional levels. Focus group discussions, historical timelines, seasonal timelines, group work and presentations were all tools used to carry out the consultations. All main reports are compiled by the PMU and endorsed by the project board.

Implementation strategy of the NAPA in Somalia

In line with the annotated guidelines for the preparation of the NAPA, as well as a country driven approach towards the implementation of the proposed project profiles, it is envisaged that following endorsement of the document by the minister of national resources, the Federal government of Somalia will begin to prepare project profiles for submission to the LDCF and other donors. The Ministry for National Resources will take the lead on coordinating identification of key activities for funding from each available source of funds. At this point, the potential consolidation of different related priorities will be considered. Specifically, the following steps will be taken:

- Launch the NAPA and its priorities nationally through an outreach programme to be supported under the UNDP-implemented NAPA project.
- Hold follow up discussions with potential international development partners including Norway, Sweden, Japan, the United Nations system, Global Environment Facility, the European Union and the multilateral development banks on funding and implementation opportunities.
- For each of the project areas, develop more detailed project proposals once a suitable source of funding has been identified, based on the priority profiles presented in the NAPA document. These project proposals will establish the specific technical and geographical scope and content in each area, necessary institutional and management arrangements, monitoring and evaluation requirements, and key partnerships to ensure successful achievement of project outcomes.
- Ensure that each project proposal is grounded in an understanding of community-based concerns and will deliver visible impacts at this level. Strengthening subnational level planning capacity to address climate risks will also need to be a visible component in each case.
- Strengthen the existing climate change working group to provide continuing oversight for NAPA implementation linked to national plans and priorities.
- Continue to use the NAPA document, process and structure as the country's principle framework for adaptation needs to climate-related risks over the medium term.

Establishing a monitoring process to climate change impacts on human health

Monitoring to assess climate-change impacts on health requires data gathering, coupled with analytical methods for quantifying the climate-attributable part of diseases, which are likely to witness incremental changes in their frequency and distribution due to climate change.

Standardized long-term monitoring of related indicators could provide direct evidence of climate-change impacts on health. Long-term surveillance should be able to detect variables with associations between climatic changes and disease incidence.

In order to achieve this important goal, it is imperative that authorities develop standardized surveillance methods of climate-sensitive health areas in order to strengthen the already existing systems designed to detect climate change impacts on human health.

Health data and information should also be made available to all research institutions especially those with linked to climate and determinants of vulnerability.

Developing effective adaptation strategies and policies

Implementation of adaptation strategies will play an important role in reducing the adverse health impacts of climate change. However, the effectiveness of adaptation strategies will depend upon cultural, educational, managerial, institutional, and legal and regulatory practices at the national and regional levels.

The existence of a sound and broadly based public health infrastructure (including environmental management, public education, food safety regimes, vaccination program, nutritional support, emergency services and health status monitoring) is a prerequisite to have an efficient adaptation programme. Other health-directed policies in other sectors, including transport, urban planning, industry, agriculture, fisheries, energy, water management and so on are needed to complement such a programme.

There is a key need for research on barriers and opportunities for enhancing adaptive capacity in order to protect human health, as well as potential interactions with ongoing development projects and programmes. Research is also needed on the processes of adaptation decision-making, including identifying the roles and responsibilities of individuals, communities, nations, institutions and the private sector in adaptation.

Moving from science to policy

Policy-focused assessment is a valuable process for providing timely and useful information to policymakers, resource managers and other stakeholders in the public health community.

Successful policy-focused assessment requires multidisciplinary assessment teams to answer questions asked by stakeholders in the public health community towards evaluation of risk management adaptation options and identification and prioritization of key research gaps. The teams should also be able to characterize and explain uncertainties and their implications for decision-making.

In addition, authorities will need to:

- Assess and prioritize questions about the potential impacts of climate change on human health that have been identified by the research community;
- Perform assessments of adaptation strategies to reduce the risks to public health from climate change;
- Evaluate the costs, benefits, effectiveness (in practice), barriers to implementation and risks of maladaptation for each adaptation option;
- Identify and develop decision support tools to help public health officials make decisions under uncertainty, given available assessment results;
- Develop needed mechanisms and interventions to integrate the proposed adaptation measures into national policies and action plans.

According to Cap-Net training manual and operational guide on integrated water resources management plans (Cap-Net, 2005), the process of integrated adaptation plans for policies and strategies is presented in seven sequential steps:

Box 10. Jordan case study: moving from science to policy (adapted from Jordan ministry of health strategy to adapt to climate change and Jordan Third National Communication (TNC) report on climate change, 2014)

Previous scientific research, surveys and scientific analysis have shown the possible expected impacts as shown in table 13 below. Climate-sensitivity analysis of these impacts has been identified in table 14.

Table 13. Expected impacts of climate change on health in Jordan (compiled from previous studies)

Future climate risks that Jordan could face	Impact description	
	Biophysical impact	Health socio-economic impacts
Drought	• Poor reproduction of livestock • Decrease in crop production	• Malnutrition, skin diseases, high mortality rate • Food shortages
Dust or sand storms	• Air pollution	• Chronic respiratory diseases including bronchial asthma
Decreasing precipitation	• Shortage of water, decrease of surface water availability • Use of alternative unsafe source of water (grey or treated wastewater) • Decrease in crop production	
Rising temperature	• Increased microorganisms growth • Extreme heatwaves	
Flooding due to extreme rainfall	• Disruption of water purification (shortage of drinking water supply) • Contamination with sewage disposal systems • Increasing the birding of diseases vectors	

Shifting in the rainy season	• Decreased availability of safe water • Decrease in crop production • Changes in the geographical distribution of infectious diseases • Alternative unsafe source of water	
Increasing humidity	• Indoor dampness or mold	• Dehydration • Heat injury heatstroke • Colonize mold and bacteria microscopic airborne particles • Chronic respiratory diseases

Table 14. Climate sensitivity scale for the health sector in Jordan

Insignificant	Minor	Moderate	Major	Catastrophic
Malnutrition	WASH-related diseases	• Chronic respiratory diseases, including bronchial asthma • Ischemic heart diseases • Patients admission • New focuses Cutaneous leishmaniasis	• Waterborne diseases such as typhoid fever dysentery, hepatitis A and E, giardiasis, bilharzia • Food poisoning outbreaks • Increasing diarrhoea from bacterial source	• Epidemics due to water and food-borne diseases • Reemerging malaria • Spread of schistosomiasis • Emerging Hemorrhagic fevers (dengue fever or rift valley) • Reemerging cholera

As a result of this analysis, the Ministry of Health of Jordan, in cooperation with WHO and all concerned stakeholders from different organizations, departments and units, has embarked on developing a climate change adaptation strategy for six climate-sensitive health areas. These areas are identified in the two tables above.

- Heatwaves
- Nutrition

- Water-and food-borne disease
- Vector-borne disease
- Occupational health
- Air-borne respiratory disease.

The task teams identified the needed adaptation measures to be taken and developed a plan for implementing four top priority adaptation measures to the impacts of climate change on the health sector projects in each of the six theme areas outlined above.

An example of the identified projects are:

- Nutrition surveillance system
- National awareness strategy on nutrition and climate change
- Real-time surveillance
- Evaluation system for heatwaves
- Establishment of an occupational surveillance system
- Raise awareness of the public on adaptation measures against ultraviolet rays
- Assessment and mapping of areas that have potential effect on respiratory diseases through production of pollen or other allergens, etc.

For full information on the case study, see Jordan TNC, 2014, and the National Climate Change Health Adaptation Strategy and Action Plan of Jordan, 2012 (www.moh.gov.jo/Documents/PDF_FINAL%20DOC.pdf).

- In the 'initiation' step, climate change impacts need to be integrated into the planning process. In advocacy towards policymakers, the argument can be brought up that this will be instrumental for decision makers to advance climate change adaptation strategies, which otherwise might be politically difficult to implement;
- During the 'vision/policy' phase, climate change adaptation is an additional element, not a replacement of health or water management goals. The overall aims of health and water strategy will remain the same;
- In the 'situation analysis' step, the use of climate information and impact analysis need to be incorporated. Further, the adaptation/mitigation theme can be brought out to suggest that adaptation programme should reduce the risk of adaptation options negatively impacting the mitigation targets, and vice versa;
- In the 'strategy choice' phase, the anticipatory or 'precautionary' approach can be introduced as the basis for the health and water sector strategies (IWRM);
- Consider the roles of local authorities in adaptation strategies when drafting an IWRM plan;
- Legal frameworks, economics and health, and other variable conditional elements that have been analysed form the cornerstone of implementation of IWRM and are decisive in how it contributes to climate change adaptation;
- During evaluation, results must be measured against indicators, taking into consideration the adaptation measures proposed in the plan.

Throughout the process, stakeholder involvement is essential so that the results of the impact assessment and strategic choice are owned by the implementing agencies. The range of solutions and strategies has been broadened over time by improvements in technologies. What has changed is our understanding and implementation of the integrated ensemble of water management measures that conform to modern principles and policies.

Box 11. Climate change-related hazards and risks in Morocco

Morocco's climate is very diverse with a warm, Mediterranean climate in the northern coastal region, continental inland areas and semi-arid areas in the south. Morocco has ambitious renewable energy targets and is making political and strategic efforts to conserve biodiversity and to mitigate and adapt to climate change.

Despite positive actions, Morocco remains vulnerable to the effects of climate change. The Mediterranean coast and low-lying Moulouya River delta, with their economic and ecological importance, are threatened by sea level rise and subsequent shoreline erosion and saline intrusion. Agriculture, which represents 16 per cent of Morocco's gross domestic product (GDP), is endangered by decreases in annual rainfall, increasing the risk of crop failures and malnutrition. Morocco could also face aggravated water scarcity; rising temperatures; severe heatwaves; and increased incidence of dengue fever, malaria and schistosomiasis.

Research has predicted that under high emissions scenarios, mean annual temperature is projected to rise by about 5.5°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.6°C.

Under high emissions scenarios and without large investments in adaptation, an annual average of 187,400 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If emissions decrease rapidly and there is a major scale up in protection (i.e. continued construction/ raising of dikes), the annual affected population could be limited to about 100 people. Adaptation alone will not offer sufficient protection, as sea level rise is a long-term process with high emissions scenarios bringing increasing impacts well beyond the end of the century.

Under high emissions scenarios, heat-related deaths in the elderly (65+ years) are projected to increase to almost 50 deaths per 100,000 by 2080 compared to the estimated baseline of just under 5 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to just over 14 deaths per 100,000 in 2080.

Morocco has an approved national health adaptation strategy and is currently implementing projects on health adaptation to climate change.

The annex presents an exercise on moving from science to policy, dealing with how to utilize scientific research results to design an adaptation programme in the health sector (see exercise 5: Moving from science to policy in Morocco).

Following up on adaptation programme development at the global policy level

Health impacts of climate change can only be identified and quantified by the availability of accurate and comprehensive information and through adopting sophisticated tools and methodologies that can be used by highly specialized public health professionals with skills that will allow managing such impacts and putting in place sophisticated and efficient adaptation programmes into the health and water sectors with IWRM process as the cornerstone of such programmes. In addition, the current research efforts to better understand climate change health impacts at the regional and global levels are by all means insufficient and the scope of this research is not wide enough to include all the required aspects.

These two points, in addition to the results of the above review process, would warrant the following steps to be taken and adopted:

A. At the regional level:

1. To develop climate change policies and strategies and integration of adaptation programmes into the health and water policies and strategies based on their national circumstances that would include health as a focus area taking into consideration the regional vision through regional networks and committees towards developing robust regional actions plans.
2. Countries of a region should establish a regional task team to undertake the required work on climate change health vulnerability assessments and adaptation planning and include the IWRM process into the task force mandate.
3. Countries of a region should use standardized tools and methodologies when undertaking assessment of vulnerability to climate change with a focus on health.
4. Two specific programmes should be included in the regional committees mandate and in the regional adaptation action plans: (i) integrated environment and health surveillance; and (ii) strengthening of health systems.

E. At the level of international bodies and agencies:

1. To implement technical support programmes towards adopting standardized methods and tools for the assessment of climate change vulnerability focusing on health for different regions of the world.
2. To facilitate the creation of a network of experts for the assessment of vulnerability in the health sector due to climate change.
3. To facilitate the creation of a data bank for the information related to the impacts of climate change on health in the region.
4. To facilitate and support different countries in establish resilience and adaptation public health objectives and targets for public health country adaptation planning.
5. To develop a climate change and health vulnerability assessment and adaptation capacity-building program with specific tools taking into consideration the different countries circumstances and capacities.

F. At the level of the UNFCCC and its subsidiary bodies:

1. To emphasize the need to include the health issues as a focus in order to reach a more resilient system of adaptation to climate change for the countries.
2. To institute technical and financial assistance mechanisms for Arab countries to facilitate the achievement of resilience and adaptation of public health objectives and targets.

References

GIZ, adelphi Consult GmbH, and EURAC, (2013). *The Vulnerability Sourcebook, Concept and guidelines for standardized vulnerability assessments.*

Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds. (2008). Climate Change and Water. *Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat,* Geneva, p.210.

Cap-Net (2009). IWRM as a Tool for Adaptation to Climate Change, Training Manual and Facilitator's Guide. *International Network for Capacity Building in Integrated Water Resources, UNDP.*

CDC (2014). Assessing Health Vulnerability to Climate Change. A Guide for Health Departments. *Climate and Health Technical Report Series, Climate and Health Program.*

Dogulu N. and Elcin Kentel (2015). *Prioritization and selection of climate change adaptation measures: a review of the literature, proceedings of the 36th IAHR World Congress, 28 June – 3 July, 2015. The Hague, the Netherlands.*

Federal Republic of Somalia, Ministry of National Resources (2013). *The National Adaptation Programme of Action on Climate Change (NAPA).*

GIZ (2011). *Climate Proofing for Development: Adapting to Climate Change, Reducing Risk.*

Huitema, D., E. Mostert, W. Egas, S. Moellenkamp, C. Pahl-Wostl, and R. Yalcin (2009). Adaptive water governance: assessing the institutional prescriptions of adaptive (co-)management from a governance perspective and defining a research agenda. *Ecology and Society 14(1): 26.* Available from URL: http://www.ecologyandsociety.org/vol14/iss1/art26/.

IWGCCH (2010). *A human health perspective on climate change, a report outlining the research needs on the human health effects of climate change: environmental health perspectives and the National Institute of Environmental Health Sciences.*

Jordan Ministry of Environment (2014). *Third National Communication to the UNFCCC.*

Kareiva, P., C. Enquist, A. Johnson, S. Julius, J. Lawler, B. Petersen, L. Pitelka, R. Shaw, J. West (2007). *Synthesis & Conclusions in U.S. Climate Change Science Program Synthesis and Assessment Product on Adaptation Options for Climate-Sensitive Ecosystems and Resources (SAP 4.4), edited by Herrod Julius, Susan, and West, J.*

Mimura, N., R.S. Pulwarty, D.M. Duc, I. Elshinnawy, M.H. Redsteer, H.Q. Huang, J.N. Nkem, and R.A. Sanchez Rodriguez (2014). Adaptation planning and implementation. *In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 869-898. Available from: http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Chap15_FINAL.pdf

RICCAR (2017). ESCWA et al., Arab Climate Change Assessment Report, Beirut, E/ESCWA/SDPD/2017/RICCAR/Report.1.

OECD (2006). Progress on Adaptation to Climate Change in Developed Countries; An Analysis of Broad Trends.

Pierre Mukheibir (2005). *Local water resource management strategies for adaptation to climate-induced impacts in South Africa, Rural Development and the Role of Food, Water & Biomass: Opportunities for Development and Climate.* Novotel, Dakar. Energy Research Centre.

Portier CJ, Thigpen Tart K, Carter SR, Dilworth CH, Grambsch AE, Gohlke J, Hess J, Howard SN, Luber G, Lutz JT, Maslak T, Prudent N, Radtke M, Rosenthal JP, Rowles T, Sandifer PA, Scheraga J, Schramm PJ, Strickman D, Trtanj JM, Whung P-Y (2010). *A human health perspective on climate change: a report outlining the research needs on the human health effects of climate change.* Research Triangle Park, NC: Environmental Health Perspectives/National Institute of Environmental Health Sciences. Available from http: "www.niehs.nih.gov/climatereport

Republic of Yemen (2007). *National Adaptation Programme of Action.*

Tearfund (2010). "*How to integrate climate change adaptation into national-level policy and planning in the water sector: a practical guide for developing country governments*".

UNEP (2013). *PROVIA guidance on assessing vulnerability, impacts and adaptation to climate change consultation document.*

WHO (2003), *Methods of assessing human health vulnerability and public health adaptation to climate change, Health and Global Environmental Change,* SERIES No. 1, 2003.

WHO, UNFCCC (2015) *Climate and Health profiles of Egypt and Oman.*

WHO (2015). *Climate change and health,* fact sheet No. 266.

World Bank (2011). *Middle-East and Northern Africa Water outlook,* Future Water.

Further Readings

RICCAR, 2017.

IPCC Fifth Report, 2014.

IPCC Fourth Report, 2007.

IPCC Third Report, 2000.

Ministry of Environment, Jordan, 3rd National Communication, 2014.

The Natura 2000 network (EC, 2009 Task 2a report).

World Bank, *Health in a changing climate*, 2011.

Cap-Net (2005). *Integrated Water Resources Management Plans, Training Manual and Operational Guide*, CAP-NET, Global Water Partnership, UNDP.

WHO (2003). *Climate Change and Human Health. Risks and Responses*. http://www.who.int/globalchange/publications/cchhbook/en/.

Barriers, *Opportunities, and Market Potential of Technologies and Practices, IPCC*, TAR.

MoEnv (2007). *National Capacity Self Assessment for Global Environmental Management (NCSA) – Jordan*. Ministry of Environment, Amman-Jordan, January 2007.

NAPA team, *Identifying synergies and barriers to adaptation within the framework of Yemen*, NAPA, May 2006.

National Environmental and Economic Development Study for Climate Change (2010). Jordan national report submitted to the United Nations Framework Convention on Climate Change, October 2010.

The Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2009.

Tearfund 2010. *How to Integrate Climate Change Adaptation into national-Level Policy and Planning in the Water Sector?*

National Strategy for Mainstreaming Gender in Climate Change in Egypt. http://www.eeaa.gov.eg/portals/0/eeaaReports/GenderEventsReports/Strategy-G-CC-Draft.pdf.

Gender, Water and Sanitation Case Studies on Best Practices. Available from http://www.un.org/esa/sustdev/sdissues/water/casestudies_bestpractices.pdf.

UNDP (2012). *Gender and adaptation. Gender and climate change series: Africa training module 2.* Available from http://gest.unu.edu/static/files/tm2_africa_gender-and-adaptation.pdf.

Annex

Exercises

Exercise 1. Climate impacts on water and public health and tracking climate readiness for a region/country

This exercise offers insight into enhancing climate readiness in water safety. The exercise is divided into four parts:

1. An overview of the effects of extreme weather and climate change on the public health infrastructure (see steps 1 and 2 in activity 1).
2. Opportunities for integrating climate readiness into existing programmes (see steps 3 and 4 in activity 1).
3. Tracking climate readiness (see step 5 in activity 2).
4. A review of the evidence that a climate readiness approach can offer co-benefits to health, financial wellbeing and the environment (see step 6 in activity 2).

Activity 1: Climate impacts

Being familiar with any country climate assessment and/or action plan:

I. What are the immediate and long-term effects of extreme weather and climate change on water safety in your country? (use table 15)

Step 1. Identify the top 1-3 climate risks to your country.
Step 2. Identify how these climate risks will impact water safety and health.
Step 3. List the agency or department that addresses each water safety impact and health.
Step 4. List the existing programmes designed to reduce the impacts identified under step 2.
Step 5. Based on your responses to steps 1-4, place an asterisk next to the climate risk that would be most appropriate to prioritize for the remainder of this assessment.

Activity 2: Negative health outcomes

II. What are the potential negative health outcomes associated with the impacts of climate change on water safety? (use table 16)

Step 1. List the climate risk identified with an asterisk in activity 1.
Step 2. In the left-hand column of table 16, list three impacts associated with this climate risk (as identified in activity 1).
Step 3. List the potential negative health outcomes associated with these impacts.

Step 4. List the populations that are particularly vulnerable to these impacts.
Step 5. List the existing public health tracking/surveillance programmes, policies and interventions designed to reduce the negative health outcomes identified under step 3.
Step 6. List the co-benefits of the public health programmes to the water safety programmes outlined in activity 1.

Table 15. Climate change impacts

	Impacts	Department/Agency	Programmes
Climate Risk 1			
Climate Risk 2			
Climate Risk 3			

Table 16. Health outcomes associated with climate change impacts

Climate risk				
	Health effects	Vulnerable populations	Programmes	Co-benefits to water safety programme
Impact 1				
Impact 2				
Impact 3				

Exercise 2. Convening a methodological framework for the vulnerability assessment

Following the steps of vulnerability assessment of the health sector as outlined in chapter 3, and using the scoring scale shown in table 17 and the vulnerability ranking scale shown in table 18, carry out a vulnerability assessment for the health sector in one of the countries of the Arab region.

Exercise steps

1. For each climate-driven phenomenon, identify the impacts on human well-being.
2. Identify potential adaptation responses.

Table 17. Scoring scales for exposure (likelihood, geographical magnitude and confidence)

Exposure factors	Score 1	Score 2	Score 3	Score 4	Score 5
Likelihood	Event is not expected to occur, but it is possible (there is less than 5 per cent probability of occurrence per year)	Event or change is unlikely to occur, but not negligible (there is between 5-33 per cent probability of occurrence per year)	Event or change is less likely than not, but still possible (there is between 33-66 per cent probability of occurrence per year)	Event or change is likely to occur (there is between 66-95 per cent probability of occurrence per year)	Event or change is very likely to occur (there is >95 per cent probability of occurrence per year)
Geographical magnitude	Less than 5 per cent of the area is affected	5-33 per cent of the area is affected	33-66 per cent of the area is affected	66-95 per cent of the area is affected	>95 per cent of the area is affected
Confidence of being correct	Very low: less than 10 per cent	Low: 20 per cent chance	Medium: about 50 per cent chance	High confidence: 80 per cent chance	Very high confidence: >90 per cent chance

3. Select up to three key criteria that the group would suggest to prioritize selected adaptation responses.
4. Evaluate the chosen adaptation actions according to the selected criteria (use a simple ranking system).

Table 18. Vulnerability ranking scale

			Impact score				
		Score	0.1-1	1.1-2	2.1-3	3.1-4	4.1-5
Adaptive capacity	Score	Description	Very low	Low	Moderate	High	Very high
	0.1-1	Very low	Moderate	Moderate	Moderate	Very high	Very high
	1.1-2	Low	Low	Moderate	Moderate	High	Very high
	2.1-3	Moderate	Low	Moderate	Moderate	High	Very high
	3.1-4	High	Very low	Low	Moderate	Moderate	High
	4.1-5	Very high	Very low	Low	Low	Moderate	High

Table 19. Climate-driven phenomena

Climate-driven phenomena	Agriculture, forestry and ecosystems	Water resources	Human health	Industry, settlements and society
• Heavy precipitation events • Frequency increases over most land areas				• Disruption of settlements, commerce, transport and societies due to flooding • Pressures on urban and rural infrastructure • Loss of property
• Drought-affected areas increase				• Water shortages for settlements, industry and societies • Reduced hydropower generation potential

Exercise 3. Distribution of roles and responsibilities in the health and water sectors

Through this exercise, stakeholder mapping will be conducted and the responsibilities of key actors involved in the governance of climate adaptation for health sector and the relationships between these actors will be further clarified. The exercise looks at formal and informal responsibility and identifies gaps that risk impeding climate adaptation.

Objective of the exercise:

- To rank identified key actors in terms of adaptive capacity, importance for climate adaptation and for seizing opportunities;
- To assess their degree of interaction with one another;
- To map divisions of responsibility across the key actors that are involved in identified areas or sectors. This will enhance the ability to decide how to proceed with: (i) long-term planning; (ii) crisis management; and (iii) seizing opportunities related to climate change.

Procedure for the exercise:

The exercise consists of three parts: 1) Brainstorming actors and their responsibilities; 2) Mapping interaction; and 3) Discussion and analysis.

A. Brainstorming actors and their responsibilities

1. Develop list of the key stakeholders.
2. Study the list. Brainstorm to determine if any key actors are missing.
3. Identify the crisis management and long-term planning role of each stakeholder.
4. If new actors are identified, they should be added to the list. Try to be as specific as possible by giving the name of the government department, section and even contact names, if possible.
5. For each actor on the list:
   - Select a circle of appropriate colour and size. The size of the planet represents its level of influence for adaptation in your case. The colours could represent different types of organizations;
   - Place the planet on a large paper and write the name of the case in the center. The closer to the middle of the paper the circle is placed, the more capable, you think it is, of influencing adaptation to climate change;
   - Repeat for all actors;
   - In the list of stakeholders, fill in the level of influence that you think the actor has on the governance of climate adaptation.

B. Mapping interactions between actors

1. Draw a line between actors that currently collaborate. The thicker the line, the stronger the interaction. A thin or dotted line symbolizes that collaboration just barely exists.

2. Use another marker to draw lines to represent collaboration between actors that should exist to facilitate climate adaptation in your case but are currently missing. On each line specify the object of the collaboration.

C. Discussion and analysis

1. Discuss the questions below. The objective is to decide on measures to increase inter-actor collaboration and involvement of any important actors that are not already connected to your process.

Questions to facilitate the group discussion:

- What forms of collaboration are needed to seize potential opportunities generated by climate change?
- Who is responsible for what important areas? Are these actors actually exercising their responsibility in the area of climate change?
- Are there actors who have an informal responsibility? Should these actors be mobilized? Are there actors who should have more (formal) responsibility?
- Are there any responsibility gaps?
- Which of the actors have resources? Are these resources utilized efficiently?
- Are there any resource gaps, "stock-piles" (not utilized today)?
- Which of the identified sensitive activities are the hardest to handle? What actors and areas of responsibility must be included in the process to best handle these issues?

Exercise 4. Crisis management and long-term strategies within the health sector

This exercise is developed to distinguish between crisis management on the one hand and more long-term strategies on the other. Experience shows that sometimes there is confusion between these two issues, which makes it hard to analyse the division of responsibility. This group exercise will help practitioners understand the difference between these two issues for the health and water sector as follows:

1. For each stakeholder already involved in the group, fill in the stakeholder list including:
   - Name, organization, and position
   - Area of responsibility
2. In order to determine other people that should be included, go through the prepared questions below and see what other stakeholders come to your mind.
3. Fill in the details of each stakeholder in the list.

Questions that may assist you in determining who to involve and why:

- What roles do various organizations play for local responses to climate change?
- Who (function as well as person) can participate in the assessment?
- Who will be using the outcomes of the assessment of challenges and opportunities?
- Who will be the potential beneficiaries?
- Who will be adversely affected?
- Who has existing rights? Who has control over resources?
- Who is likely to be voiceless? Who can represent them?
- Who is likely to mobilize resistance?
- Who is dependent on whom?
- Who is responsible for the intended plans?
- Who has money, skills or key information?

Table 20. List of stakeholders, their responsibilities, levels of influence and gaps in current cooperation

Name	Organization	Position	Area of respon-sibility	Degree of involv-ement	Level of influence	Lack of coop-eration (with whom)	Lack of coop-eration (about what)

- Whose behaviour has to be changed to attain certain key goals?
- What power gaps exist between stakeholder groups? How should these be dealt with? In what way could each stakeholder be involved that will best aid the process?
- Who should be recipients of the assessment outcomes such as the final report?

Exercise 5. Moving from science to policy in Morocco

This exercise deals with how to utilize scientific research results (the case of Morocco) to design an adaptation programme in the health sector. Uncertainty has to be discussed first to come up with a reasonable planning scenario for adaptation in the health sector.

The following items are covered in this exercise:

1. Level of expected uncertainty in the research outcome (justify your answer).
2. Suggested climate change impacts on the health sector according to the research results outlined in the research summary shown in box 6. This research covers Morocco profile with a focus on the health sector as well as other related sectors.
3. For each of the categories listed below, detail all possible measures, plans or strategies for health adaptation to climate change to improve the resilience of the country to climate change impacts:
   - Governance and policy
   - Health adaptation implementation
   - Financing and costing mechanisms
   - Health benefits from climate change mitigation

ENVIRONMENT

Climate Change Adaptation and Ecosystem-Based Management
Using Integrated Water Resources Management Tools

AGRICULTURE

Climate Change Adaptation in Agriculture, Forestry and Fisheries
Using Integrated Water Resources Management Tools

HEALTH

Climate Change Adaptation in the Health Sector
Using Integrated Water Resources Management Tools

HUMAN SETTLEMENTS

Climate Change Adaptation in Human Settlements
Using Integrated Water Resources Management Tools

ECONOMIC DEVELOPMENT

Climate Change Adaptation in Economic Development
Using Integrated Water Resources Management Tools

16-00295